SAN JOAQUIN VALLEY UNIFIED AIR POLLUTION CONTROL DISTRICT

FINAL STAFF REPORT AND RECOMMENDATIONS ON AGRICULTURAL BURNING

May 20, 2010
(Revised July 21, 2010)

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Agricultural Industry Representatives
Applied Development Economics
Biomass Industry Representatives
California Air Resources Board
Chipping and Shredding Operators/Vendors
County Ag Commisioners
County Farm Bureau
Environmental Protection Agency
Other SJVAB Agencies and Districts
Other SJVAB Growers

May 20, 2010
(Revised July 21, 2010)

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Executive Summary

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Executive Summary

The historical cultural practice for disposing of agricultural materials, such as prunings and orchard removals, is to burn the materials. Burning agricultural materials in the field has helped prevent the spread of diseases, as well as control weeds and pests. However, recognizing the impacts that open burning has in the San Joaquin Valley Air Basin (SJVAB), concerned Valley growers have reduced open burning through the use of sustainable agricultural practices. Those practices have contributed to a significant reduction in particulate matter (PM) emissions over the last several years: since 2002, PM2.5 emissions from open burning have been reduced by 64%, or eight tons of PM2.5 per day.

Open burning of agricultural crops and materials is managed by the District's Smoke Management System (SMS). The District's use of the SMS is intended to limit emissions to levels below the federal ambient air quality standards and to better distribute emissions temporally and spatially for flexibility of burn days for growers while minimizing the impact on the public. The SMS analyzes the daily impact of open burning on air quality in 103 zones in the SJVAB and allocates daily burning allowances in a given zone based on factors such as the local meteorology, the air quality conditions, the atmospheric holding capacity, the amount of burning already approved in a given area, and the potential impacts on downwind populations. Public exposure to smoke has been significantly reduced with the implementation of the smoke management program. The Valley has not experienced episodes where communities are inundated with smoke due to the District's ability to better manage and minimize smoke production based on local meteorological conditions for each of the SMS zones. Greater control over the timing of burns also improved the general air quality in all areas of the District. Under the SMS, no burns have been allowed in zones on days when exceedances of the federal ozone standard have occurred. The continued issuance of burn permits for these crop types would not cause or substantially contribute to a violation of an applicable federal ambient air quality standard

For more information on the California Health and Safety Code requirements and how the crop categories have been addressed since 2004, please refer to Appendix B of this report. The District has also completed an Initial Study for said rule that indicates the project will not result in any significant adverse effects to the environment, and a Proposed Negative Declaration has been prepared and properly noticed pursuant to the California Environmental Quality Act Guidelines (CEQA).

State Law Requirements

In 2003, state law was amended to require the District to limit open burning for diseased crops, establish best management practices for other weeds and maintenance, and prohibit open burning for numerous crop categories. In addition to those requirements, the state law authorizes the District to postpone the burn prohibition dates for specific types of agricultural material if the District makes three specific determinations and the Air Resources Board (ARB) concurs. The determinations are: (1) there are no economically feasible alternatives to open-burning that type of material; (2) open-burning that type of material will not cause or substantially contribute to a violation of a National Ambient Air Quality Standard (NAAQS); and (3) there is no long-term federal or state funding commitment for the continued operation of biomass facilities in the Valley or the development of alternatives to burning.

The District has continued to work closely with the stakeholders to identify economically feasible alternatives to open burning of various agricultural materials and to meet its legal obligation under the CH&SC. To fulfill the state law requirements, the District has implemented the requirements for most crop categories identified in California Health and Safety Code (CH&SC) Section 41855.5. This report examines the feasibility of prohibiting open burning for the remaining crop categories and crop types, as well as to satisfy the determinations required by the CH&SC Section 41855.6.

Summary of the Recommendations Contained in this Report

For the purposes of this project, District staff will not address the following crop categories and crop types:

- Prohibited crop types from earlier deadlines: In 2005 and 2007, District staff evaluated several alternatives to open burning for the crop categories identified in the CH&SC and has prohibited open burning for most of those crops and materials.

- Diseased crops: The District incorporated the state law requirements for diseased crops into Section 5.9 of Rule 4103 in 2004. The requirements provide for the issuance of a conditional crop burning permit if certain criteria were met and the county agricultural commissioner makes specific determinations for the crop type. This category includes crop types that are identified as diseased per Section 5.9 of Rule 4103.

- Other weeds and maintenance: These materials have already been addressed in 2005 as part of the CH&SC requirements to establish best management practices for the control of other weeds and maintenance. The best management practices were developed in consultation with the University of California Cooperative Extension, stakeholders (growers), producers, and agricultural industry groups. See Rule 4103, Attachment 1, to view the Best Management Practices for the control of other weeds and maintenance.

- Attrition of various crops: According to the District's policy, attrition is vegetative materials not associated with pruning (as defined in Rule 4103) or orchard/vineyard removals. Attrition materials include the incidental cuttings of dead or broken branches, tree mortality, water sprouts or suckers, or other damage to tree crops. CH&SC does not prohibit these materials from being open burned.

This report analyzes the crop categories that are subject to the June 1, 2010 burn prohibition deadline, as well as the crop types that were postponed from earlier phases. The table below shows the crop categories and District staff's recommendations.

Table ES – 1 Summary of Revised Proposed Recommendations on Specific Crop Type

Crop Categories and Crop Type	Revised Proposed Recommendations and Findings	For More Information, see Sections:
Vineyard Removal Materials		
Grape and Kiwi Crops	Allow Burn Findings: • Difficult, if not impossible, to remove wires embedded in wood • Biomass alternative is not economically feasible	3.1; 5.2; 6.1.1; 6.2.1; 6.3.4; 9.1; B.3.1
Orchard Removal Matter		
Small Other Orchards (Currently at 20 acres or less)	Reduce Burn allowance to 15 acres or less per location per year. Findings: • Cost analysis shows that the cost-per-acre increases to a level where biomass alternative is not economically feasible for orchard removals at 15 acres or less • Biomass alternative is economically feasible for orchard removals above 15 acres	3.2.1; 4.1.1; 5.2; 5.3; 5.4; 6.1.1; 6.2.1; 6.3; 7.2.1; 7.2.2; 9.1; B.3.1
Fig Crops	Reduce Burn allowance to 15 acres or less per location per year. Findings: • Biomass alternative is found to be common practice • This category would be included in the Small Other Orchards category. • Biomass alternative is economically feasible as part of the Small Other Orchards category.	3.2.2; 4.1.1; 5.2; 5.3; 5.4; 6.1.1; 6.2.1; 6.3; 7.2.1; 7.2.2; 9.1; B.3.1
Citrus Crops	Allow Burn Findings: • Biomass alternative is not economically feasible • Uncertainty in whether all citrus materials could be accepted at biomass power plants, due to the lack of future commitments to biomass plant operations	3.2.3; 4.1.1; 5.2; 5.3; 6.1.1; 6.2.1; 6.3; 7.2.1; 7.2.2; 9.1; B.3.1
Apple, Pear, and Quince Crops	Allow Burn Findings: • No technologically feasible alternatives • Disease, specifically, Fireblight, is prevalent among these crop types	3.2.4; 5.3; 5.2; 6.1.1; 6.2.1; 6.3; 9.1; B.3.1

Table ES – 1 Summary of Revised Proposed Recommendations on Specific Crop Type (CONTINUED)

Crop Categories and Crop Type	Revised Proposed Recommendations and Findings	For More Information, see Sections:
Weed Abatement		
Ponding & Levee Banks	Allow Burn Findings: • Mowing and herbicides are not viable alternatives due to slopes and remote locations.	3.3; 4.1.10; 5.2; 9.1
Other Materials		
Brooder Paper	Prohibit Burn Findings: • Landfill alternative is found to be common practice	3.4.1; 5.2; 9.1
Deceased Goats	Prohibit Burn Findings: • Burial alternative is found to be common practice	3.4.2; 4.2; 5.2; 9.1
Diseased Bee Hives	Allow Burn Findings: • CH&SC identifies this crop type as “diseased” bee hives. • No technologically feasible alternatives	3.4.3; 4.2.4; 5.2; 9.1
Field Crop		
Rice Stubble	Interim phase-down schedule would be modified: • Only 70% of acreage can be burned starting 6/1/08 • 50% limitation (6/1/10) would be removed • Burning is prohibited starting 6/1/15 Findings: • Market is not available for baling rice stubble • Lack of available water in the post-harvest season in the SJVAB for soil incorporation • Baling and soil incorporation are not viable alternatives	3.5; 4.1.11; 4.1.12; 4.1.13; 5.2; 9.1
Prunings		
Apple, Pear, and Quince Crops	Allow Burn Findings: • No technologically feasible alternatives • Disease, specifically Fireblight, is prevalent among these crop types	3.6.1; 4.1.2; 5.2; 5.3; 6.1.2; 6.2.2; 6.3; 9.1; B.3.2
Fig Crops	Prohibit Burn Findings: • Shredding alternative is found to be common practice	3.6.2; 4.1.2; 5.2; 5.3; 5.4; 6.1.2; 9.1; B.3.2

Table ES – 1 Summary of the Recommendations on Specific Crop Type (CONTINUED)

Crop Categories and Crop Type	Revised Proposed Recommendations and Findings	For More Information, see Sections:
Surface Harvested Prunings		
Grape vines – prunings from grape vines	Prohibit Burn Findings: • Soil incorporation alternative is found to be common practice	3.7.1; 4.1.2; 5.2; 6.3.3; 9.1
Grape canes – defined as “Vineyard Materials”	Prohibit Burn Findings: • Soil incorporation alternative is found to be common practice	3.7.1; 4.1.2; 5.2; 6.3.3; 9.1
Raisin Trays – defined as “Vineyard Materials”	Allow Burn Findings: • Raisin trays contain five percent polymer, which slows the decomposition process for soil incorporation and are not accepted at biomass power plants. • Market is not available to ship the materials overseas for recycling. • Soil incorporation, biomass, and recycling overseas are not viable alternatives	3.7.2; 4.1.2; 5.2; 9.1
Almond, Walnut, and Pecan Crops	1. Prohibit burning of prunings for each agricultural operation whose total nut acreage (i.e., almonds, walnuts, and pecans) at all agricultural operation sites is 3,500 acres or more. 2. For each agricultural operation whose total nut acreage at all agricultural operation sites is less than 3,500 acres, a. Allow burning of up to 20 acres of prunings per year, and b. Allow burning of additional prunings, provided: i. The operator submits to the APCO before the pruning operation is completed, a representative cost estimate(s) for shredding all prunings generated by the total nut acreage at the agricultural operation site. The cost estimate(s) shall reflect shredding in a time frame that allows the operator to proceed with established post-pruning cultural practices. ii. The APCO determines that either the submitted cost estimate(s) represent(s) an unreasonable financial impact to the operator, or that adequate shredding services are not available in time for the operator to proceed with established post-pruning cultural practices. Findings: • Equipment is available to shred prunings to smaller pieces to help speed the decomposition process. • Cost to buy the shredding equipment is feasible only for larger growers • Most growers are shredding the pruning material as a viable alternative • Current fleet of contractor shredding equipment cannot meet demand of a full prohibition • Set-up charges make shredding economically infeasible at 20 acres or less	3.7.3; 4.1.2; 5.2; 5.3; 5.4; 6.1.2; 6.2.2; 6.3; 9.1; B.2.2; B.3.2

Summary of Methodology for Determining Recommendations

During the research process, District staff worked closely with representatives from the Ag industry and other agencies to address the burn prohibition requirements for various crops. The Ag industry representatives have conducted extensive research and effort to provide District staff with key information to help move this project forward. The information used for further analysis include economic data, costs for chipping and burning, description of operation, and other related information.

District staff reviewed the technologically feasible alternatives for each of the affected agricultural crop in the SJVAB. From those alternatives, District staff continued to evaluate what appears to be the most viable and likely method to open burning for many of the affected crops. For the crop types that did not have any technologically feasible alternatives to open burning, District has recommended postponing the burn prohibition for that specific crop type. District staff also recommended that the crop types where viable alternatives are considered common practice be prohibited from open burning. For the remaining crop types, District staff conducted further research and analyses on costs and economic impact based on the alternatives that were determined to be most viable and likely method to open burning. Growers are not bound to the selected alternative for each of the specific crop type in this report and may choose other alternatives.

In addition to the analyses above, District staff analyzed the emissions and emissions reductions from agricultural burning and the selected alternatives, as well as the health considerations from those emissions. District staff also conducted extensive research on biomass power plants, including the capacity to accept agricultural materials and long-term federal or state funding commitment. The air quality impacts of continued open burning and alternatives, as well as the District's determinations, are presented toward the end of this report.

Each of the chapter in this report is summarized below.

Chapter One discusses the reasons for the report, describes the affected crop categories, and provides a brief description of questions staff asked throughout the report research, and writing process.

Chapter Two examines regulatory information regarding the current District Rule and the CH&SC burning prohibitions.

Chapter Three discusses each individual crop type and provides a summary of the analysis and recommendation as well as a description of the crop type, and alternative methods of disposal that were evaluated.

Chapter Four provides an in depth discussion and analysis of the various technological alternatives to open burning. This discussion includes alternative methods that may not necessarily be in use currently, but could potentially be put to use in the future.

Chapter Five presents data from the District databases regarding criteria emissions from open burning of each crop type. The emission inventory from agricultural burning is compared to expected emissions from alternative methods of disposing of the agricultural materials. A discussion of the emission reduction analysis methodology and calculations is included. Also in this chapter is a discussion of the health benefits from reduced open burning, and a health risk assessment of open burning and alternatives to open burning.

Chapter Six discusses the costs for open burning of orchard and vineyard removal and orchard prunings. Costs for sending the material from orchard removals, vineyard removals to biomass power plants, as well as a discussion on the costs for the disposal of orchard prunings by chipping it is provided.

Chapter Seven provides an in depth look at the biomass power plants that are currently operational in the Valley. A general description of how a biomass power plant operates and receives biomass fuel is provided. Locations, fuel use and storage capacities are discussed, as well as a detailed look at the emissions and technologies used to reduce and control emissions from plant activities. Staff also explores the economics of accepting agricultural materials versus accepting urban waste material as fuel sources at the biomass power plants. Questions are asked and answered such as how much more agricultural material is expected due to prohibition of open burning and can the biomass power plants physically handle the increase in material. An analysis exploring the outlook of the future of biomass power plants is provided through discussions of policies for renewable energy, contracts with utility companies for the sale of the generated electricity, the District's own legislative platform affecting biomass power plants, State and Federal commitments for continued operation of the biomass power plants, and the potential new facilities that once operational would increase the capacity of biomass plants to accept agricultural materials as fuel.

Chapter Eight discusses air quality impacts of continued open burning and alternatives.

Chapter Nine illustrates the determinations required by state law regarding economic feasibility, Federal and State commitments for biomass facilities, air quality impacts, and the need for ARBs concurrence with District recommendations.

Governing Board Approval of this Report Satisfies the Determinations Required by State Law

The California Health and Safety Code (CH&SC) Section 41855.5, which was added in 2003, prohibits the continued open burning of certain types of agricultural material, according to a phased-in schedule of deadlines, but also authorizes the Governing Board of the San Joaquin Valley Air Pollution Control District (District) to postpone the deadlines if economically feasible alternatives are not available and the Air Resources Board concurs with the Governing Board's determinations. The District addressed the requirements from the California Health and Safety Code (CH&SC) through a two-step process. For the first step, District staff proposed to the Governing Board an amendment to Rule 4103 (Open Burning) to incorporate the provisions of CH&SC Section 41855.5 and Section 41855.6 directly into the rule. The Governing Board's approval of this action would allow the District to consider the feasibility of non-burning alternatives for specific crops and materials. The revised proposed amendments to the rule would become effective June 1, 2010.

Governing Board approval of this report implemented the second step of the process and addressed the technological research and economic analysis associated with the June 2010 deadline. The recommended determinations on the economic feasibility of burn alternatives for specific crops and materials are presented in this report. The Governing Board's approval of the recommended determinations, in the form of a Resolution, would satisfy the requirements in the State law and the revised proposed Section 5.5.2 of Rule 4103. The District will periodically review the burning prohibitions and provide any new recommendations to the Governing Board before any new prohibition take effect, but no later than December 31, 2015.

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Chapter 1

Background

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Chapter 1: BACKGROUND

1.1 REASONS FOR THIS REPORT

1.1.1 State Law Requires Determinations by the District, with Concurrence by ARB

In 2003, state law was amended to require the District to limit open burning for diseased crops, establish best management practices for other weeds and maintenance, and prohibit open burning for numerous crop categories. In addition to those requirements, the state law authorizes the District to postpone the burn prohibition dates for specific types of agricultural material if the District makes three specific determinations and the Air Resources Board (ARB) concurs. The determinations are: (1) there are no economically feasible alternatives to open-burning that type of material; (2) open-burning that type of material will not cause or substantially contribute to a violation of a National Ambient Air Quality Standard (NAAQS); and (3) there is no long-term federal or state funding commitment for the continued operation of biomass facilities in the Valley or the development of alternatives to burning.

The District has continued to work closely with the stakeholders to identify economically feasible alternatives to open burning of various agricultural materials and to meet its legal obligation under the CH&SC. To fulfill the state law requirements, the District has implemented the requirements for most crop categories identified in CH&SC Section 41855.5.

While the CH&SC is designed to achieve emissions reduction by implementing wide scale prohibitions and regulations on agricultural burning, it recognizes that technological and economic factors may limit the non-burning alternatives to agricultural material disposal, and it allows the District to determine the details and timing of the prohibitions. As a result, this report is intended to satisfy the requirements from CH&SC Section 41855.6 by presenting the District's recommended determinations for specified crops and materials, particularly those that do not have any technologically or economically feasible alternatives to open burning. As proposed in the amendments to Rule 4103, the District would revisit this report at least once every five years to review the determinations for any crops and materials that have been postponed. This process would protect public health without adverse impacts to the economic viability of these crops in the Valley.

1.1.2 Description of Affected Categories

For the purposes of this project, the following categories will not be addressed:

- Prohibited crop types from earlier deadlines: In 2005 and 2007, District staff evaluated several alternatives to open burning for the crop categories identified in the CH&SC and has prohibited open burning for most of those crops and materials.

- Diseased crops: The District incorporated the state law requirements for diseased crops into Section 5.9 of Rule 4103 in 2004. The requirements provide for the issuance of a conditional crop burning permit if certain criteria were met and the county agricultural commissioner makes specific determinations for the crop type. This category includes crop types that are identified as diseased per Section 5.9 of Rule 4103.

- Other weeds and maintenance: These materials have already been addressed in 2005 as part of the CH&SC requirements to establish best management practices for the control of other weeds and maintenance. The best management practices were developed in consultation with the University of California Cooperative Extension, stakeholders (growers), producers, and agricultural industry groups. See Rule 4103, Attachment 1, to view the Best Management Practices for the control of other weeds and maintenance.

- Attrition of various crops: According to the District's policy, attrition is vegetative materials not associated with pruning (as defined in Rule 4103) or orchard/vineyard removals. Attrition materials include the incidental cuttings of dead or broken branches, tree mortality, water sprouts or suckers, or other damage to tree crops. CH&SC does not prohibit these materials from being open burned.

This report describes the methodology and supporting data for determinations for affected categories. This report will address several crops and materials that had been postponed during earlier burn prohibition deadlines and the crop categories for the June 1, 2010 burn prohibitions of CH&SC Section 41855.5. The June 1, 2010 categories include Vineyard Removals, Prunings from Surface Harvested Crops, and Other Materials, listed below as items One, Two and Three. The crops and materials that were postponed until June 1, 2010 in earlier amendments to Rule 4103 are listed on the following page. This report does not address materials whose burn prohibitions were not postponed from earlier actions by the District.

1. "Surface harvested prunings" which includes, but is not limited to, any of the following:

    a. Almond prunings.
    b. Walnut prunings.
    c. Pecan prunings.
    d. Grape vines.
    e. Vineyard materials, which includes grape canes and raisin trays[1].

2. "Vineyard Removals" which includes vineyard removal materials from grape vineyards and kiwi vineyards[2].

3. "Other materials" which includes, but is not limited to, any of the following:

    a. Brooder paper.
    b. Deceased goats.
    c. Diseased bee hives.

4. Weed abatement activities affecting ponding and levee banks.

5. Prunings from apple crops, pear crops, fig crops, and quince crops.

6. Orchard removal matter from citrus crops, apple crops, pear crops, quince crops, and fig crops and orchard removal matter from a total of 20 acres or less of orchard removal at a single location, per calendar year.

7. Rice stubble, residual rice stubble, spot burning of rice stubble, burning of weeds and vegetative materials on rice field levees and banks.

The District minimizes the impacts from the burning of these crops through the burn permitting process and the Smoke Management System (SMS). In previous amendments to the rule, the District has determined that the continued issuance of burn permits for the postponed crop categories would not cause or substantially contribute to a violation of an applicable federal ambient air quality standard.

The agricultural materials categories affected by this project are described more fully in Chapter 3 of this report.

[1] The definition in the CH&SC for "vineyard materials" includes grape canes and raisin trays. Based on District's staff's interpretation of CH&SC Section 41855.5, "grape canes should be in "Surface Harvested Prunings", not in "Vineyard Removals".
[2] Similarly, "vineyard removal materials" should be in "Vineyard Removals" category, not in "Surface Harvested Prunings" category.

1.2 OVERVIEW OF THE METHODOLOGY FOR ALTERNATIVES TO OPEN BURNING FOR MAKING THE DETERMINATIONS

In order to more effectively address the requirements of CH&SC Section 41855.5 and Section 41855.6, District staff has developed a methodology for the purpose of evaluating the alternatives to open burning of crops/materials affected by this report. For the purposes of this report, District staff has gathered information on alternative methods to open burning of agricultural material and conducted analyses based on the consideration for the SJVAB. The review process will include, but not be limited to, the items listed below.

1.2.1 Is There a Technologically Feasible Non-Burning Alternative for Disposing of the Specific Crop Type?

District staff has reviewed and considered available information in the evaluation of alternatives to open burning of crops affected by this project and has evaluated the most practical alternatives to determine whether the alternatives can be used for the affected crops in the SJVAB. District staff realizes that there can be substantial differences in the factors that need to be considered in evaluating technologically feasible alternatives to open burning of agricultural materials. Alternatives that may be technologically feasible for one crop may not be for another crop, such as burning for disease prevention. If a specific crop/material does not have a technologically feasible alternative to open burning, District staff recommends postponing the burn prohibition for that specific crop/material. For those crops/materials where a technologically feasible alternative exists, District staff has determined whether those options are viable alternatives to continue to conduct further analysis in the following section.

District staff will continue to review and analyze relevant information and work with affected operators, chippers, power plant operators and any other interested parties for future review of the technologically feasible alternatives. District staff anticipates that additional alternatives will be identified as technology progresses and will evaluate them accordingly.

1.2.2 Does the Cost Analysis Show an Economically Feasible Non-Burn Alternative?

For those crop categories where a technologically feasible alternative exists, the District must perform an analysis that determines the cost and economic feasibility of implementing the preferred alternative in order to consider postponement of those categories. District staff began by estimating the per-acre costs for each alternative method, based on the appropriate technique for that specific crop and practice, and considering economies of scale. The cost estimates used to determine the economic feasibility of the selected alternatives could include capital costs, maintenance costs, and operational costs. For the economic analysis, District staff analyzed economic impact stemming from the difference in cost between open burning and grind-and-haul approaches to orchard removal, and between open burn and shredding in place (land application) approaches for pruning. For the purposes of the pruning analysis, the costs for nuts producers cover a two-year period as, generally, almond, walnut and other nut orchards could be pruned every two years. For the purposes of the orchard/vineyard removal analysis, costs for orchard and vineyard removals cover a ten-year period. Some growers mentioned that they pull out orchards every few years to keep the farm productive. The 10-year value has been used in previous District analyses. These years constitute the bearing or harvested years, not the non-bearing years.

In accordance with state law, the District has conducted an economic analysis of the potential impacts of the burning prohibitions in Chapter Three of this report. The analysis compares the per-acre costs for the alternative to the per-acre net profit for each crop category. If the cost of implementing the alternative exceeds ten percent of the crop category's net profit, District staff will recommend a temporary postponement of the burn prohibition for that specific crop/material.

The 10 percent threshold utilized in this analysis represents the economic significance level generally utilized by the District in the development of District rules, and represents the level that a regulatory action would pose a significant economic impact to affected sources. More specifically, the criteria for determining the level of "significance" of economic impact for District rulemaking projects is a ten percent change in Return on Sales (ROS). The ten percent threshold was based on the parameters of accepted methodologies discussed in a 1995 California Air Resource Board (ARB) report called "Development of a Methodology to Assess the Economic Impact Required by SB 513/AB 969" (by Peter Berck, PhD, UC Berkeley Department of Agricultural and Resources Economics, Contract No. 93-314, August, 1995). One methodology described in the report relates to determining a level below or above which a rule and its associated costs is deemed to have significant economic impacts. ARB has incorporated the methodologies described in the report in its own assessment of economic impacts for rules or regulations adopted by ARB, and uses a similar threshold, ten percent change in the Return on Equity (ROE), in its rulemaking projects. Both methods are expected to generate similar results with regard to economic impact.

1.2.3 Do Biomass Power Plants or Other Facilities in the Valley Have Capacity?

A key consideration in the evaluation of an alternative to open burning is whether the operators, facilities and other resources that would be impacted by the alternative have the capability and capacity to receive large amounts of the agricultural material if the material cannot be soil incorporated. If additional agricultural material is prohibited from being open burned, District staff expects that such prohibition would generate a substantial amount of agricultural material. The alternatives to open burning would need to be able to accept and handle the additional diverted agricultural material.

Growers normally prefer to clear away the agricultural material from their farms as soon as possible in order to carry on with their farming operations; therefore, growers depend on operators such as chippers to provide timely service. The ability to provide such timely service could be impacted if chipping operators are not equipped to handle the additional agricultural material. Similarly, if biomass power plants are not prepared to handle the additional agricultural material, the plants may be forced to turn away agricultural material. Other affected operators could face similar issues in regards to their capability to handle additional agricultural material. District staff has evaluated the potential ability of the affected operators to handle, store and process the additional agricultural material. While biomass plants may represent a cleaner option to open burning, those reductions come at the price of increased diesel emissions from equipment used to chip the biomass and transport it to the plant. This report will calculate those diesel emissions and examine any public health impacts which they may pose compared to open burning.

1.2.4 Does ARB Concur With the Analysis?

One of the four criteria that must be met in order to postpone the burn prohibition commencement dates set forth in the CH&SC is ARB's concurrence with the District's determinations. District staff has worked closely with ARB staff to better ensure that ARB's concurrence is provided in accordance with the requirements. ARB and District staff has conducted several biweekly meetings to address the crops and issues related to this project.

1.3 PROCESS AND SCHEDULE FOR 2010 DETERMINATIONS

During research of the various areas involved in this project, District staff has contacted several affected stakeholders for the purpose of gathering data and other pertinent information. District staff has also participated in several stakeholder meetings to obtain further information about the crops, alternatives and other related issues. District staff has included relevant information obtained through this process in this report. District staff appreciates the contribution of data and other information by the Valley growers, chipping and shredding operators, biomass operators, and vendors during this process.

The final phase of the CH&SC burn prohibitions is set for June 1, 2010, and District staff proposes to address the final deadline in a two-step process. The District's Governing Board adopted the amendments to Rule 4103 to incorporate the provisions from the CH&SC on April 15, 2010 as part of the first step. These provisions allow the District to periodically review changes in agricultural practices and consider non-burning alternatives and economic conditions as they develop without having to conduct a full rulemaking action.

This report constitutes the second part of the process. On April 14, 2010, District staff conducted a public workshop to present the findings and draft recommendations from the draft report and to seek public comments. District staff published a Proposed Report for further public comments prior to the Public Hearing. Additional comments were submitted to District staff and presented to the Governing Board on May 20, 2010.

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Chapter 2

Agricultural Burning Requirements of Rule 4103 and CH&SC

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Chapter 2: AGRICULTURAL BURNING REQUIREMENTS OF RULE 4103 AND CH&SC

The District has implemented the burn prohibition for many crops and materials specified in CH&SC Section 41855.5. In addition to the burn prohibitions, the District has addressed the diseased crops and materials by regulating the burning of those materials through issuance of a conditional burning permit. Staff has also continued to monitor burning of agricultural materials through the District's SMS.

2.1 CURRENT DISTRICT RULE

Rule 4103 was originally adopted on June 18, 1992 and it has been amended several times to incorporate state law requirements. The provisions of Rule 4103 apply to open burning conducted in the San Joaquin Valley Air Basin, with the exception of prescribed burning and hazard reduction burning, as defined in Rule 4106 (Prescribed Burning and Hazard Reduction Burning). The current rule, which would be effective until June 1, 2010, has limitations on the amount and the type of materials that can be burned and restricts when such burning can occur.

2.2 CH&SC BURNING PROHIBITIONS (see Appendix A for affected crops/ materials)

As legislated in 2003, Section 41855.5 of the CH&SC prohibits the issuance of a burn permit for specific categories of agricultural material. This section also requires that the District regulates the burning of diseased crops and establish best management practices for the control of other weeds and maintenance. The schedule below shows the requirements for specific categories of agricultural material and their corresponding prohibition dates.

June 1, 2005

- Prohibit burning for Field Crops, Prunings, and Weed Abatement
- Establish best management practices for Other Weeds and Maintenance
- Regulate burning of diseased crops

June 1, 2007 Prohibit burning for Orchard Removals

June 1, 2010 Prohibit burning for Vineyard Removals, Prunings from Surface Harvested Crops and Other Materials

The agricultural materials subject to the first two deadlines were previously addressed in separate rulemaking projects. The District has incorporated the diseased crops and the materials from Other Weeds and Maintenance into Section 5.5.5 and Section 5.9 of the rule in previous rulemaking. Further details on the CH&SC definitions are provided in Appendix A of this report.

Section 41855.6 of the CH&SC allows the District to postpone the burn prohibition implementation dates of Section 41855.5 for any category of agricultural material or crop. Postponement of those deadlines requires the District to meet additional criteria; however, the CH&SC does not permit the District to provide a "permanent" postponement of the burning prohibition. All of the following criteria must be met for the District to postpone a burn prohibition commencement date for a specific category or crop:

1. The District determines that there is no economically feasible alternative means of eliminating the agricultural material.

2. The District determines that there is no long-term federal or state commitment for the continued operation of biomass facilities in the San Joaquin Valley or the development of alternatives to burning.

3. The District determines that the continued issuance of permits for that specific category or crop will not cause, or substantially contribute to a violation of an applicable federal ambient air quality standard.

4. The State Air Resources Board concurs with the District's determinations.

Chapter 3

Technical and Economic Analysis of Affected Crop Categories and Recommendations

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Chapter 3: Technical and Economic Analysis of Affected Crop Categories and Recommendations

In 2005 and 2007, District staff evaluated several alternatives to open burning for the crop categories identified in the CH&SC. While most of those crops and materials are already subject to the requirements of Rule 4103 and are prohibited from being burned, there were no technologically or economically feasible alternatives available for some crops and materials at the time. District staff has reviewed the technologically feasible alternatives for each of the affected agricultural crop in the SJVAB. From those alternatives, District staff has evaluated what appears to be the most viable and likely method to open burning for many of the affected crops in the SJVAB. Further discussion on emissions and costs for open burning and the alternatives for these crops are presented in the following chapters of this report. This chapter analyzes the crop categories that are allowed to be burned until June 1, 2010 and presents the findings for those crops.

During the research process, District staff has worked closely with the ag industry representatives and other agencies to address the burn prohibition requirements for various crops. The ag industry representatives have conducted extensive research and effort to provide District staff with key information to help move this project forward. The information used for further analysis include economic data, costs for chipping and burning, descriptions of operations, and other related documents. The ag industry has made significant progress over the years in reducing emissions from open burning through research, development, and implementation of viable alternative methods. However, there are concerns for some crops where growers have not been able to identify technologically or economically feasible alternatives.

The basis of the economic feasibility analysis is a comparison of compliance costs of the likely non-burning alternative to profit rates (Return on Sales, or ROS) of the industry sector. To evaluate the economic feasibility of burn prohibitions on orchard pruning/removal operations for subject crops, the District engaged their regulatory economic consultant, Applied Development Economics, Inc. (ADE). ADE has familiarity with and constant access to comprehensive and applicable profitability and revenue data. Compliance costs for non-burning disposal alternatives were estimated by District engineers and ag industry representatives using a variety of data sources and methodologies. The development of compliance cost estimates is presented in Chapter 6.

Profits for subject industry sectors were estimated by ADE by applying published profitability rates for crops to estimated revenues. Profit rates, production, acreage, and prices were taken from the USDA Ag Census 2007, University of California Cooperative Extension, and California Agricultural Commissioners' Annual Report, as well as data compiled commercially by Dun and Bradstreet. While the profitability rates used in the analysis below are long-term averages from Dun and Bradstreet, it should be noted that industry stakeholders engaged in extensive effort and provided significant input regarding the recent profitability of certain crops. These data are presented in Appendix E and confirm the District's conclusions on the significance of economic impacts (i.e., greater or less than 10% of profit) on each crop operation.

The analysis was conducted for each crop/operation (nut orchard prunings, citrus orchard removals, vineyard removals, and removal of other orchards such as stone fruit). The calculations are shown on the tables in Appendix E, and the results of the analysis are shown below.

Summary of Results, Economic Feasibility

Crop	Operation	Farm Scale, Acres	Cost/Profit, %
Vineyard – Wine Grapes	Vineyard Removal	<100	55.2% – 82.0%
Vineyard – Wine Grapes		≥100	46.9% – 69.6%
Vineyard – Raisin & Table Grapes		<100	22.6% – 33.6%
Vineyard – Raisin & Table Grapes		≥100	19.2% – 28.6%
Vineyard – Kiwi		<100	11.1% – 16.6%
Vineyard – Kiwi		≥100	9.5% – 14.1%
Citrus	Orchard Removal	<100	10.9% – 11.9%
Citrus		≥100	9.4% - 10.3%
Other orchards	Orchard Removal	<100	7.0%
Other orchards		≥100	5.9%
Almond, Pecan, Walnut	Pruning	<100	10.0%
Almond, Pecan, Walnut		≥100	8.5%

3.1 VINEYARD REMOVAL MATERIALS

Summary and Recommendation

Table 3-1 Summary of Analysis

Vineyard Removal Materials	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	Percent of Return on Sales	Economically Feasible? (less than 10% ROS)
Grapes (wine grapes only)					
Farms Less than100 acres	Possibly Biomass	No. Wire Issues.	$762 - $1,132	55.2%-82.0%	No
Farms 100 acres or more	Possibly Biomass	No. Wire Issues.	$762 - $1,132	46.9%-69.6%	No
Grapes (raisin and table grapes)					
Farms Less than100 acres	Possibly Biomass	No. Wire Issues.	$762 - $1,132	22.6%-33.6%	No
Farms 100 acres or more	Possibly Biomass	No. Wire Issues.	$762 - $1,132	19.2%-28.6%	No
Kiwi					
Farms Less than100 acres	Possibly Biomass	No. Wire Issues.	$762 - $1,132	11.1%-16.6%	No
Farms 100 acres or more	Possibly Biomass	No. Wire Issues.	$762 - $1,132	9.5%-14.1%	No

*Biomass power plants can accept vineyard removals given that wires are removed from the vines.

Recommendation:

District staff evaluated biomass power plants as an alternative to open burning of vineyard removal materials and other factors. The economic feasibility analysis is presented in Section E-1 of Appendix E. At this time, District staff recommends that vineyard removal materials continue to be allowed to be open burned based on the following reasons:

- There is currently no economically feasible alternative to remove the wire that is embedded in the cordon and canes to prevent damage to the chipping equipment or prevent the wires from going to the biomass power plants. Wire removal adds a significant cost to the growers. Increasing the amount of materials going into landfills is not considered a viable alternative as landfills are required to divert wood and green materials.

- Most chipping operators are not willing to chip and haul away the vineyard removal materials or would charge a higher fee.

Description and Findings

Vineyards include both grape vines and kiwi vines because both crops require support, such as the trellis systems to help keep the fruits off the ground. Grape vines are used to produce table grapes, wine grapes or raisin grapes. The cultural practices and the type of trellis system used at a vineyard are based on the intended use of the grapes (table, wine, or raisins) and other factors. In addition to the vine and trellis wire, a vineyard may contain cross arms, as well as metal or wooden stakes and posts. Treated stakes (sometimes with metal braces) cannot be chipped and must be taken to a landfill. The posts currently being used are predominantly made out of steel. Metal stakes are removed before chipping and taken to a steel plant. The end posts can also be made out of redwood which can be burned.

According to ag representatives, disposal methods for vineyard removal materials are the same for table, wine and raisins grapes. A grower will generally grow a crop to produce specifically table grapes, wine grapes or raisin grapes. However, some vineyards provide the grower some flexibility so that based on several factors, including market prices, a grower can determine well into the production year whether the grape crop will end up as table grapes, wine grapes or raisin grapes.

Depending on the disposal method with the vineyard removal materials, the materials that help support the vine can pose several issues for the grower during the removal process. In many cases, most of the foreign material can be removed from the vine. However, there are some situations where complete removal of the material, such as wire, can be difficult and expensive for the grower. When too much wire is embedded into the vines, chippers can refuse to chip the agricultural materials. If the wires were to be chipped along with the wood, the number of power plant operators that will accept such agricultural materials can be limited.

According to biomass power plant operators, vineyard removal materials are accepted. The only restriction with vineyard removal materials is that wire is removed and treated posts are taken out. Substantial amount of wire in the chipped material can cause problems for the biomass power plant. Other contamination (as long as not excessive) in the material, such as dirt, need to be controlled but is not a major concern to the operators since some amount of dirt is expected of all agricultural fuel. It is generally not an issue if the chipped materials are clean.

While growers can hire laborers to remove most of the wires that connect the vines, it is not practical to remove the wire that is embedded into the cordon or the canes. Ag representatives indicated that the raisin vineyards are pruned in such a way that the remaining canes are wrapped around the vineyard wire to support the crop. In order to chip the materials for fuel use at biomass power plants, ag representatives indicated that the wire must be cut more times (compare to open burn) and be removed completely from the vineyard or must be present only in very short lengths before it can be chipped. This presents an issue for vineyards where a cordon is created by wrapping the vine around the wire in the second year. As the vine grows, the wire becomes more and more embedded in the vine, making it impossible to remove. In some trellis systems, there may be as many as four wires embedded in the cordon. Ag representatives also indicated that chipping operators have reported the wire causing problems and getting wrapped around the moving parts of their machinery, and that biomass facilities prefer not to receive material with wire because the wire causes havoc with their equipment.

Ag representatives have also indicated that getting the materials chipped according to the grower's schedule has been an issue because it could take weeks or months to have a field chipped, which may be too late to plant for the next season.

3.2 ORCHARD REMOVAL MATTER FROM CITRUS, APPLE, PEAR, QUINCE, AND FIG CROPS AND ORCHARD REMOVAL MATTER FROM A TOTAL OF 20 ACRES OR LESS

In 2007, ARB concurred with the District's limited postponement to allow for the burning of orchard removal matter from 20 acres or less and other type of orchard removals. Rule 4103 defines "Orchard Removal Matter" as agricultural material generated by the removal of orchards. This includes leaves, branches, trunks, roots, stumps and untreated branch support sticks. The rule prohibits burning of orchard removal material generated as a result of land use conversion from agricultural to nonagricultural purposes.

Since 2002, the Natural Resources Conservation Service (NRCS) has encouraged growers to chip debris left from orchard or vineyard removals by providing a cost-share basis through the Environmental Quality Incentives Program (EQIP), which help reduce NOx, VOC, PM10, and PM2.5 emissions generated from open burning. The program also includes chipping of almond and walnut pruning, which will be discussed in Section 3.7.3 of this chapter. According to NRCS staff, the payment rate has increased from $100 per acre to $150 per acre. In order for the growers to replant the field, the chipped orchard removal materials are typically removed from the farm to a biomass power plant or a composting facility. The chips could also be deposited on unpaved roads for dust control purposes. Based on NRCS data, the amount of chipped materials from the orchard and vineyard removal category averaged about 270 acres in the SJVAB per year, from 2007 to 2009.

3.2.1 Orchard Removal Matter from a Total of 20 Acres or Less

Summary and Recommendation

Table 3-2 Summary of Analysis

Orchard Removal Matter	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	Percent of Return on Sales	Economically Feasible? (less than 10% ROS)
*Orchard Removal Matter from 20 Acres or Less Category**					
Farms Less than100 acres	Biomass	Yes	$161	7.0%	Yes
Farms 100 acres or more	Biomass	Yes	$161	5.9%	Yes

*Reduce Burn allowance to 15 acres per location per year. No case by case determinations for additional acreage.

Recommendation:
District staff has completed the review process for the technologically feasible alternatives to open burning of orchard removal matter from a total of 20 acres or less. The economic feasibility analysis is presented in Section E-2 in Appendix E. Biomass power plants appear to be the most technologically feasible alternative to open burning of orchard removal matter; however, due to the limiting factor of increased cost per acre for smaller acreage and availability of chipping operators, District staff believes that open burning be allowed to continue for small orchard removals. District staff recommends that the current open burning limit be reduced to 15 acres or less of orchard removal at a single location, per calendar year. District staff also recommends that there be no case by case determinations for additional acreage since the cost analysis shows that it becomes more expensive as the acreage becomes smaller regardless of the total size of the farm.

In addition chipping operator typically refuses small jobs, making it difficult for many growers to remove small acreages of orchard removals. The District has increasingly refused most requests for burns that are over 15 acres. The District's Compliance Department has indicated that several requests above 15 acres have been denied because the costs to chip and remove the orchards were determined to be economically feasible.

District staff has found that limiting the acreage amount to 15 acres would be feasible based on the District's cost analysis to chip and haul the orchard removal materials to the biomass power plants, where the cost per acre appears to level out at about 15 acres or more. Further information on cost analysis can be found in the Costs section of this report. According to the burn applications, burn permits that were approved for less than 15 acres make up for most of the burns, over 84%. According to some growers and chipping operators, the cost per acre could level out to as low as 10 acres for some growers; however, District staff believes that 15 acres is a reasonable limit based on the cost analysis and considering fluctuations in cost caused by location, fuel costs, and materials, and other factors.

Description and Findings

Since June 2007, the District has provided limited burning allocation for orchard removal matter from 20 acres or less and has required a case-by-case economic justification of the open burning alternatives from growers before evaluating and determining whether a burn permit may be issued for farms burning less than 20 acres but are greater than 100 cumulative acres. ARB concluded that the postponements will not substantially contribute to the violation of an applicable federal air quality standard, and discussed the important role of the District's comprehensive smoke management program in preventing impacts to nearby communities. However, ARB noted that orchard removal of 20 acres or less from all other crop types must be implemented narrowly. This category includes all orchard type, except for citrus and pome fruits (apples, pears, and quince crops). As recommended above, figs would be considered as part of this category.

Growers typically need to remove some orchards every few years to keep the farm productive. Growers, ag representatives and chipping operators have expressed several concerns with the chipping of orchard removal matter from small acreage. Generally, small acreage growers are not a priority for chipping operators because of amount of materials generated compared to the time it takes to travel and move the equipment to the field. Biomass power plant operators have indicated that the large chippers are doing jobs less than twenty acres with an understanding that the cost of chipping has gone up.

Chipping operators also charge a minimum fee (or move-in fee) to the grower. As a result of the minimum charge, the per acre cost for such small removals increases as the acreage becomes smaller. Based on the District's cost analysis and information received from ag representatives, the cost per acre appears to level out at a certain acreage. The fee could vary among chipping operators and is dependent on the availability of chipping contractors, storage at biomass power plants, the crop type and density, topography, soil type, and location. Given these considerations and the fact that most growers are already chipping the orchard removals above 20 acres, District staff has used a conservative estimate for chipping costs for the analysis.

Ag representatives have indicated that when chipping operators work on small acreage jobs, growers are often forced to wait until the chipping operator plans to be in the area. This can cause significant delays in fumigation, land preparation, irrigation, and planting. Trees must be ordered a year in advance. When the land is not prepared in time for the trees to be planted, these young trees die, at a large cost to the grower.

For farms greater than 100 cumulative acres in the SJVAB, the District has required a case-by-case economic justification of the open burning alternatives from growers before evaluating and determining whether a burn permit may be issued for less than 20 acres. District staff evaluated the economic feasibility of the alternatives based on the applications and copies of receipts, written bids, or supporting information for the economic justification. District staff has found that the case-by-case economic justification varies significantly, from net losses to the cost exceeding the ten-percent (10%) net profit threshold. Information provided by growers also supports the higher costs per acre for chipping of orchard removal for smaller acreages, which in the past has shown to be less economically feasible.

From June 2007 to February 2010, the District received a total of 1088 applications for orchard removals of 20 acres or less per year. Of those applications, the District issued burn permits for 964 applicants of various farm sizes, including those that are greater than 100 cumulative acres. However, based on the evaluation of the economic justifications, District staff issued burn permits for only 305 applications for farm over 100 cumulative acres. For the approved burn permits, the amount of acres burned relative to the amount of acres farmed is equivalent to four percent (4%), or about 8,200 acres burned from a total of 196,400 acres. Based on this analysis, the District has implemented narrowly the provisions for burning orchard removals of 20 acres or less.

3.2.2 Fig Crops Orchard Removal Matter

Summary and Recommendation

Table 3-3 Summary of Analysis

Orchard Removal Matter	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	District Percent of Return on Sales	Economically Feasible? (less than 10% ROS)
*Fig Crop**					
Farms Less than100 acres	Biomass	Yes	$161	7.0%	Yes
Farms 100 acres or more	Biomass	Yes	$161	5.9%	Yes

*Analysis of fig crop will be considered as part of “Other Fruit Orchards”. Reduce Burn allowance to 15 acres per location per year. No case by case determinations for additional acreage.

Recommendation:
District staff has considered the factors currently impacting the alternatives for disposing of fig orchards and recommends that open burning of fig orchard removals be reduced to less than 15 acres at a single location, per calendar year after June 1, 2010. The economic feasibility analysis is presented in Section E-2 of Appendix E. Fig orchard removals would be considered as part of the small other orchard removals category. District staff also recommends that there be no case by case determinations for additional acreage.

Description and Findings

When fig orchards are removed, the trees are typically no longer productive and would be replaced with new fig orchards or are no longer an economical crop and would be replaced with other crops. There are no fire blight issues or other concerns for fig crops. In addition, the orchard materials would be acceptable at biomass power plants as an additional fuel source.

3.2.3 Citrus Crops Orchard Removal Matter

Summary and Recommendation

Table 3-4 Summary of Analysis

Orchard Removal Matter	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	Percent of Return on Sales	Economically Feasible? (less than 10% ROS)
*Citrus Crop**					
Farms Less than100 acres	Biomass	Some operators	$369	10.9%-11.9%	No
Farms 100 acres or more	Biomass	Some operators	$369	9.4%-10.3%	No

*Biomass power plants are willing to take citrus crops; however, the materials are typically blended with other materials and are less desirable.

Recommendation:
District staff evaluated the factors currently impacting citrus crops and the proposed alternative for disposal. The economic feasibility analysis is presented in Section E-3 in Appendix E. For citrus crops, District staff has considered biomass power plants as the most technologically and viable alternative to open burning. Based on District staff's analysis, it is not economically feasible to prohibit open burning for citrus crop. In addition, there appears to be uncertainty in whether all of the citrus materials could be accepted at biomass power plants at this time, due to the lack of future commitments to biomass plan operation.

District staff recommends that citrus orchard removals continue to be allowed to be open burned. As recommended and supported by the industry, District staff also recommends that growers allow a drying time of between eight to ten weeks for citrus materials as a best management practice before burning.

Description and Findings

The following citrus crops are all grown in the San Joaquin Valley: grapefruits, lemons, oranges (primarily Navels and Valencias), tangerines, and mandarins. According to the County Agricultural Commissioner's Data for Calendar Year 2008, oranges make up about 82% of the harvested acreage of citrus crops in the SJVAB. Growers typically remove old citrus orchards in the year prior to planting. Based on the District's data, orchard removals from citrus crops are spread out through the year; however planting usually occurs between February and April.

Citrus is often grown in clay-like soil that adheres to its roots. The extensive lifespan of citrus crops leads to the development of an extensive root structure that is difficult to free of soil debris when the root is removed. Clay soil, common to citrus orchards, is difficult to remove from the roots. Separating the roots from the trunk and then processing the trunk and the stump or root separately for the purpose of multiple uses increase the costs of operations, such as chipping and grinding. Furthermore, screening of chipped materials to remove excessive clay from stumps increases the overall citrus orchard removal costs to growers. It takes about six to eight weeks of drying time for a typical non-citrus orchard; citrus takes longer to dry. Growers would need to dry the material long enough so that a biomass facility will take the material and ration it.

In addition to the concerns noted above, growers, ag representatives and chipping operators have expressed several other concerns with the chipping of citrus crop orchard removal matter. Key concerns include 1) the reluctance or refusal of some power plants to accept citrus chips, 2) the additional processing and costs that are required to make the citrus chips acceptable by the power plants, and 3) whether biomass operators will take citrus once the economy improves and they start getting more construction material.

Biomass power plant operators recognize that citrus has been a problem in the past, but feel that this no longer seems to be the case as there have been considerable changes in processing the citrus materials. Biomass power plant operators have indicated that mixing citrus chips with chips from other crops helps promote better flow of the chips through their equipment. In the past, one of the issues was that clay soil could become trapped in the rootballs and damage the power plant boiler refractories. The stringy nature of citrus tree chips could also clog conveyors and material handling equipment unless the chips were finely ground. Biomass power plant operators have indicated that from 2003 to 2005, the roots seemed to be a problem initially with citrus materials getting into the conveyor systems, but later it was determined that citrus needed a drying process of around six to eight weeks, maybe shorter in hotter temperatures.

According to CBEA, all of the facilities have worked diligently with the orchard removal contractors to resolve the issues with citrus wood and as a result, higher percentage of citrus material could now be accepted. Biomass power plants continue to fall short of their goals for more citrus orchard materials and a number of plants continue to be extremely short of wood fuel. Many are currently curtailed or operating at reduced loads and are in need of more fuel at this time. The District looks forward to working with the biomass industry to achieve long-term commitments toward the extensive use of agricultural biomass.

For more information on biomass facilities, please refer to Chapter Eight of this report.

3.2.4 Apple, Pear, and Quince Orchard Removal Matter

Summary and Recommendation

Table 3-5 Summary of Analysis

Orchard Removal Matter	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	District Percent of Return on Sales	Industry Stakeholder Percent Return on Sales
Apple, Pear, & Quince Crops	None. Disease Issues.	N/A	N/A	N/A	N/A

*N/A: not applicable

Recommendation:
District staff has considered the factors currently impacting the alternatives for disposing of orchard removals for apple crops, pear crops, and quince crops and has determined that there are currently no feasible alternatives that would substitute open burning of these crops. There are two factors for this consideration: 1) biomass operators will not accept treated materials and 2) requiring that these crops transport materials in closed containers is beyond what is required for other orchard removals and therefore, costs are expected to be greater. For the second factor, District staff is not aware of any chipping operators that have closed containers for this purpose. District staff recommends that open burning continue for these crops.

Description and Findings

As mentioned above for prunings from pome fruits, crops such as apples, pears, and quince are susceptible to fire blight, a bacteriological disease that can spread through insects, wind, and mechanical devices and kills blossoms, shoots, limbs, and sometimes the entire tree. In most cases, the on-set of fire blight is unidentifiable and can be spread by contact or exposure to other healthy orchard material. For orchard removals, the equipments used to cut or remove the tree are also routinely sterilized with antibacterial agents to mitigate exposure to the disease or potential disease.

Similar to pruning, orchard removals from apple, pear, and quince crops need to be burned to combat further spread of fire blight within orchards and to prevent potential infection of nearby orchards. As indicated by some operators and county ag commissioners, they are not aware of an effective treatment for fire blight. Growers have considered chipping the orchard removals and transporting the materials to biomass facilities. However, the primary concern with this alternative is potentially spreading the disease to other orchards during transportation. In addition, biomass operators prefer clean product and will not accept treated materials. As a result, burning is the preferred and most viable method used in the SJVAB to dispose of these crops in order to avoid potential exposure of the fire blight to healthy trees.

3.3 WEED ABATEMENT ACTIVITIES AFFECTING SURFACE WATERWAYS, INCLUDING PONDING AND LEVEE BANKS

Summary and Recommendation

Table 3-6 Summary of Analysis

Weed Abatement Activities	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	Percent of Return on Sales	Economically Feasible? (less than 10% ROS)
Surface Waterways – Ponding and Levee Banks	None. Mowing and Herbicide Issues.	N/A	N/A	N/A	N/A

*N/A: not applicable

Recommendation:
District staff has considered the factors currently impacting the weed abatement activities affecting surface waterways, including ponding and levee banks and recommends that open burning be allowed to continue as part of weed abatement activities affecting surface waterways, including ponding and levee banks. While chemicals and mowing are available for weed control in many locations, these alternatives are not viable because of the slopes and remote locations.

Description and Findings

It is noted in the May 19, 2005 Rule 4103 Final Staff Report, that although some weeds and locations lend themselves to Best Management Practices (see Attachment 1 in Rule 4103), there remains a need for limited burning of some weeds. As mentioned earlier, this analysis does not include the category for “other weeds and maintenance”. The CH&SC required the District to establish best management practices in 2005 for the control of other weeds and maintenance, which includes ditch bank work, canal bank work, dodder weed, star thistle, tumbleweeds, noxious weeds, pesticide sacks, and fertilizer sacks. Since the implementation, landowners and irrigation districts have continued to do their part to reduce burning by seeking alternative ways to manage weeds.

The best management practices in the rule were developed in collaboration with affected sources and are alternatives that must be considered prior to any open burning. Landowners and operators have also opted for more mechanical and chemical control of weeds and only burned at times when conditions, such as remote locations or other requirements, prevent other alternative practices.

Since 2005, open burning is no longer allowed for weed abatement activities from berms, fence rows, pasture, grass and Bermuda grass. However, open burning is currently allowed for weed abatement activities affecting surface waterways, including ponding and levee banks. The following materials are not considered to be part of the burn allowance for weed abatement activities affecting surface waterways, ponding, and levee banks: 1) weeds that originate from outside and away from the surface waterways, ponding or levee banks and 2) any other debris or materials that are gathered from surface waterways, ponding, or levee banks, such as tree limbs or foreign materials.

According to comments and information received from ag representatives and several agencies, there are currently no feasible alternatives to burning all of the weeds along surface waterways, ponding and levee banks. Landowners and operators have considered using hand crews for removing weeds but found the alternative to be impractical. Landowners and operators typically mow and spray most of the weeds or use flame desiccation, for direct heating of residual weed foliage and over growth of weeds to assure the destruction of weed seeds. One operator discs specific sites as needed. In many remote locations along surface waterways, ponding, and levee banks, fire is the only option for effective control of weed seeds and for safety of workers.

In addition, ag representatives and agencies have indicated that burning weeds is the most effective option to slope the banks to stabilize them and allow the water to flow easily, with less erosion. Rodents, such as gophers, have also been a concern around levees, including some ground squirrels that have bored through entire levees. Standing weeds make it nearly impossible to check the banks for rodents, which can cause ditch breaks or erosions and lead to flooding of surrounding areas. Complete prohibition to open burning in these areas could also increase additional use of other chemicals for pest control.

The Federal EPA and the State and Regional Water Boards continue to push to eliminate the use of chemicals near any waterway. Recognizing these issues, many landowners and operators are controlling the use of chemicals along surface waterways, ponding, and levee banks due to concerns over runoff of chemicals from land to waterways. Ag representatives have provided a copy of the California's Porter-Cologne Water Quality Act of 1969 and related information from the federal EPA (attached as part of Appendix B), which further explains the water regulations. The California Porter-Cologne Water Quality Act regulates the discharge of waste into ambient waters, and authorizes Regional Boards to impose requirements on waste dischargers after consideration of several factors. Along with other responsibilities, the Regional Boards also regulate all pollutant or nuisance discharges that may affect either surface water or groundwater. One of the purposes of the federal Water Pollution Control Act (or Clean Water Act) is to restore and maintain the chemical, physical, and biological integrity of the nation's waters by preventing point and nonpoint pollution sources.

One operator indicated that the ability to burn occasionally would reduce the amount of chemical needed. According to the operator, the area of the banks by the water line make up about 0.2% of the agency's total acreage and only a portion of that is burned annually.

3.4 OTHER MATERIALS

Other materials include brooder paper, deceased goats and diseased bee hives.

3.4.1 Brooder Paper

Summary and Recommendation

Table 3-7 Summary of Analysis

Other Materials	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	Percent of Return on Sales	Economically Feasible? (less than 10% ROS)
Brooder Paper	Landfill	Yes	N/A	N/A	N/A

*N/A: not applicable

Recommendation:
District staff has found that the current and primary disposal method for brooder paper is landfilling. District staff considers landfills to be a viable alternative to open burning and will recommend that these materials be prohibited from being burned. The District's SMS data also shows an insignificant amount of emissions from open burning of brooder paper in the SJVAB in the last few years.

Description and Findings

A broad variety of fowl are raised in confined animal facilities in the SJVAB. Poultry operators use brooder paper to protect their young birds during transportation and the first few weeks of life. In general, the paper needs to easily absorb poultry droppings and disintegrate for easier disposal. District staff contacted four operators that raise poultry. Three of the operators indicated that they do not burn their brooder paper but put it in a dumpster for delivery to a landfill. A large operator that raises turkeys and chickens indicated that he doesn't "…believe that burning brooder paper is a common practice in California." District staff also contacted an operator that burns the brooder paper used for raising ducks. The operator indicated that he has alternatives to burning the brooder paper including composting the brooder paper or taking it to a landfill.

3.4.2 Deceased Goats

Summary and Recommendation

Table 3-8 Summary of Analysis

Other Materials	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	Percent of Return on Sales	Economically Feasible? (less than 10% ROS)
Deceased Goats	Burial	Yes	N/A	N/A	N/A

*N/A: not applicable

Recommendation:
District staff considers burial to be a viable alternative to open burning. District staff does not consider rendering to be a viable alternative to open burning due to the many issues noted for that technology. District staff recommends that these materials be prohibited from open burning. The District's SMS data also shows an insignificant amount of emissions from deceased goats being burned in the SJVAB in the last few years.

Description and Findings

Several published articles have noted that meat goat production has been gaining in popularity in the United States in recent years. Some goat operators confirmed that there is increased demand for their products.

The discussion below on deceased goats differentiates goats that expire from diseases (diseased) and goats that expire from other causes (not diseased).

Deceased goats that were not diseased - Whether goats are raised for their milk, their meat or their fur, goats are subject to fatal injury due to accidents, predatory animals, exposure to the elements, and other causes. Operators have experienced several particular issues in the past few years with the disposal of goats that have died from causes other than diseases. Issues have included the die off of goats due to high summer temperatures and the reluctance or refusal of rendering plants to accept goats due to concerns over the cost to collect the animals and possible diseases. Two goat operators noted that they did not know of any operators that used open burning to dispose of their goats. Instead, operators usually bury the goats on their property in as safe a manner as possible.

Deceased goats that were diseased - In the interest of protecting public health, several regulatory agencies have regulations affecting the handling of diseased animals. Two diseases of particular concern are mad cow disease and scrapie. Bovine spongiform encephalopathy (BSE), also known as mad cow disease is a fatal disease that causes progressive neurological degeneration in cattle. Scrapie is a fatal, degenerative disease affecting the central nervous system of sheep and goats.

The California Department of Food and Agriculture (CDFA) regulates on-site carcass disposal in the case of animals suspected of succumbing to contagious disease. The California Code of Regulations, California Food and Agriculture, Division 5, Part 1, Chapter 1, Section 9141 requires that "Any person that has the care or control of any animal that dies from any contagious disease shall immediately cremate or bury the animal." Section 9142 requires that "An animal which has died from any contagious disease shall not be transported, except to the nearest crematory." And Section 9143 requires that "An animal which has died from any contagious disease shall not be used for the food of any human being, domestic animal, or fowl."

In addition, the Department of Resources Recycling and Recovery (CalRecycle) has prohibitions that impact the disposal of deceased goats. Section 17855.2 of California Code of Regulations Title 14, Natural Resources, Division 7, CIWMB, Chapter 3.1, Compostable Materials Handling Operations and Facilities Regulatory Requirements, prohibits the composting of unprocessed mammalian tissue except for certain specific instances.

In 1997, FDA published a final regulation designed to prevent the spread of BSE through animal feed. The 1997 FDA rule prohibits the use of most mammalian protein in the manufacture of animal feeds given to ruminant animals, such as cows, sheep, and goats. The regulation also requires process and control systems to ensure that feed for ruminants do not contain the prohibited mammalian tissue. In 2008, FDA published a regulation that strengthened the 1997 rule by prohibiting the tissues that have the highest risk for carrying the agent thought to cause BSE in animal feed.

When goats die from unknown causes, some operators will try to discover the cause of death by taking the carcass to a veterinarian for an examination in an effort to determine the cause of death.

3.4.3 Diseased Bee Hives

<u>Summary and Recommendation</u>

Table 3-9 Summary of Analysis

Other Materials	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	Percent of Return on Sales	Economically Feasible? (less than 10% ROS)
Diseased Bee Hives	None. Disease Issues.	N/A	N/A	N/A	N/A

*N/A: not applicable

Recommendation:
Several key considerations for diseased bee hives are that the diseases could be dormant in the frames and used equipment, as well as develop resistance to chemicals used in the sterilization process. The CH&SC specifically identify this crop type as “diseased” bee hives. District staff believes that there are currently no technologically feasible alternatives to open burning of diseased bee hives at this time. District staff recommends that diseased bee hives be allowed to continue to be burned.

<u>Description and Findings</u>

Bees are a key component in the growing of crops. The importance of bees was noted in an article in the U.S. Department of Agriculture's science magazine, "Agricultural Research." The author Kevin J. Hackett (ARS National Program Leader, Biological Control, Beltsville, Maryland) noted in the March 2004 issue of Agricultural Research magazine that "The value of honey bee pollination to U.S. agriculture is more than $14 billion annually, according to a Cornell University study. Crops from nuts to vegetables and as diverse as alfalfa, apple, cantaloupe, cranberry, pumpkin, and sunflower all require pollinating by honey bees. For fruit and nut crops, pollination can be a grower's only real chance to increase yield. The extent of pollination dictates the maximum number of fruits." In light of this, it is vitally important to growers that the supply and availability of bees are protected to the highest degree possible.

Artificial bee hives serve two purposes: production of honey and pollination of crops. The hives are commonly transported so the bees can pollinate crops in selected areas. Modern bee hives are usually constructed of wood and consist of several parts which include the following:

- Bottom board - this has an entrance for the bees to get into the hive.

- Brood box - is the most bottom box of the hive and is where the queen bee lays her eggs.

- Honey Super - same as brood box, but is the upper-most box where honey is stored.

- Frames and Foundation - wooden frame and plastic sheet with honey comb impression where bees build wax honey combs.

- Inner and Outer Cover - As the name implies.

Beekeepers have experienced several problems in the past few years. A recent development is the problem of colony collapse disorder (CCD), a phenomenon where bees mysteriously abandon their hives. The UC Davis Department of Entomology website contains an article dated Oct. 16, 2007, about a lecture presented by UC Davis honey bee specialist Eric Mussen. The article notes the following comment: "One-third of America's honey bees vanished this past year due to the mysterious CCD, characterized by almost total hive abandonment. Nearly all adult worker bees unexpectedly fly away from the hive, abandoning the stored honey, pollen, larvae and pupae. Usually they leave in less than a week, and only the queen and a few young workers remain".

Section 29208 of California Code of Regulations Title 3, Food and Agricultural Code, Division 13, Bee Management and Honey Production, requires that "If American foulbrood is found in an apiary, the abatement shall be by killing the bees in the infested colonies and disposing of the hives and their contents, together with any other infested comb, hives, and associated appliances which are found in the apiary, in one of the following ways: If abatement is by burning, the person abating shall act in accordance with applicable air pollution control district or air quality maintenance district regulations and state and local fire control laws. If the regulations or laws prohibit burning immediately, the diseased colonies shall be sealed and placed in an enclosed structure and thereafter burned on the first date allowed by the regulation or law. All the activities shall be reported to the inspector prior to burning, who may require that burning occur only under his or her supervision."

3.5 RICE STUBBLE (STRAW)

Until June 1, 2010, permits may be issued for the burning of rice stubble up to 70% per year of the total acreage of rice farmed by the operator. Permits may also be issued for the burning of residual rice stubble, spot burning of rice stubble, and burning of weeds and vegetative materials on rice field levees and banks.

Summary and Recommendation

Table 3-10 Summary of Analysis

Rice Stubble (Straw)	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	*District Percent of Return on Sales*	*Industry Stakeholder Percent Return on Sales*
Rice Stubble (Straw)	No. Market and Water Issues.	N/A	N/A	N/A	N/A

*N/A: not applicable

Recommendation:
District staff has considered the factors currently impacting the alternatives for disposing rice stubble. Due to the fluctuation in market demand for rice stubble, which impacts growers ability to effectively remove the material, and issues with water allocation, District staff recommends that open burning of rice stubble be allowed to continue for burns at 70% per year of the total acreage of rice farmed by the operator after June 1, 2010 and until June 1, 2015. District staff will review the feasibility of a complete burn prohibition for rice stubble in 2015.

Description and Findings

Most of the rice grown in the SJVAB is grown in the northern part of the air basin. Rice is planted in the spring and harvested in the fall. Once the rice is harvested, the rice straw remains in the field for disposition. Reducing the amount of post-harvest straw residue in the rice fields is important to the successful production of the next crop. Burning has been the historical cultural practice for removing straw and residues for the California rice industry. Burning rice straw helps prepare the field for the next rice crop as burning destroys any diseases in the rice straw of the current crop.

The farming operations for rice growers in the SJVAB are different from Sacramento Valley growers, where significant acres of rice are also farmed. Rice growers in the Sacramento Valley typically dispose of their rice straw by incorporating the rice straw into the soil. Unlike Sacramento Valley where water allocations allow post-season irrigating, water cannot be delivered to agricultural operations in the Northern SJVAB in the post-harvest season due to the annual distribution schedules designated by irrigation districts. Due to the lack of available water in the post-harvest season, rice growers in the SJVAB do not use soil incorporation to dispose of their rice straw because the residue may not breakdown by planting season. Most rice growers in the SJVAB do not have access to water wells for their rice fields.

In 2007, District staff believed that rice growers could sell the rice straw to rice straw baling operators who would then sell it to their customers such as dairies. Therefore, the District prohibited open burning for 30% of rice stubble per year.

In 2009, District staff attended a meeting held by several rice growers that farm in the Escalon area. According to the growers, the baling alternative worked well for the 2007 harvest as there was a market for the baled rice straw. However, rice growers stated that they were having difficulty in their efforts to comply with the 70% burn allowance for 2009. Specifically, they were having difficulty in getting their rice straw baled and removed from their farms. The rice growers and a rice straw baling operator indicated that they have conducted several searches on alternatives to burning the rice material and there is currently no market for baled rice straw. In November 2009, a variance was approved for a group of rice growers that farm in the Escalon area to allow them to burn the remaining 30% of their acreage. Growers noted in their variance application that there were no viable alternatives currently available for disposal of the rice stubble.

According to the District's burn data for rice stubble, the annual burn acreage have fluctuated since 2006. This change is primarily due to the market demand for rice stubble. However, open burning from rice stubble have been reduced by 42% since 2005, base on a three-year average from 2007 to 2009. The market should continue to be assessed annually to ensure that rice stubble can continue to be used for other alternatives, such as dairies.

3.6 Prunings from Apple, Pear, Quince, and Fig Crops

3.6.1 Prunings from Apple, Pear and Quince Crops

Summary and Recommendation

Table 3-11 Summary of Analysis

Prunings	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	Percent of Return on Sales	Economically Feasible? (less than 10% ROS)
Apple, Pear, & Quince Crops	None. Disease Issues.	N/A	N/A	N/A	N/A

*N/A: not applicable

Recommendation:
District staff has considered the factors currently impacting the alternatives for disposing prunings from apples, pears, and quince crops and do not believe that there are technologically feasible alternatives to open burning of these materials. Depending on the amount and size of materials, it may not be feasible to require that growers place the materials into plastic bags for burial. The chemicals are preventative measures to help control fire blight; however, chemicals are not the solution to ensure complete control since the bacterial disease may develop resistant strains. District staff recommends that prunings from apples, pears, and quince be allowed to be burned to help control the spread of fire blight.

Description and Findings

Pome fruit including apple, pear, and quince crops are susceptible to a disease called fire blight. Fire blight is a destructive bacterial disease that kills blossoms, shoots, limbs, and sometimes the entire tree. Insects, wind, and mechanical devices can spread fire blight. According to the ag representatives and an agricultural commissioner, fire blight can destroy an entire orchard in a single season if left uncontrolled. The bacterium can be easily transmitted to susceptible tissue by contact. The equipments used to prune the tree are routinely sterilized with antibacterial agents when moving from one tree to the next to mitigate exposure to the disease or potential disease. The unrestricted movement of infected tissue will cause the disease to spread rapidly and under certain environmental conditions (hot and wet). Containment of the infected tissue is an essential element for control.

Apple, pear, and quince prunings are burned to combat further spread of fire blight within orchards and to prevent potential infection of nearby orchards.

Some operators and county ag commissioners have indicated that they are not aware of an effective treatment for fire blight. Chemicals that are used to control the bacterial disease could prove ineffective if the disease becomes resistant over time. According to an agricultural commissioner, the options for controlling fire blight that is becoming resistant to chemical means of control with Streptomycin are burning on site or disposal by placing infected plant material in double plastic bags for burial.

3.6.2 Prunings from Fig Crops

Summary and Recommendation

Table 3-12 Summary of Analysis

Prunings	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	Percent of Return on Sales	Economically Feasible? (less than 10% ROS)
Fig Crop	Shredding	Yes	N/A	N/A	N/A

*N/A: not applicable

Recommendation:
District staff has considered shredding as an alternative to open burning of prunings from fig crops and other factors currently impacting fig crops. Shredding the pruning materials on site appears to be a common practice and the most feasible alternative to open burning of prunings from fig crops. Shredding the fig prunings and allowing it to decompose should not be a significant fruit degradation concern for fig orchard removal as the chipped material should have decomposed or be reduced in size by the time of harvest. The current mowing and sorting practices would help reduce any excessive materials from the figs during harvest. As a result, District staff recommends that open burning be prohibited for prunings from fig crops.

Description and Findings

Most figs are harvested as a dried crop. Figs are dried on the tree and allowed to fall to the ground. Dried figs are mechanically swept into windrows and collected and harvests are repeated at two to three week intervals. This method of surface harvesting requires the orchard grounds to remain free of excess debris that will hinder the harvest. The harvested figs are then transported to a dry location to be sorted before being sold.

According to ag representatives, there are no fire blight issues for figs and shredding the pruning material has become a common practice. Fig crops are typically pruned by hand during the winter. The pruning materials are placed in the aisle of the tree rows and shredded in place. Operators typically mow the center of the tree rows a few times a year to manage and maintain the orchard floor.

3.7 SURFACE HARVESTED PRUNINGS

3.7.1 Prunings from Grape Vines and Grape Canes

Summary and Recommendation

Table 3-13 Summary of Analysis

Surface Harvested Prunings – Vineyard Materials	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	Percent of Return on Sales	Economically Feasible? (less than 10% ROS)
Grape Vines	Soil Incorporation	Yes	N/A	N/A	N/A
Grape Canes	Soil Incorporation	Yes	N/A	N/A	N/A

*N/A: not applicable

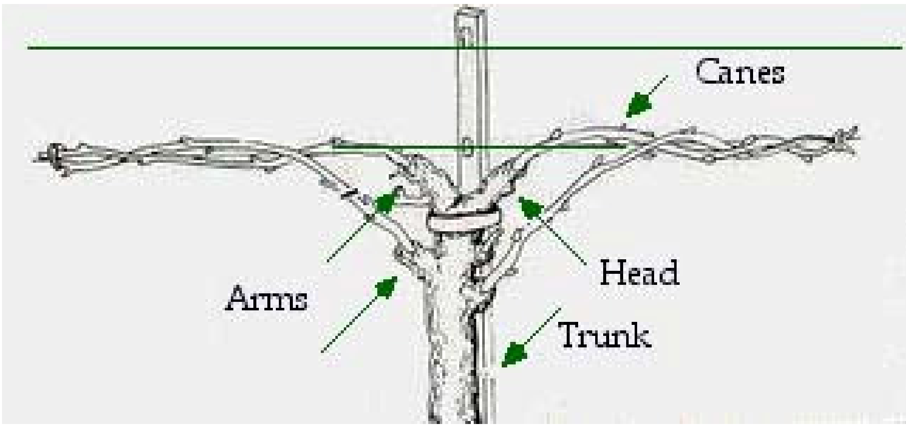
Recommendation:
As shredding and soil incorporation of prunings from grape vines and grape canes are already widely practiced, District staff considers soil incorporation to be a viable alternative to open burning and recommends that prunings from grape vines and grape canes be prohibited from open burning.

Description and Findings

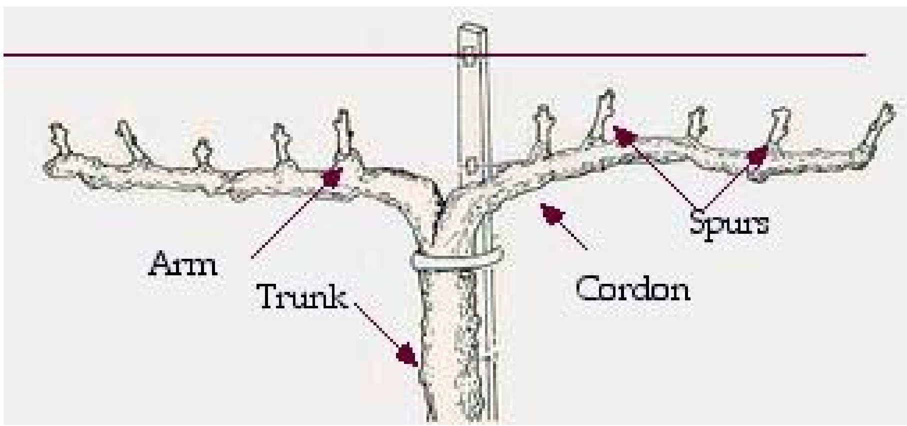
This category does not include grape attrition. According to the District's policy, attrition is vegetative materials not associated with pruning (as defined in Rule 4103) or orchard removals. Attrition materials include the incidental cuttings of dead or broken branches, tree mortality, water sprouts or suckers, or other damage to tree crops. Attrition materials may be burned provided that the materials are listed on a valid burn permit and daily burn authorization is granted.

Grape vines are used to produce table grapes, wine grapes or raisin grapes. The grape canes and spurs from a grape vine are usually pruned once a year in the winter when the grape vine is dormant. Wine vineyards now have high tensile wire to withstand the machines that go through the rows during pruning. The pruned grape canes and any other pruned material, such as spurs, are positioned in the center of the grape vine rows and shredded. Many growers typically shred their grape vine pruning material using a tractor and a shredder. Grape canes and other materials from the grape vines do not include the prunings from kiwi crops, which are already subject to Rule 4103.

Figure 3-1 Illustration of Grape Vine and Cane



A head-trained vine with cane pruning



Bilateral cordon training with spur pruning

http://www.ipm.ucdavis.edu/PMG/GARDEN/FRUIT/CULTURAL/grtrainprune.html

According to ag representatives and growers, the shredding and soil incorporation of grape cane prunings and other pruning materials from a grape vine have been long time traditional practices of growers. According to ag representatives, growers and biomass power plant operators, they are not aware of anyone doing anything with grape canes and other pruning materials from vines, except for shredding them and incorporating the shredded material back into the soil.

3.7.2 Raisin Trays

Summary and Recommendation

Table 3-14 Summary of Analysis

Surface Harvested Prunings – Vineyard Materials	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	Percent of Return on Sales	Economically Feasible? (less than 10% ROS)
Raisin Trays	None. Polymer & Recycling Issues.	N/A	N/A	N/A	N/A

*N/A: not applicable

Recommendation:
District staff has considered the factors currently impacting the alternatives for open burning of raisin trays and recommends that open burning of raisin trays be allowed to continue. There is currently not enough research information for using raisin trays as fuel at biomass power plants. In addition, District staff believes that the increase to 40% of mechanical harvest for raisin production in 2009 alone has also significantly reduced the amount of emissions from these materials. As growers continue to switch to mechanical harvesting as an alternative to using raisin trays and open burning the material, District expects that open burning emissions from raisin trays will subside as well. According to the District's burn data, growers have continued to reduce open burning of raisin trays. Since 2007, growers have reduced burning of raising trays by over 27%, or 0.11 tons. District staff recommends that growers implement the practices below to control open burning of raisin trays and that the District work with the ag industry to develop any additional measures.

Description and Findings

Raisin trays are used in producing raisins. There are several types of drying trays used for sun-dried raisins. Wooden trays were used in the past, but have been replaced by paper trays. Due to changes in farming practices and other factors, several new paper trays have been developed. The types of paper trays available include regular paper, wet-strength paper and poly-coated paper. Both wet-strength paper and poly-coated paper trays are especially suited for protecting the raisin crop under wet conditions.

The traditional paper tray is approximately 24 inches wide and 36 inches long although other sizes are available for certain situations. The continuous tray, which consists of tray material wound into rolls of specified widths, resulted from the development of mechanical harvest machines. The continuous paper is a heavier weight than individual trays.

Once the raisins have cured adequately and the moisture in the rolls is acceptable, normally in late September, they are ready to be collected. Raisins must be at 16 percent or less moisture content to meet the industry's incoming inspection requirements. There are several methods used for collecting the raisins and preparing them for the next step in their processing. After the raisins are collected, they are separated from the raisin trays for further processing and delivery to a raisin handler. Once the raisins are removed from the raisin trays, the raisin trays are ready for some other use or disposal.

Growers have continued to pursue alternative ways to burning raisin trays for over 50 years. Ag representatives indicated that only about 50,000 acres of vineyards using raisin trays are expected by 2015 because growers are transitioning to mechanical harvesting, which does not include the use of raisin trays. It is expected that there will be a continual reduction in burning. The long term goal of the California raisin industry is to transition toward 100% mechanization of raisin harvest and drying[5]. Based on information received from the ag representatives, the historical use of paper raisin trays has been significantly reduced by over 52% since 1990. The table below is a summary of information provided by ag representatives and shows the progress made in reducing the use and open burn of raisin trays.

Table 3-15 Raisin Tray Paper Volume History

Year	Total Amount of Raisins in Production (tons)	Percentage of Raisins Mechanized (%)	Amount of Raisins Produced on Raisin Trays (tons)	Number of Raisin Trays (four pounds of raisins per tray)
1990	395,000	5	375,000	188,000,000
2000	432,000	10	389,000	195,000,000
2009	300,000	40	180,000	90,000,000

According to ag representatives, some growers used recycling firms to dispose of their trays in the past. The trays were then shipped to China. The growers were typically charged a fee when the recycling firms picked up the trays at the growers site. However, China has cut off import of raisin trays because of the dollar's value and the practice of sending raisin trays to China is no longer a feasible alternative.

District staff has considered soil incorporation and biomass power plants as possible alternatives; however, the materials in the raisin trays create several potential issues. Ag representatives have indicated that some growers grind and soil incorporate their raisin trays. The raisin trays contain polymer (5%) so that the moisture on the ground can not be absorb efficiently through the raisin trays. The trays that are ground up and soil incorporated into the soil can create problems because the materials are slow to decompose and some pieces will scatter around. Growers prefer clean fields for operations, which also help keep rodents and pests away.

The raisin trays currently can not be recycled for use as fuel at biomass power plants due to the polymer in the material. According to biomass power plant operators, both Madera and Mendota power plants are permitted to burn paper. Power plant operators indicated that they are willing to work with the District to address these issues. Power plant operators are determining a way to incorporate raisin trays into their fuel and analysis is pending. Additional research is needed for the potential use of raisin trays as fuel for biomass power plants.

In efforts to help reduce and control the burning of raisin trays, Ag representatives have developed and recommended the following practices for the burning of raisin trays:

1) All burning locations must be attended at all times when the raisin trays are burning, by able bodied adults with adequate tools or equipment to control a fire from escaping.
2) All burn locations must have adequate clearance to avoid escape. The burn area should be a "fire safety zone" away from dry fields, homes, shops, garages, utility poles or utility supply lines, and other buildings or equipment. A rule to remember is to remove all combustible materials from 30 or more feet around the burn area.
3) Paper raisin trays must be burned in a container to avoid escape of burning embers or ash, such as a wire cage. A wire cage may be constructed out of hardware cloth or chicken wire provided that the mesh is no larger than a ½ inch opening. The cage should never be filled beyond half and should be placed in a "fire safe zone". Using a burn barrel for burning anything is illegal.
4) Don't burn on windy days.
5) Avoid burning near a highway or roadway. Ashes or heavy smoke can create a very dangerous situation for drivers and winds caused by vehicles could cause the fire to escape from the fire safety zone.

6) Don't cause a smoke nuisance to your neighbors.

District staff will work with the Ag stakeholders to implement the recommended practices when burning raisin trays.

3.7.3 Almond, Walnut, and Pecan Prunings

<u>Summary and Recommendation</u>

Table 3-16 – Summary of Analysis

Surface Harvested Prunings	Potentially feasible alternative	Currently in practice by operators?	Incremental Cost, $/acre at 20 acres or more:	Percent of Return on Sales	Economically Feasible? (less than 10% ROS)
Almonds, Walnuts, and Pecans					
Farms Less than 100 acres	Shredding	Some Operators	$38	10.0%	Yes
Farms 100 acres or more	Shredding	Some Operators	$38	8.5%	Yes

Recommendation:
The economic feasibility analysis is presented in Section E-4 in Appendix E. Based on the considerations and analysis for prunings from almonds, walnuts, and pecans, District staff recommends the following:

The District would provide limited burn allocation for surface harvested prunings from almonds, walnuts, and pecans according to the following:

1. Prohibit burning of prunings for each agricultural operation whose total nut acreage (i.e., almonds, walnuts, and pecans) at all agricultural operation sites is 3,500 acres or more.
2. For each agricultural operation whose total nut acreage at all agricultural operation sites is less than 3,500 acres,
    a. Allow burning of up to 20 acres of prunings per year, and
    b. Allow burning of additional prunings, provided:
        i. The operator submits to the APCO before the pruning operation is completed, a representative cost estimate(s) for shredding all prunings generated by the total nut acreage at the agricultural operation site. The cost estimate(s) shall reflect shredding in a time frame that allows the operator to proceed with established post-pruning cultural practices.
        ii. The APCO determines that either the submitted cost estimate(s) represent(s) an unreasonable financial impact to the operator, or that adequate shredding services are not

available in time for the operator to proceed with established post-pruning cultural practices.

Description and Findings

Although the pruning methods will vary among growers, nut crops in general would have similar or common practices. So, unless otherwise noted, the following description for nut crops applies to almonds, walnuts, and pecans.

Nut trees are usually pruned after harvesting, either late or early in the year. In the past, growers generally open burned nut prunings to dispose of the material. However, many growers have found alternative ways to convert prunings into something useful such as soil amendment, dust control on unpaved surfaces, compost material, or fuel for biomass power plants. According to published documents and stakeholder comments, most nuts growers are currently shredding the prunings and leaving the materials on the orchard floor. Stakeholder comments include growers, vendors, and custom shredders. The ability to shred the materials varies among growers of different size farms and regions. One top nut grower in the SJVAB has continued to help minimize impact on air quality through environmentally responsible efforts, which include a contract with a biomass power plant to take its orchard removals and prunings. In 2008, another farm of several thousand acres initiated cultural practices and equipment necessary to shred all of the prunings rather than burn. District staff has also received comments from growers and custom shredders indicating that shredding of nut prunings has been a successful procedure in the farming operation, particularly for walnuts for one grower. However, there were also concerns from other growers regarding the burn prohibition for the prunings of nut crops.

A primary concern that some almond and walnut growers have is preventing the pruning material from interfering with the harvesting of the crop. Some of the existing shredding equipment currently shred the materials from one inch to a few inches in size.

One problem that some growers have experienced with chipping is the build up of chipped material on the ground, which slows the decomposition process. This situation can then cause the chipped material to be picked up during harvest. Some growers till the shredded material to help the decomposition. A grower noted that all pecans are no till operations whereas only a third of walnuts are no till operations. Although tilling could be done to bury the chipped material to promote faster decomposition, growers try to minimize the number of tractor passes in their orchards.

According to ag representatives, the almond hullers indicated that the impact of almond prunings or chips has been problematic. The chips are picked up with the almonds during the harvest process. The chips pass by the "detwiggers" which remove the larger sticks and branches that may get knocked down during the typical harvest process (shaking, sweeping and pick-up). The product then goes to the almond hullers/shellers, which separate the hull and shell from the almonds. Growers want to keep the harvest as clean as possible in order to maximize the price they receive from the almond hull processors that convert the hulls into animal feed. In order to keep the ground surface free of pruning material at harvest time, many growers have mostly relied on removing the pruning material from the field and open burning the pruning material.

Ag representatives also provided the following information to the District. The hull has significant feed value to dairies, and hulls with 15% fiber content or less are considered "prime hull" and receive the highest value. The next product is "hull and shell" which is limited to a fiber content of between 15% and 29%. And lastly, the shell or any product that has greater than 29% fiber content has little value and hardly any market. The almond hullers that the ag representatives spoke to estimate a five percent to 11% loss in prime hull revenue due to the presence of chips. Prices vary from year to year, but prime hull sells for significantly more than hull and shell. During a survey that the ag representatives conducted in 2009 for the purposes of developing comments for Rule 4103, prime hull was selling for $75 per ton, while hull and shell was selling for $45 to $50 per ton. Chips are high fiber content and when picked up with the hulls during the hulling process, they can significantly shift the fiber content. One huller estimated that the 4,000 tons out of 35,000 expected tons were shifted from "prime hull" to "hull and shell" due to the existence of chips. This was an 11.4% loss amounting to $120,000 in lost revenue. Another huller lost an estimated five percent of their "prime hull sales" due to the existence of the chips.

For walnuts, the hulls are not used for feed; however, growers still need to keep the harvest clean in order to minimize any negative impacts during the processing of the nuts. According to the ag representatives, the walnut growers and walnut processors have indicated that the primary issue is that the chips plug the lines at the processor, especially under wet conditions. Walnuts are typically harvested from mid-September through mid-November. About half of the time, rains during the fall begin before the harvest can be completed. Since the prunings occur in the winter, it is impossible to get a chipper into the orchard until after the rains subside. The chips do not decompose in the six to seven months between the pruning and the beginning of harvest. This is where the plugging occurs. The wet chips impede the ability to move the walnuts through the ductwork at a huller/dehydrator and processor, as the chips are picked up with the walnuts.

Ag representatives stated that walnut processors have also expressed concern with the chips being left in the orchard due to concerns over food safety. Since the chips are an organic material, they are subject to mold growth. If this mold is picked up during harvest, it can create a significant food safety issue in terms of the potential for aflatoxin. Food safety has become the number one issue of concern for the tree nut industry, and any issue that would confound food safety would be problematic.

As the trees are pruned late in the year, the ground is usually too wet to run heavy equipment in the field in order to chip the prunings. Growers will then wait for the ground to dry but they can only wait for a limited time as they need to spray and irrigate their fields early in the year and the pruning material can interfere with these operations. This gives the growers a short window of opportunity to have their prunings chipped. Some growers usually find it more conducive to their operations to gather the prunings and burn them.

For growers that shred the pruning material as an alternative method to open burning, the practice varies among nut growers. In addition, the pruning practice for the growers in the northern region appears to be different than the southern region. Growers could shred the prunings by renting, purchasing, or borrowing special equipment, or by hiring a custom shredder. These options depend on the availability of the custom shredder or the equipment. Costs for the options above also vary; however, District staff has analyzed the cost of hiring a custom shredder as the likely alternative (see section on Costs for analysis) for growers that own smaller farms. Custom shredders currently charge a two hour minimum fee to shred nut prunings. The average charge is around $260 per hour for a total of $520 for two hours. Purchasing a special shredding equipment that can shred the material into fine pieces to address the issue with the chips being picked up during harvest season could cost over $300,000 and is an expensive option and less likely for a small grower.

Ag representatives, custom shredders, and growers have mentioned that there is a shredder in the market which can shred the prunings into smaller pieces, thereby reducing problems during the harvest season. The shredder can also operate in all weather conditions, including the raining season. The vendor of the shredding equipment has indicated that 48 of those shredders are currently available for the industry and that previous shredding equipments have been sold mostly to growers where some also provide custom shredding service. One of the custom shredder indicated that most growers that farm over 3500 acres typically shred their own material and that it would be more costly for a grower that farms less than that to purchase the same shredder.

District staff conducted an analysis to determine whether it would be viable for growers to purchase a shredder instead of hiring a custom shredder. The following information was used to conduct this analysis:

1. Harvesting ends in October and cultivation begins around January/February. District staff estimated that the available months during the pruning season are November, December, and January (three months).
2. According to a custom shredder, the specific shredding equipment can cover eight to ten acres per hour. District staff estimated nine (9) acres per hour for the shredding equipment.
3. One working day equates to about eight (8) hours. Average number of working days per month is 22 days. District staff estimated that two hours are used to prepare the equipment before and after operation and six hours are used to shred (process) the pruning material.

The calculations for one shredder are as follow:

1. Total Number of Acres Processed Per Month

   Hours Processed Per Day x Acres Processed Per Hour x Averaged Number of Days Per Month:

   6 hrs/day x 9 acres/hr x 22 days/month = 1188 acres/month

2. Total Number of Acres Processed During the Pruning Season (Three Months)

   Total Acres Per Month x Three Seasonal Months:

   1188 acres/month x 3 months = 3564 acres

Based on the calculations, one shredder can cover approximately 3500 acres. District staff believes that it would be reasonable for a grower that farms 3500 acres or more to purchase an equipment to address heavy to light prunings from the nut orchards. As mentioned by the vendor and custom shredder, many growers that own their own shredding equipment also provide custom shredding service to other growers.

District staff conducted further analysis on the cost benefit of purchasing the shredding equipment for a farm over 3500 acres. The analysis below is intended to compare the two methods for the shredding alternative and is not representative of the incremental cost. The analysis is based on the following factors:

1. Hiring a Custom Shredder:

    - Per custom shredder, the average charge is $520 for two hours minimum.
    - Equipment can process eight to ten acres per hour, or 16 to 20 acres minimum (Averaged: 18 acres).
      (Reference: http://www.panerofarms.com/why-flory-powertrack.html)
    - Based on the above information, minimum averaged cost per acre is $29.

2. Purchasing a Shredding Equipment:

    - Per vendor and custom shredder, the estimated cost of purchasing the shredding equipment range from $315,000.
    - Labor rate of $14.74 per hour for machine operators, which includes payroll overhead of 34%.
      (Reference: http://coststudies.ucdavis.edu/files/almondvs08sprink.pdf)
    - Price for on-farm delivery of diesel is $2.50 per gallon, which includes a 2.25% sales tax on diesel fuel.
      (Reference: http://coststudies.ucdavis.edu/files/almondvs08sprink.pdf)
    - Fuel use for a shredding machine with similar horsepower is 12 to 15 gallons per hour. District staff estimates that the averaged amount of fuel (diesel) required to operate the shredder for one hour is 14 gallons (References: http://www.jgpress.com/archives/_free/001555.html and http://www.neequip.com/KFNA/BROCHURES/PDF_BRO/Crambo_2005E.pdf)
    - Annual maintenance is calculated as two percent of the purchase price. (Reference: http://coststudies.ucdavis.edu/files/almondvs08sprink.pdf)
    - Other additional costs include property insurance and property taxes (cash overhead). According to the *2008 Almonds costs and Returns Study*, the cash overhead contributes to about 9.5% of the capital recovery. (Reference: http://coststudies.ucdavis.edu/files/almondvs08sprink.pdf)

Based on the best available information and analysis above, the following calculations use 3564 acres per year for an equivalent comparison of the cost of purchasing a shredder and the cost of hiring a custom shredder.

The calculation for hiring a custom shredder is as follows:

1. Total Annual Cost of Hiring a Custom Shredder

Minimum Averaged Cost Per Acre x Number of Acres:

$29/acre x 3564 acres = **$103,356**

The calculations for purchasing a shredder are as follows:

1. Total Annualized Capital Costs of the Shredder

   The District uses the following formula to calculate an equivalent annual cost from a capital cost using a capital recovery factor as shown below:

   $$A = [P \times i(1 + i)^n] / [(1 + i)^n - 1]$$

   Where:
   A = Equivalent annual cost of control
   P = Capital cost of the control equipment, including installation cost

   I = Interest rate (used 10% as a conservative estimate)

   n = Equipment life (used 10 years as a conservative estimate)

   [$325,000 x 10%(1 + 10%)^10yrs] / [(1 + 10%)^10yrs – 1] = **$51,265**

2. Total Annual Cost of Diesel Fuel

   [Estimated Amount of Fuel (in Gallons) Used Per Hour x Hours Processed Per Day x Averaged Number of Days Per Month] x Cost of Fuel Per Gallon:

   [14 gallons/hr x 6 hrs/day x 22 days/month x $2.50/gallon] x 3 months = **$13,365**

3. Total Annual Cost of Hiring a Machine Operator

   Labor Rate Per Hour x Total Number of Work Hours Per Day x Averaged Number of Days Per Month x Three Seasonal Months:

   $14.74/hr x 8 hrs/day x 22 days/month x 3 months = **$7,783**

4. Total Annual Cost of Maintenance

   Cost of the Shredder x Two Percent of the Cost of the Shredder:

$315,000 x 2% = **$6,300**

5. Total Annualized Cost of Property Insurance and Property Taxes

   Total Annualized Costs of the Shredder x 9.5 Percent for the Cash Overhead (Insurance and Taxes):

   $52,892 x 9.5% = **$4,883**

Table 3-17 and Table 3-18 summarizes the annualized cost estimates for the purchase of a shredder and the annual costs of hiring a custom shredder.

Table 3-17 – Annualized Cost Estimates for the Purchase of a Shredder

Description	**Costs**
Total Capital Cost	$315,000
Total Annualized Capital Cost of the Shredder (10% - 10 years)	**$51,265**
Annual Operation & Maintenance Costs	
Total Annual Cost of Diesel Fuel	$13,365
Total Annual Cost of Hiring a Machine Operator	$7,783
Total Annual Cost of Maintenance	$6,300
Total Annualized Cost of Property Insurance & Taxes	$4,883
Total Annual Operation & Maintenance Costs	**$32,331**
Net Annual Costs (Annualized Capital Cost + Annual O&M Costs) **($/year)**	**$83,596**

Table 3-18 – Annual Cost Estimates for a Custom Shredder

Description	**Costs**
Averaged Cost Per Acre	$29
Total Annual Cost for 3564 acres	**$103,356**
Net Annual Costs ($/year)	**$103,356**

Based on the analysis above, the estimated savings from purchasing a shredder is close to $20,000 per year.

According to GrowingProduce.com, the 2009 Top Nut Growers make up about 228,000 of nut acreages in California. Out of the 25 Top Nut Growers, 18 of those growers are in the District's burn permit database or the Conservation Management Practices (CMP) database. The 18 growers make up about 183,154 acres of nut crops. Pistachios contribute to about 16% of the total acreage in the SJVAB, therefore the estimated acreage for almonds and walnuts for SJVAB growers is 154,327 acres, which is about 20% of the total nut acreage in the SJVAB. Twelve of those growers are over 3,500 total farm acres of nut crops and contributes to over 94% of the top acreages on the list, or about 212,000 total nut acreages. At least two growers in this group are either shredding the pruning material or taking the material to the biomass power plant. Based on the 2007, 2008 & 2009 Top Nut Growers tables, District staff expects that at least 80 percent of the farms in the top 25 list could buy their own shredding equipment. At the bottom of the 80 percent range, the total nut acreages average about 3460 acres.

According to the custom shredders, the average charge to shred the prunings is a minimum of two hours. The recommended shredder, which can shred the materials to finer pieces to address issues with the chips not being decomposed by harvest season or being picked up during harvest, can process eight to ten acres per hour. Due to the two hours minimum that custom shredder charges the grower, District staff believes that the cost on a per acre basis would increase as the acreage becomes smaller. Therefore, the 20 acres limit within the two hour timeframe is reasonable.

District staff is aware of at least three custom shredders in the SJVAB that operate a total of five of those shredders and another two contractors that do custom shredding. There are also several types of other shredding equipment available, where some may require more passes in order to shred the prunings into acceptable sizes.

The Jack Rabbit equipment is typically used to remove the material from the orchard. Transporting the material to composting facilities appear to be less common among growers compared to shredding the material onsite or taking the material to the biomass power plants. According to biomass power plant operators, some biomass power plants purchase some, but not all, of these prunings. The preferred alternative at this time for most pruning material is to shred and leave the material on the ground, since it can be more efficient than chipping and transporting the material offsite. Some growers have found that shredding and incorporating the materials back into the ground helps replenish the soil with nutrients. Several growers are also moving towards lighter pruning, which are about one-fifth of what they used to be. Since 2007, the amount of almond prunings burned has been reduced by over 22,000 acres, or 76 tons of

PM2.5. The amount of burn acres from walnut prunings has also been reduced by over 5,500 acres, or over 13 tons of PM2.5. The category for pecan prunings has shown a slight change in open burning; however, prunings are also shredded and left on the ground. The overall amount of emissions reduced since then could be even higher as a result of lighter prunings.

Over the past ten years, NRCS has encouraged growers to chip or shred the prunings from almond and walnut orchards by providing a cost-share basis through the Environmental Quality Incentives Program (EQIP). According to NRCS staff, it is uncertain how long this program will last. Many of the growers shred the material on site through this program, which helps reduce Nox, VOC, PM10, and PM2.5 emissions generated from open burning. According to NRCS, the program resulted in an average of 120,333 acres of almond and walnut prunings chipped per year in the SJVAB from 2007 to 2009. Along the same years, the average amount of almond and walnut prunings burned from the District's database was 68,802 acres per year. According to the County Agricultural Commissioner's data for Calendar Year 2008, the total harvested acreage for both of those crops in the SJVAB was 753,515 acres. The total harvested acreage for pecans is 611 acres, or 0.08% of the total nut harvested acreage. See table below for a summary of the alternative methods for almond and walnut prunings. Pecans are not included in the analysis below because NRCS data only addresses almonds and walnuts.

Table 3-19 – Analysis of Alternative Methods for Almond and Walnut Prunings

Surface Harvested Prunings from Almond and Walnut Crops	Acres
Total Harvested Acreage for Almonds	625,814
Total Harvested Acreage for Walnuts	127,701
Total Harvested Acreage for Almonds and Walnuts	753,515
Estimated Acreage Pruned per Year[1]	376,758
Chipped/Shredded Acreage of Almond & Walnut Prunings per year (NRCS)	120,592
Open Burned Acreage of Almond & Walnut Prunings per year (District)	68,802
Estimated Acreage from Alternative Disposal of Almond & Walnut Prunings[2]	187,364

[1]Assume Pruning is done in alternate years: [(753,515) / 2] = 376,758. The *2008 Almonds Costs and Returns Study* and *2007 Walnuts Costs and Returns Study* use alternate years for pruning of mature orchard. Both studies analyzed the alternative method of chipping and shredding onsite and indicated that the practices will vary among growers and regions.
[2]The remaining acreage is likely to be voluntary disposal through alternative methods to open burning, such as shredding, chipping, biomass fuel, or other methods, and without the EQIP program.

Based on the table above, if growers prune the harvested orchards during the dormant period every other year, the actual amount of acres pruned per year would be about 376,758 acres. Based on the analysis above, about 18% of the acreage pruned per year is contributed to open burning, while most of the growers are using other alternative practices rather than open burn.

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Chapter 4

Technological Feasibility of Alternatives to Burning

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Chapter 4: TECHNOLOGICAL FEASIBILITY OF ALTERNATIVES TO BURNING

District staff has conducted detailed research and identified several potentially feasible alternatives to open burning of agricultural materials. Some of the alternatives were previously identified during the 2005 and 2007 burn prohibition schedules. Potential alternatives for agricultural wood and agricultural non-wood materials were identified for each of the following groups: 1) vegetative and related material and 2) animal-related material.

The more common methods of disposing of agricultural material that cannot be open burned include the following:

- Some agricultural materials, like orchard removals, are primarily transported to biomass power plants for use as fuel.
- Chip or grind the material and transport it off-site for disposal or other renewable uses.
- Prunings and some field crop materials may be shredded in place, chipped onsite, or tilled into the soil.
- Some materials, such as rice straw, may be baled and sold for various commercial purposes, although the market for such product is much less than available supplies.

The potential alternatives to open burning of agricultural wood and agricultural non-wood materials are described below.

4.1 VEGETATIVE AND RELATED MATERIAL

Most alternatives to open burning agricultural wood materials and pruning materials require that the agricultural materials go through a chipping, grinding or shredding process. These processes are typically used to change the agricultural wood materials into a more manageable and useable size. Some of the benefits of chipping, grinding and shredding include faster decomposition of the materials, easier incorporation into the soil, easier to process and transport, and better combustion when used as fuel at biomass power plants.

Agricultural wood and pruning material that are to be chipped need to be as free of debris as possible to prevent damage to the chipping equipment and to increase its acceptability by potential end users such as biomass power plants and other processors. Orchard removal material is usually removed from the farm after the chipping process, as growers want a relatively clean field for planting a new crop. For pruning, growers may recycle the materials onsite or remove the material from the farm.

4.1.1 Biomass Power Plants

Biomass power plants in the SJVAB will generally accept agricultural, forestry, construction, and urban residues. The power plants burn the material in combustors to produce steam. The steam is then used to spin turbines to generate electricity.

Biomass power plants do not universally accept all agricultural material due to concerns that some materials may harm power plant machinery. Several issues have been noted concerning the types of material, such as citrus chips, that can be burned by the biomass power plants and the amount of agricultural materials that is accepted at the biomass power plants at any given time. Biomass power plant operators have indicated that these issues have been overcome over the past few years as the facilities involved have adapted in processing the ag materials to better suit the situations encountered.

Using the orchard removal materials for fuel at the biomass power plant is currently the most viable and cost effective alternative to open burning for growers due to available tax credits for biomass facilities and required agricultural offsets for some biomass power plants. However, reliance on biomass fuel as a primary alternative to burning is somewhat uncertain since there are no long-term federal or state funding commitments for the biomass facilities in the SJVAB. It is also relatively more affordable for the biomass power plants to accept urban waste than agricultural materials. Pruning materials are sometimes accepted by biomass power plants. The residents of a typical community are being charged more money to divert urban waste out of a landfill. Therefore, the urban waste is subsidized by the community in their waste payments and this provides the urban fuel to be processed at biomass plants at a more competitive price.

4.1.2 Land Application/Soil Incorporation

Applying agricultural materials to the soil is a common method of disposal of the materials. The pruning material from many tree crops and vineyards is usually gathered into windrows and shredded in place using grinders suitable for brush. The shredded material can either be left on the ground or be incorporated into the soil when the field is tilled. Over time, the material decomposes into the soil which adds valuable organic material to the soil and can lead to better water infiltration and soil quality. This practice is evolving as more growers and equipment manufacturers innovate and collaborate to make the process work for everyone.

Current practice does not work well for all crops, especially for pome (apple, pears, and quince) fruits with concerns over the spread of diseases and for nut crops which harvest the nuts from the ground. With the exception of the potential spread of diseases from pome fruits, other operators can usually minimize or prevent this problem for other crops by taking steps to better ensure that chipped pruning material has decomposed by the time that crops are harvested or that chipped pruning material is not placed in the area where the crop is to be harvested. The pruning material can be chipped into smaller pieces using upgraded technologies that can shred the material into finer quality. The cost of this equipment will be assessed later in this report to determine if it would be economically feasible.

4.1.3 Anaerobic Digestion

Anaerobic digestion is a biological process that decomposes organic matter with minimal or no oxygen level, which results in a liquid/solid stream (digestate) and biogas that contains mostly methane and carbon dioxide. This biological process can either be found or managed through some of the following: marshes, sediments, wetlands, the digestive tracts of ruminants and some insects, landfills, many wastewater treatment facilities, and animal feeding operations and dairies. The anaerobic digestion technology that is managed at a farm or facility could include several steps in the process, such as feedstock handling/storage, preprocessing, digester, collection and storage of the biogas, dewatering of the digestate, and handling/storage of the dewatered digestate.

There are currently no commercial-scale solid waste digesters in operation in the United States even though anaerobic digesters have long been used to treat agricultural and municipal wastewater. Although, District staff has found that the anaerobic digestion technology will be installed in Emmetsburg, Iowa, in 2011, as part of a commercial scale cellulosic ethanol plant. The digestate would be used as a source to power the plant.

District staff is not aware of any facilities in the SJVAB that can process agricultural materials through anaerobic digesters on a commercial scale. In addition, it is not believed to be practical to require that growers install an anaerobic digester for the purpose of disposing the agricultural material. The agricultural materials that are subject to Rule 4103 are typically pruned or removed once a year or every few years for orchard removals. Based on these considerations, District staff will not conduct further analysis on anaerobic digesters as a viable technology in the SJVAB.

4.1.4 Composting

Composting is the process by which organic material is broken down aerobically to form a biologically stable organic substance suitable as a soil enhancer and plant fertilizer.

Agricultural material is one of the sources of organic material for composting operations. Other sources could include, but are not limited to, urban waste, biosolids, and manure. The District distinguishes the blend of organic material into two categories, composting and co-composting. Along with vegetative material, co-composting includes biosolids, manure, and/or poultry litter. The vegetative materials are a good source of nitrogen, whereas, chipped wood provides carbon to the mixture. As a result, compost and co-compost facilities sometimes accept agricultural materials either as feedstock or as amendment for the operation. Some compost and co-compost facilities also accept and store the material for other use such as fuel for biomass power plants or animal feed. Based on District's data, there are currently 19 composting and co-composting facilities in the SJVAB that might be able to accept and process the agricultural material.

Sources usually pay a tipping fee to compost operators to dispose of the material at the composting site. With competing materials from subsidized urban waste, disposal costs for agricultural materials could be higher and the accepted amount of agricultural materials could vary. This fee would be additional to other operational costs, such as chipping and transporting the material to the compost facility. These operational costs for the grower would be similar to the cost of chipping and transporting the material to the biomass power plants, which does not charge a fee for disposal. Based on discussion with the chipping operators, most of the agricultural materials that are chipped are transported to biomass power plants for use as fuel. Therefore, District staff plans to conduct the economic feasibility analysis on transporting the material to biomass power plants as a more cost effective alternative.

4.1.5 Landfill

Growers and chipping companies can take agricultural materials to local landfills for disposal. Not all landfills will accept these materials, particularly landfills designated for hazardous waste. Municipal solid waste landfills are allowed to receive putrescible waste, such as yard waste or any methane producing material. Agricultural materials accepted at these landfills may be disposed at the site but are primarily being used as alternative daily cover (ADC) to reduce odor and for vector control. State Assembly Bill AB 939 was passed in 1989 and mandated local jurisdictions to meet solid waste diversion goals of 25 percent by 1995 and 50 percent by 2000. Local agencies within California are required to comply with the mandated landfill diversion requirement every year.

There are four landfill facilities within the District that are currently accepting organic material, which could include materials from agricultural crops and orchard removals. Similar to compost facilities, landfills also charge tipping fees for the disposal. Due to the state mandated landfill diversion requirement and the small number of landfills that are allowed to accept organic material, it is not feasible to promote agricultural material going to the landfills. District staff has considered the information above and plans to conduct the economic feasibility analysis on transporting the material to biomass power plants as a more cost effective alternative.

4.1.6 Cellulosic Ethanol Production

Cellulosic ethanol, a key next-generation biofuel, can be made from switch grass, corn stover, forest waste, fast-growing trees, wood chips and other plant material.

Advanced biofuels are those that do not rely on the corn kernel starch. In contrast, the most common type of ethanol in the United States is corn ethanol which is produced from corn with only the grain being used. Corn ethanol is primarily used in the United States as an alternative to gasoline and petroleum (first-generation biofuel).

The production of cellulosic ethanol is still predominately in the demonstration plant phase of development. At this time, District staff is not aware of any commercial plant within the SJVAB that currently uses agricultural materials for the production of cellulosic ethanol.

4.1.7 Gasification for Liquid Fuels

There are emerging technologies that can convert agricultural materials, sewer sludge, wood, trash, and plastics into diesel or biofuel. In traditional gasification, oxygen is used, but the new technique uses hydrogen and steam at nearly 1,500 degrees F to break apart the feedstock into a gas made up of its molecular components. After gasification, the resulting gas then goes through additional steps that produce water, wax, and diesel fuel. Up to 85% of the feed material becomes usable liquid fuel at the end of the process.

Agricultural wood materials can be used as a solid fuel by being burned in a combustion device or it can undergo processing to convert it into a gas or liquid fuel. Operators could choose to purchase a system given adequate space, but many of these vendors are located outside of California. For most of these situations, the agricultural wood materials are usually chipped on the farm site and then transported to the processing facility. District staff is not aware of these types of facilities currently in operation in the SJVAB, which would indicate that these technologies are not current alternatives to burning.

4.1.8 Pyrolysis

A new biofuel derived from wood chips through a pyrolysis process has been developed. The process involves heating wood chips and small pellets in the absence of oxygen and high temperature (pyrolysis). About a third of the dry wood becomes charcoal and the rest becomes a gas. The gas then undergoes a chemical process where it is converted into liquid bio-oil. According to researchers, the new method offers environmental benefits and could reduce industrial costs of alternative fuel for conventional diesel engines. The technique is still in the early stage; therefore, use of wood chips for this process would not be a viable alternative source in the SJVAB at this time.

4.1.9 Mulch

Soil Stabilization / Dust Control
A project in Northern California gauged the use of wood chips as an alternative source for soil erosion and stability to roads and parking areas. The Road Stabilization and Improvement Demonstration Project demonstrated that the use of wood chippings not only provides stabilization and erosion control on light duty, low-use roads, parking, and access areas, but is also cost-effective when compared to the use of other road materials.

The project found that using wood chips for road use was a feasible alternative to expensive materials such as rock or shale. Other benefits resulting from the project include added value to the chipped materials, improved site and off-site water quality, improved stability, usability, and mud free road and area conditions. The project addresses the successful use of wood chippings for soil stabilization or dust control as potential alternatives. District staff is not aware of a feasible market in the SJVAB that could accept and process all of the agricultural material for use as dust control but this alternative would be considered as a similar alternative to soil incorporation and a possible option, given that the materials serve as beneficial use. Typically, operators apply the chipped material onto surfaces for nutrient value and may apply the extra material on road surfaces. In other cases, not all roads are in need of chipped materials.

Hydraulic Mulch
Agricultural material can be shredded into wood fiber and used as hydraulic mulch by Caltrans or others. Hydraulic mulch is a mixture of shredded wood fiber or a hydraulic matrix and a stabilizing emulsion or tackifier. The mixture is

typically applied to disturbed areas requiring temporary protection until permanent vegetation is established or disturbed areas that must be re-disturbed following an extended period of inactivity (Caltrans Storm Water Quality Handbooks, Section 3, Hydraulic Mulch SS-3). Caltrans uses hydraulic mulch as one of the alternatives to temporarily protect exposed soil from erosion by rain or wind. However, the wood fiber hydraulic mulches are generally short-lived, lasting only a part of a growing season, which operators may have to take into account for long-term projects. In addition, for the wood fiber hydraulic mulches to be effective, the material requires a drying time of 24-hours (Standard Specifications Sections 20-2.08).

Wood chips to be used as hydraulic mulch are required to be cleaned and free of salt and deleterious materials such as clods, coarse objects, sticks, rocks, and weeds. Such requirements may minimize efficiency during processing of the agricultural materials, and increase costs from separating the material or diverting different parts of the material to various locations for alternative use. Use of hydraulic fiber mulch has increased over the years as it has proven to be a cleaner alternative to hay or straw mulches, however, staff is not aware of agricultural material being used for the hydraulic mulch process on a market scale. Therefore, staff will not pursue this option as a feasible alternative for open burning of agricultural material.

Wood Mulch

Agricultural materials could also be recycled as wood mulch. Wood mulching can be used in landscape projects or for erosion control and may be a mixture of shredded wood mulch, bark, and compost. The material is primarily used to reduce erosion by protecting bare soil from rainfall impact, increasing infiltration, and reducing runoff. Caltrans found that wood mulching can be used as temporary soil stabilization for disturbed areas awaiting revegetation and permanent cover or as a temporary, non-vegetative ground cover on slopes (Caltrans Storm Water Quality Handbooks – Section 3, Wood Mulching SS-8). As part of wood mulching, the greeneries from the agricultural materials may also be used for similar purposes and composted as necessary to kill weed seeds. However, there are limitations to using wood mulch, such as introduction to unwanted species, possible sheet erosion because the material cannot withstand concentrated flows, and the green materials may bring in unwanted weeds and plant materials. In addition to these considerations, staff is not aware of most agricultural material being used for this process on a market scale. Therefore, staff will not pursue this option as a feasible alternative to open burning of agricultural material.

4.1.10 Hand Crews for Removal of Materials

Some operators have considered using hand crews to remove materials, such as weeds, as a potential alternative for open burning. The labor-intensive removal of individual weeds is often characterized with unreasonable costs and safety issues. Additionally, hand removal of weeds is technically unfeasible due to the magnitude of weed abatement. Technological development is needed to reduce the burning of weed abatement material.

4.1.11 Overseas Shipment of Raisin Trays

In the past, some growers have shipped reusable materials, such as raisin trays, overseas to be recycled. However, the alternative is no longer available for these materials.

4.1.12 Water Decomposition for Rice Stubble (Straw)

In recent years, water decomposition has become more prevalent than burning rice fields stemming with the passing of the Connelly-Areias-Chandler Rice Straw Burning Reduction Act of 1991. The Act mandated the reduction of burned rice acres over a ten year period besides that which is done for disease control. Currently, rice farmers are restricted to burn no more than 25% of planted acres, or up to 125,000 acres basinwide, and have moved more to flooding rice fields to improve the rate of decomposition.

Rice farmers flail mow the rice stubble into about 4-inch sections and stubble disk it, to ensure it has contacted with the soil four to five inches deep. It is then flooded as soon as possible to keep the clods covered. Flooding the fields during the winter helps with blast and speeds decomposition, as well as providing some fertilizer benefits.

Water availability and costs for winter water are a concern but can be offset by other practices. Some disadvantages of water decomposition arise with certain weather conditions but extra precaution is taken, such as managing the water flow and battening down the hatches, to prevent damage to the rice patties. Water decomposition is a common alternative to burning and is required in areas that limit the amount of acreage that can be burned.

4.1.13 Baling Rice Stubble (Straw)

As discussed above, alternatives to burning rice fields have been sought, especially with the passing of the Connelly-Areias-Chandler Rice Straw Burning Reduction Act of 1991. Baling rice straw was a highly anticipated option when the Act was passed but has declined in viability. It is estimated that only about 3-5%

of farmers use rice straw off-field. Baling rice straw is utilized even less due to a diminished market need and cost of production. Soil incorporation and flooding rice fields are more feasible and viable alternatives while potential uses are still being explored.

4.2 ANIMAL-RELATED MATERIAL

4.2.1 Burial

Burial seems to be most suitable for small amounts of material. Burial requires care in site selection because as carcasses decompose, they release materials that can pollute ground water, particularly if large volumes are buried. Advantages of burial are the low cost (if the operator owns the necessary equipment) and biosecurity (no trucks coming to the farm to pick up carcasses).

4.2.2 Incineration

Field incineration is only appropriate for deceased animals in those instances where the spread of disease is a concern. Decisions on how to dispose of diseased animals are deferred to local agricultural commissioners.

4.2.3 Rendering

Rendering provides a much needed service to the animal industries in the SJVAB and is subject to certain government food safety and environmental regulations. There are six rendering plants in the SJVAB. Five of the plants are independent operations and collect animals from other sites. The sixth plant is an integrated plant and operates in conjunction with its affiliated animal slaughter and meat processing plants.

In most rendering systems, raw materials are ground to a uniform size and placed in continuous cookers or in batch cookers, which evaporate moisture and free fat from protein and bone. A series of conveyers, presses, and a centrifuge continue the process of separating fat from solids. The finished fat (e.g., tallow, lard, yellow grease) goes into separate tanks, and the solid protein (e.g., meat and bone meal (MBM) and poultry meal) is pressed into cake for processing into feed. Other rendering systems are used, including those that recover protein solids from slaughterhouse blood or that process used restaurant grease.

The five independent rendering plants provide pick up and delivery for their customers. The plants do not allow public drive-up delivery in order to better control traffic at the plant and the quality of the animals processed. The pick up and delivery service is not available to any operator that has animals available for several reasons. A key reason is the traveling expense which may make it impractical to pick up small numbers of carcasses.

Rendering companies have certain regulatory and operational restrictions regarding the condition of the carcasses they process. In addition to complying with regulations governing diseased animals, rendering companies will generally not accept carcasses that do not remain intact when handled. Depending upon the end product of the rendering process, there may be other restrictions on carcass quality and condition. Although this alternative is available, District staff does not consider rendering to be a viable or feasible alternative. District staff considers burial and incineration (for deceased animals with diseases) to be viable alternatives, which are current practices for the industry.

4.2.4 Sterilization

For bee hives of diseased colonies that must be destroyed, disease experts recommend that the frames and combs be burned in a pit and the ashes covered. The heavy woodenware (supers, tops and bottoms, etc.) may be sterilized by scraping them clean (the scrapings should be burned) and scorching the inside surfaces. The scorching can be done with a propane torch with particular attention being paid to cracks and corners. If large quantities of supers are to be scorched they may be stacked and painted inside with kerosene and lit. To sterilize large quantities of equipment, operators could set up a barrel with a boiling lye solution. The woodenware should be immersed in the solution and boiled until clean. Frames may also be sterilized in this manner.

Chapter 5

Emissions from Agricultural Burning and Alternatives to Burning and Health Considerations

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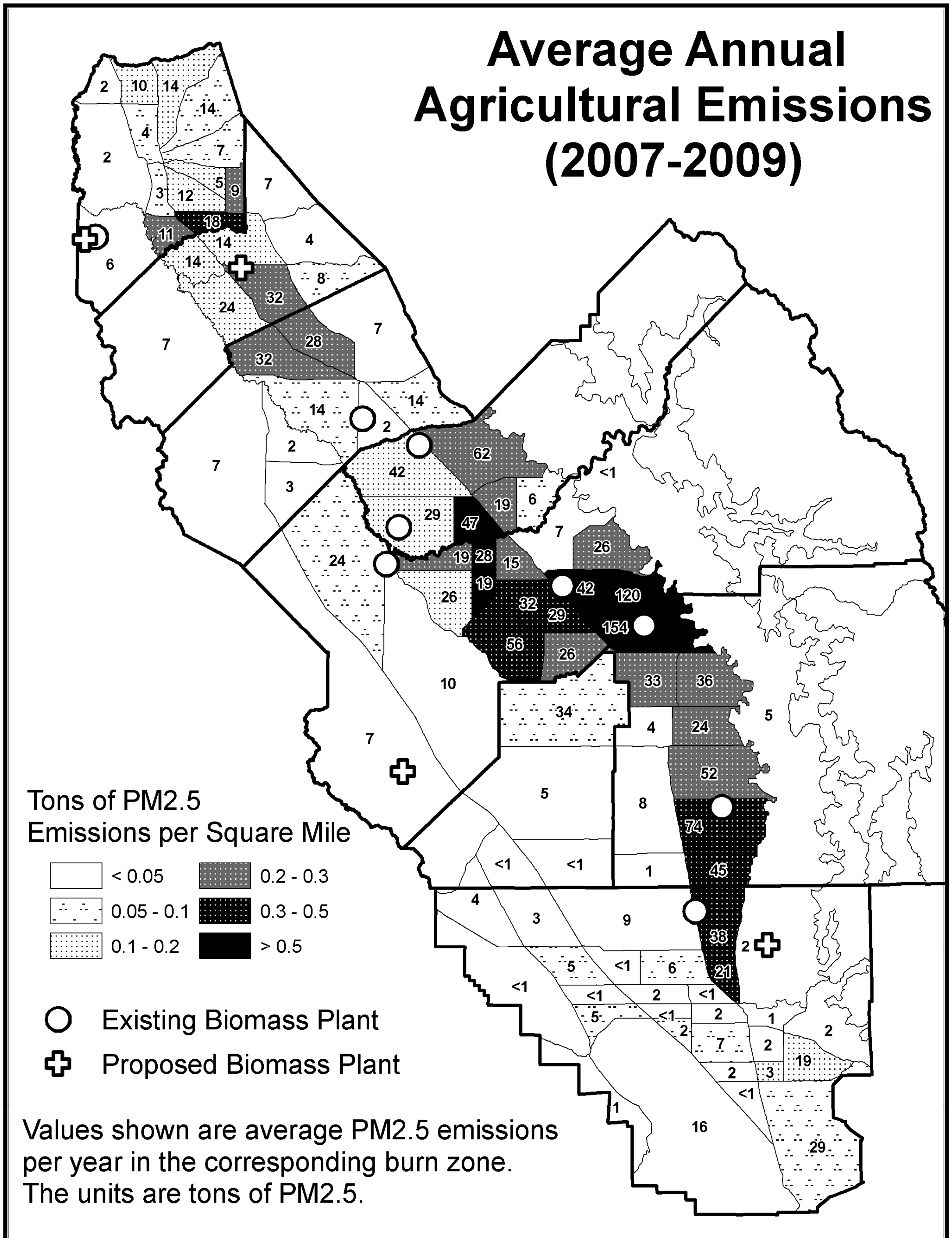
Chapter 5: EMISSIONS FROM AGRICULTURAL BURNING AND ALTERNATIVES TO BURNING, AND HEALTH CONSIDERATIONS

Figure 5.1 Map illustrating PM2.5 Emissions in the Valley from Open Burning



5.1 DISTRIBUTION OF AGRICULTURAL OPEN BURNING EMISSIONS

The map on the previous page illustrates the tons of PM2.5 emissions per square mile and existing and proposed biomass plants in the San Joaquin Valley air basin (Valley). The Sectional divisions of the map are the 103 burn allocation zones as developed by the District for use in the smoke management system (SMS). Each zone in the map is marked to illustrate the three-year average annual tons of PM 2.5 emissions per square mile generated from agricultural burning of all types for that zone between the years of 2007 and 2009. Most of the burn allocation zones with the highest emissions from agricultural burning have biomass facilities in or near them.

5.2 CURRENT EMISSIONS INVENTORY FROM AGRICULTURAL BURNING

For purposes of this report, the criteria pollutants analyzed include volatile organic compounds (VOC), oxides of nitrogen (NOx), and particulate matter (PM2.5). The 2007 Ozone Plan control measure for Open Burning (S-AGR-1) (Managed Burning and Disposal) pertains to the burning of any material including agricultural materials. The Plan identified the summer 2005 emissions inventory for open burning as 4.8 tons of NOx per day and 5.7 tons of VOC per day. In the winter, the 2008 PM2.5 Plan control measure for Open Burning (S-AGR-1) (Managed Burning and Disposal) identifies the 2005 emissions inventory for open burning as 8.16 tons of NOx per day, 10.70 tons of PM2.5 per day and 0.19 tons of SO_2 per day. As shown in Figure 5-2, agricultural burning is concentrated in winter months when PM2.5 is elevated and ozone values are relatively low.

Figure 5-2
Average Monthly Agricultural Burning (2007-2009)

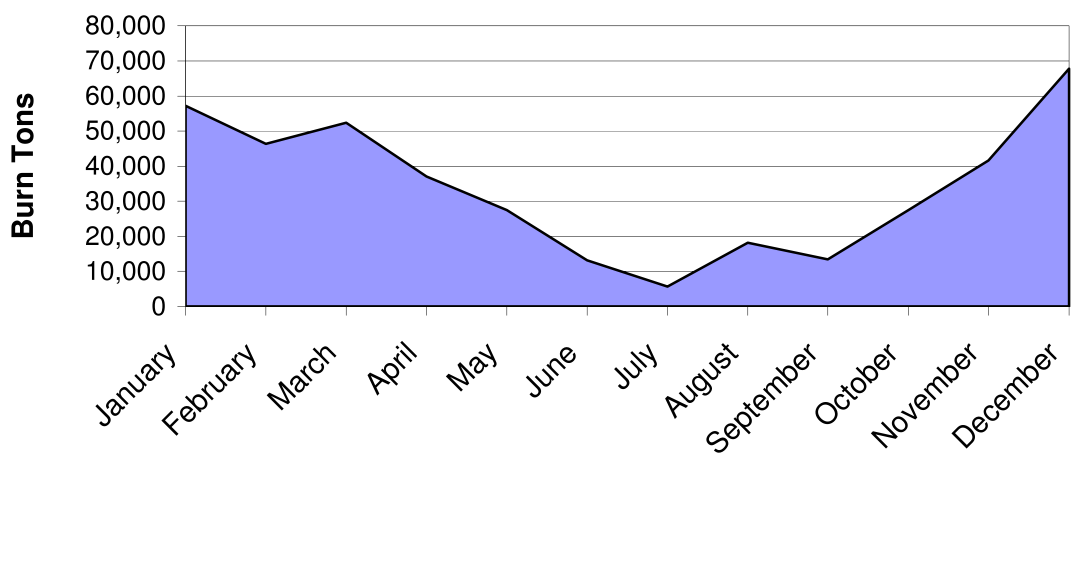


Table 5-1 below presents the burn tons, burn acres, and tons of associated criteria pollutant emissions associated with agricultural burning averaged over a three year period for specific crop types and activities. The specific crop types and activities are the crops to be analyzed for the 2010 burn prohibitions resulting from state law. Because several crops are not a part of this analysis and do not pertain to this report, the data from those crops has been omitted from the table below. The data for this table is the best available information, and came from the District SMS emission database.

Table 5-1
Average Annual Tons, Acres, and Emissions
from Open Burning of the Remaining CH&SC Crop Types (2007-2009)

			Emissions (Tons)			
Crop Name	Burn Tons	Burn Acres	NOx	PM 2.5	VOC	PM 10
Almond Pruning	51718	51718	152.57	173.26	134.47	181.01
Apple Pruning	900	391	2.34	1.66	1.03	1.75
Fig Pruning	1227	558	3.19	3.99	3.68	4.23
Pear Pruning	286	110	0.74	1.19	0.73	1.26
Pecan Pruning	501	295	1.30	1.83	1.58	1.96
Quince	47	28	0.12	0.17	0.15	0.18
Walnut Pruning	17083	14236	38.44	34.17	41.00	35.88
<20 Acre Orchard Removal (all crops)	70010	2334	182.03	255.54	220.53	273.04
Apple Orchard Removal	691	23	1.80	1.28	0.79	1.35
Citrus Orchard Removal	54035	1801	140.49	151.30	183.72	159.40
Fig Orchard Removal	2392	80	6.22	7.78	7.18	8.25
Pear Orchard Removal	490	16	1.27	2.03	1.25	2.16
Quince Orchard Removal	10	0	0.03	0.04	0.03	0.04
Brooder Paper	<1	n/a	0.00	0.00	0.00	0.00
Diseased Beehives	90	41	0.20	0.68	0.48	0.71
Goat	<1	n/a	0.00	0.00	0.00	0.003
Ponding/Levee Banks	302	139	0.68	2.29	1.62	2.40
Rice *	9049	3073	23.45	27.79	21.98	29.65
Raisin Trays	890	29683	1.90	0.33	1.94	0.35
Vineyard Removal	197140	13143	512.56	719.56	620.99	768.85
Totals:	**406,861**	**117,668**	**1,069.3**	**1,384.9**	**1,243.2**	**1,472.5**

* Note: no citrus pruning after 2005
1. Rice category includes residual rice straw, rice straw, rice stubble, and rice field levees.

Table 5-1 includes the Phase IV materials that were issued open burning permits. District staff calculated the burn acres and associated emissions from a list of the amounts of selected Phase IV materials that were issued open burning permits, averaged from 2007-2009. The list includes almond pruning, walnut pruning, pecan pruning, vineyard removal, raisin trays, and rice stubble. The total acres burned from the three-year average of the crops previously mentioned are 109,128 acres. The emissions from such activities are presented below:

Table 5-2
Average Annual Emissions From
Open Burning of Selected Phase IV Crops (2007-2009)

Emissions	NOx	PM 2.5	VOC	PM 10
Tons per Year	706.98	929.38	800.17	988.30

5.3 EXPECTED EMISSIONS FROM ALTERNATIVES (Criteria Pollutant – PM 2.5)

Pruning Materials
The analysis in this report indicates that prunings from several crops will most likely be shredded on site, or already are shredded on site, as an alternative to open burning. The table below is a comprehensive comparison of the average annual PM 2.5 emissions from open burn versus shredding for the aforementioned crops. For purposes of this analysis, District staff assumed the average burn acres would remain constant and that all burn acres would be shredded on site.

The information for this analysis was derived by inputting the burn acre data from the "Average Annual Tons, Acres, and Emissions from Open Burning of Crops (2007-2009) table presented in Section 5-1 of this report into the District Emissions Calculator. The District Emissions Calculator incorporates the emissions from various pieces of equipment, including tractors and excavators associated with the activity, emissions from transfer and delivery vehicles, and other processes such as chipping, as well as the emission factor for each crop type and activity. The data presented in the table below is a comprehensive emission inventory encompassing all aspects of the affected crops.

Table 5-3
Comparison of the Average Annual PM 2.5 Emissions
From Open Burning and Shredding (2007-2009)

Crop Name	Burn Acres	PM 2.5 Emissions (Tons)	
		Open Burn	Shred
Almond Pruning	51718	203.0	4.8
Apple Pruning	391	3.5	0.1
Fig Pruning	558	4.8	0.1
Pear Pruning	110	1.1	0.01
Pecan Pruning	295	2.0	0.0
Quince	28	0.2	0.003
Walnut Pruning	14236	67.0	1.4
Total:	67336	281.6	6.4

<u>Orchard Removal Materials</u>
The analysis in this report also indicated that several crops are sent to the biomass facilities and will most likely continue to be sent to biomass facilities as biomass fuel as an alternative to open burning. The table below is a comprehensive comparison of the average annual PM 2.5 emissions from open burn versus biomass processing for the aforementioned crops. For purposes of this analysis, District staff assumed the average burn acres would remain constant and that all burn acres would be sent to the biomass plant as fuel.

The information for this analysis was derived by inputting the burn acre data from the "Average Annual Tons, Acres, and Emissions from open burning of Crops (2007-2009) table presented in Section 5-1 of this report into the District Emission Calculator. The District Emission Calculator incorporates the emissions created from various pieces of equipment, including tractors and excavators associated with the activity, emissions from transfer and delivery vehicles, and other processes such as chipping, as well as the emission factor for each crop type and activity. The data presented in the next table is a comprehensive emission inventory encompassing all aspects of the affected crops.

Table 5-4
Comparison of the Average Annual PM 2.5 Emissions
From Open Burning and Biomass Operations (2007-2009)

Crop Name	Burn Acres	PM 2.5 Emissions (Tons)	
		Open Burn	Biomass
<20 Acre Orchard Removal (all crops)	2334	264.2	32.8
Citrus Orchard Removal	1801	203.9	25.3
Fig Orchard Removal	80	9.1	1.1
Total:	4215	477.2	59.2

5.4 EMISSION REDUCTION ANALYSIS

5.4.1 Introduction

The recommendations as described elsewhere in this report will result in greater curtailment of agricultural open burning currently allowed under District Rule 4103. The recommendations will result in the following additional prohibitions:

<u>Orchard Removals</u>

- The prohibition of burning of all orchard removals from fig crops over 15 acres (District Rule 4103 currently allows burning at all acreage sizes).

- The prohibition of burning of all orchard removals for all crops (with the exception of citrus, apples, pears, and quince) with acreages over 15 acres up to and including 20 acres (District Rule 4103 currently allows burning of acreages in this range).

<u>Prunings</u>

- The prohibition of burning of all orchard pruning material from fig crops for all acreages (District Rule 4103 currently allows burning at all acreage sizes).

- The prohibition of burning of prunings for each agricultural operation whose total nut acreage (i.e., almonds, walnuts, and pecans) at all agricultural operation sites is 3,500 acres or more. For each agricultural operation whose total nut acreage at all agricultural operation sites is less than 3,500 acres, burning of up to 20 acres of prunings per year is allowed plus additional acreage when a determination of economic hardship is made by the District (District Rule 4103 currently allows burning at all acreage sizes).

The estimated emission reductions to be achieved by the new prohibitions listed above are presented in Table 5-5. Details of the emission reduction analysis are discussed in the next section (Methodology and Calculations).

Table 5-5
Total Annual Emission Reductions from All New Open Burning Prohibitions

Category	Crop	Nox (ton/year)	PM2.5 (ton/year)	VOC (ton/year)
Orchard Removals	Figs	2.8	6.7	6.1
	All Orchards Less Than 20 Acres*	25.8	61.7	56.4
Orchard Prunings	Figs	0.4	2.1	1.7
	Almond	9.5	48.8	38.0
	Pecan	0.0	0.1	0.1
	Walnut	0.7	3.7	2.9
Total		39.2	123.1	105.2

* except citrus, apples, pears and quince

5.4.2 Methodology and Calculations

Step 1: Determine the reduction in acreage which will be burned as a result of the new prohibitions

District staff analyzed information collected during 2007-2009 from the District's Smoke Management System (SMS) in order to estimate the reduction in acreage of burning resulting from the new prohibitions. The SMS manages agricultural open burning in the San Joaquin Valley Air Basin (SJVAB) and collects and maintains information pertinent to the amount and type of material burned in the SJVAB. For each permitted open burning operation during the time period, the SMS identifies the specific item burned and the associated acreage.

In order to estimate the reductions in acreage of orchard burning resulting from each of the new orchard prohibitions listed, it was assumed that average annual acreage of permitted burns in the SMS for the period 2007-2009 is representative of the expected burning reduction for each category.

Extraction and analysis of data from the SMS for orchard removals yielded the following annual reductions in acres burned:

Table 5-6 Data from the SMS for Orchard Removal and Pruning

New Prohibition	Annual Reduction in Acreage Burned
Orchard removals from fig crops over 15 acres	61
Orchard pruning material from fig crops for all acreages	557
Orchard removals for all crops (with the exception of citrus, apples, pears, and quince)	560
Almond pruning material	12,670
Pecan pruning material	22
Walnut pruning material	969

Step 2: Establish Applicable Emission Factors on a Per Acre Basis

Differential emission reduction factors for orchard removals and for orchard prunings, along with the basis for their development, are presented in Tables 5-7 and 5-8 respectively of the cost and emissions section of this staff report (Chapter 5).

Differential emission reduction factors for orchard removals (assuming 30 tons dry biomass per acre) are based on chipping and conversion of the removed trees to biomass fuel rather than burning:

$$\text{Differential Emission Factor (tons/acre)} = \text{Burning Emission Factor (tons/acre)} - \text{Chipping/Biomass Emission Factor (tons/acre)}$$

From Table 5-4 of the cost and emissions section the differential emission factors for orchard removals between 15 and 20 acres are:

NO_x 0.0460 tons per acre
$PM_{2.5}$ 0.1101 tons per acre
VOC 0.1007 tons per acre

Differential factors for prunings (assuming 1 ton of dry prunings per acre) are based on chipping and land incorporation of prunings in lieu of burning:

Differential Emission Factor (lb/acre)	=	Burning Emission Factor (lb/acre)	-	Land Incorporation Emission Factor (lb/acre)

From Table 5-8 of the cost and emissions section the differential emission factors for orchard prunings are:

NO_x 1.5 lb per acre
$PM_{2.5}$ 7.7 lb per acre
VOC 6.0 lb per acre

Step 3: Apply Applicable Emission Factor to Acreage Data Extracted from the SMS

Tables 5-11 and 5-12 present the results for orchard removals and prunings respectively.

Table 5-7
Emission Reductions from New Orchard Removal Prohibitions

Prohibition			Acres Reduced per SMS	NOx		PM2.5		VOC	
Crop	Current Permitted Open Burning	New Prohibition		Differential Emission Factor (ton/acre)	Annual Emission Reduction (tons)	Differential Emission Factor (ton/acre)	Annual Emission Reduction tons)	Differential Emission Factor (ton/acre)	Annual Emission Reduction tons)
Figs	Permitted at all acreages	Prohibited for acreage greater than 15 acres	61	0.046	2.8	0.1101	6.7	0.1007	6.1
All other crops (with the exception of citrus, apples, pears, and quince)	Permitted for 20 acres or Less	Prohibited for acreage greater than 15 acres	560	0.046	25.8	0.1101	61.7	0.1007	56.4

Table 5-8
Emission Reductions from New Orchard Pruning Prohibitions

Prohibition			Acres Reduced per SMS	NOx		$PM_{2.5}$		VOC	
Crop	Current Permitted Open Burning	New Prohibition		Differential Emission Factor (lb/acre)	Annual Emission Reduction (ton)	Differential Emission Factor (lb/acre)	Annual Emission Reduction (ton)	Differential Emission Factor (lb/acre)	Annual Emission Reduction (ton)
Figs	Permitted at all acreages	Prohibited for all acreages	557	1.5	0.4	7.7	2.1	6.0	1.7
Almond (surface harvested crop)	Permitted at all acreages	Prohibited for acreage greater than 20 acres	12,670	1.5	9.5	7.7	48.8	6.0	38.0
Pecan (surface harvested crop)	Permitted at all acreages	Prohibited for acreage greater than 20 acres	22	1.5	0.0	7.7	0.1	6.0	0.1
Walnut (surface harvested crop)	Permitted at all acreages	Prohibited for acreage greater than 20 acres	969	1.5	0.7	7.7	3.7	6.0	2.9

5.5 HEALTH BENEFITS OF REDUCED OPEN BURNING

Given the minimal impact of open burning on ozone levels in the Valley mentioned above, this discussion emphasizes the health benefits of reduced open burning and associated PM 2.5 emissions. Prior scientific studies as well as District experience have shown the importance of steadily reducing population exposure to PM 2.5 through controls on residential wood burning and open burning. The San Joaquin Valley experiences some of the highest annual average concentrations of PM 2.5 in the nation. Well-defined epidemiological relationships have been established between exposure to elevated PM 2.5 and a range of health endpoints, including ischemic heart disease, asthma, chronic bronchitis, premature mortality, and others. The region can experience multi-day periods of atmospheric stagnation during which very little air mass is transferred in and out of the Valley. The net result can be a daily buildup of PM 2.5 levels, sometimes beyond the 24 hour federal standard of 35 $\mu g/m^3$.

Unlike areas such as Southern California where PM 2.5 levels are more distributed throughout the year, fine particulates are seasonally concentrated in the Valley. Because of this seasonal concentration effect, District controls currently imposed on open burning and residential wood burning have had a disproportionate effect in reducing wintertime PM 2.5 concentrations. In the case of residential wood burning, an external scientific evaluation was conducted by California State University (CSU) Fresno of Rule 4901's periodic curtailments (see www.cvhpi.org). This assessment found that as of the winter 2007-08 season (prior to the October 2008 amending of Rule 4901), daily curtailments coupled with reduced household wood burning overall had resulted in a 12.9% and 13.6% reduction in annual PM 2.5 concentrations for Bakersfield and Fresno, respectively. Using the US EPA's BenMAP model for calculating health benefits of reduced PM2.5 exposure, these reductions translated into significant public health benefits, including significantly reduced cardiovascular disease, pulmonary disease, and pre-mature deaths.

A key element in this success has been the imposition of restrictions in residential wood burning on days when meteorological conditions create the risk of health standard violations. Initially, as of November 1, 2003, that threshold was established at the 1997 24 hr. PM 2.5 standard of 65 $\mu g/m^3$. As amended in October 2008 for the 2008-09 winter season, that daily curtailment threshold was substantially reduced to 30 $\mu g/m^3$. That reduced curtailment threshold has benefited public health in three ways: First, it has resulted in an absolute reduction in the total seasonal tonnage of residential wood burned. Second, it has insured that on days when wood burning is allowed, each ton of emissions is more thoroughly diluted and dispersed, with attendant reductions in harmful peak exposures. And third, by restricting burning to days with reasonably good atmospheric dispersion, the formation of secondary aerosols such as ammonium nitrate during multi-day stagnation events is minimized.

By restricting the analysis to the Bakersfield and Fresno/Clovis metro areas, the health evaluation of Rule 4901 (Wood Burning Fireplaces and Wood Burning Heaters) was made possible by a well-defined pre-and post-Rule 4901 population exposure estimate for PM2.5. However, in the case of health benefits from reduced burning under Rule 4103, it is not possible to replicate this analysis for several reasons. First, ambient monitors are generally not found in rural areas. In addition, the population density is considerably lower. As a result, estimating accurate population exposure reductions resulting from current or estimated reductions on agricultural burning is very difficult and not attempted here.

However, it is possible to draw on the experience of the District evaluation of Rule 4901 to draw some reasonable conclusions that provide a public health justification for past and prospective reductions in open burning under Rule 4103. First, the basin-wide emissions inventory for open burning and residential wood combustion are comparable. According to the 2008 CARB emissions inventory, estimated tons per day (tpd) of PM2.5 from wood burned by households was 9.5 and 14.8 for agricultural material. Second, it is important to note at that as of December 2009, daily county-level curtailments of open burning are based on the same predicted 24 hr. 30 $\mu g/m^3$ concentration threshold used in Rule 4901. This means that a predominant source of rural and urban open burn emissions has been eliminated on low dispersion days, with corresponding reductions in overall exposure to individuals in areas where open burning is occurring, as well as minimizing exposure to secondary PM2.5.

Reduced emissions from Rule 4103 are presented below in Table 5-9. In a historical sense, reductions achieved to date represent a very rapid rate of emission decline in a given economic sector, with attendant health benefits to a more dispersed, rural population.

Table 5-9
Reductions in Criteria Pollutants Under Rule 4103 Since 2004

	NOx	PM10	PM2.5	VOC	CO
Total Tonnage Reduction Since 2004	1,217	1,981	1,860	1,516	15,273
% Reduction Since 2004	48.9%	52.7%	52.6%	50.4%	48.5%
TPD Reduction Since 2004	3.3	5.4	5.1	4.2	41.8

Additional reductions anticipated under the amended Rule 4103 are shown above. The more modest reductions arising from the recommendations reflect the current balance of commodity profitability and costs for processing at biomass plants, as defined by the CH&SC. Past experience has shown that the per unit costs of alternative disposal options with less environmental impacts tend to decline over time due to, in this case, new biomass plant capacity and the emergence of alternative disposal technologies. The District supports legislation that will encourage, promote and facilitate alternative uses for agricultural material as well as policies and initiatives that encourage renewable energy and energy efficiency including supporting legislation that provides additional biomass capacity utilizing agricultural materials. It is likely that the current constraints on open burning emission reductions imposed by the CH&SC will be reduced over time, with proportional health benefits.

5.6 HEALTH RISK ASSESSMENT OF OPEN BURNING AND ALTERNATIVES

Often under the requirements of CEQA-mandated risk assessments, the District routinely employs several health risk assessment (HRA) models in order to estimate health risks posed by exposure to air pollutants from existing or hypothetical sources. These HRA models are based on the following elements: (1) knowledge from prior scientific studies about the relative toxicity of pollutants, (2) similar knowledge about the relative effects of increased concentrations of a given pollutant, (3) the hourly rate of emissions by mass or parts per volume, i.e. emission factor, from a given source and the duration of those emissions, (4) specification of meteorological conditions, (5) how the pollutants are dispersed and/or transformed in the atmosphere, (6) a gradient or exposure surface that specifies various concentration levels at a given distance from a source and time, (7) (in some cases) the spatial distribution and characteristics of the exposed population, and (8) (in some cases) whether and how different sub-populations may be differentially affected such as children to a given level and duration of exposure.

To evaluate the acute (short-term) and chronic (long-term) health impact of open burning of agricultural material and alternative disposal methods, the following scenarios were analyzed (modeled):

Scenario 1: Open burning of prunings from 20 acres of nut trees. Emission sources included diesel exhaust from equipment used to form the burn piles, and emissions from combustion of the organic material.

Scenario 2: Land incorporation of prunings from 20 acres of nut trees. Emission source included diesel exhaust from equipment used to shred and incorporate prunings into the soil.

Scenario 3: Transfer of prunings from 20 acres of nut trees to a biomass facility. Emission sources included diesel exhaust from equipment used to collect and chip/shred prunings, diesel exhaust from trucks used to transport the chipped material to the biomass plant, diesel exhaust from equipment used to unload and process the chipped material at the biomass plant, and emissions from the biomass combustor.

Scenario 4: Open burning of 20 acres of nut trees (orchard removal). Emission sources included diesel exhaust from equipment used to form the burn piles and emissions from the combustion the organic material.

Scenario 5: Transfer of 20 acres of nut trees (orchard removal) to a biomass facility. Emission sources included diesel exhaust from equipment used to collect and chip/shred the orchard material, diesel exhaust from a truck used to transport the chipped material to the biomass plant, diesel exhaust from equipment used to unload and process the chipped material at the biomass plant, and emissions from the biomass combustor.

5.6.1 Methodology and Calculations

Emissions for each scenario evaluated were calculated using District-developed spreadsheets and the parameters listed below:

Table 5-10
Variables used to estimate scenario emissions

Variables	Prunings	Orchard Removal
Crop type	Orchard	Orchard
Ag material (acres)	20	20
Material removed (tons/acre)	1	30
Roots removed (tons/acre)	0	1
Field equipment activity (hours/acre)	1	1
Power plant equipment activity (hours/acre)	2	2
Ag material delivered to power plant (tons/truck)	24	24
Round trip distance to power plant (miles)	100	100

Off-road diesel equipment was used to process crop material in the field and at the biomass facility. Off road equipment activity was modeled as an area source over the entire surface of the orchard or that portion of the biomass facility used to receive and process wood chips. All particulate matter from off-road diesel equipment exhaust was modeled as diesel particulate matter (DPM). Relative risks generated by air contaminants from the open burning of agricultural material were calculated using the California Air Resources Board (CARB) particulate matter speciation profile 450 for particulates, and emission factors from Lemieux, Lutes and Santoianni (2002) for volatile organic compounds. Emissions from open burn piles were modeled as point sources to allow for thermal loft from the heat of combustion. The open burning of orchard prunings was assumed to occur in four separate piles located at the southern border of the orchard. The open burning of the orchard removal material was assumed to occur in twenty piles evenly distributed within the orchard over a 24 hr. period. All particulate matter from on-road diesel truck exhaust was modeled as DPM. On-road truck travel was modeled as a line source consisting of a one mile series of volume sources.

To calculate pollutant dispersion and the resulting exposure gradient, the AERMOD model was used. Meteorological data for 2004-2008 from Bakersfield was employed to determine the dispersion factors (i.e., the predicted concentration or X divided by the normalized source strength or Q) for a receptor (human population) grid. These dispersion factors were input into the Hot Spots Analysis and Reporting Program (HARP) risk assessment module to calculate the chronic and acute hazard indices as well as the carcinogenic risk for five scenarios outlined above. No actual locations and nearby populations were used in the model analysis.

5.6.2 Health Risk Assessment Results

Worst case health risks for the open burning of agricultural material and their alternatives are presented in Table 5-11 (pruning scenario) and Table 5-12 (orchard removal scenario). The model results for open burning of prunings show that the cancer risk and chronic hazard indices are very low and not of concern for all disposal options. The acute hazard index in this case pertains to risk of an acute respiratory response over the short-term (24 hour) exposure generated by the burning of the prunings for a person standing within 25 meters of the burn piles. In this air pollutant modeling scenario, any acute hazard index score of over 1.0 indicates the potential for a negative impact on respiratory health. As shown, this threshold is not exceeded for a maximum 24 hour. exposure scenario.

In the case of a worst-case health risk assessment for orchard removal options are shown in Table 5-11. As in the case of prunings, cancer and chronic hazard indices for all options are very low values that do not indicate excessive risk. As shown in Figure 5-3, the open burning exposure scenario is based on the assumption that removed trees are put into 20 piles, one per acre, and burned simultaneously. In this case, the acute hazard index score for 24 hr. exposure in the zone nearest the burn piles is excessive (10.70). As one moves further from the burn zone this relative hazard to short-term respiratory health drops relatively quickly, falling by approximately 50% after 500 meters and to an acceptable level of less than 1.0 after 1,000 meters.

Table 5-11
Comparative Pruning Risk (20 Acres): Open Burning vs. Chipping/Shredding and Incorporation vs. Biomass Facility

Source	Health Risk		
	Maximum Individual Cancer Risk[2] ($x 10^{-6}$)	Acute Hazard Index	Chronic Hazard Index
Orchard Burning	3.32	0.83	0.07
Land Incorporation	7.59	nc[1]	nc
Biomass Facility – Off Site			
Orchard	9.69	nc	nc
Transit	0.00	nc	nc
Off Site Total	9.69	nc	nc
Biomass Facility – On Site			
Facility	0.10	0.00	0.00
Transit	0.00	nc	nc
On Site Total	0.10	0.00	0.00

[1] Acute and Chronic Hazard Indices were not calculated since there is no risk factor or the risk factor is so low that it has been determined to be insignificant for this type of unit.
[2] 70 year exposure used.

Table 5-12
Comparative Orchard Burning Risk (20 Acres): Open Burning vs. Chipping/Shredding, On-Site Biomass Facility vs. Off-Site Biomass Facility

Source	Health Risk		
	Maximum Individual Cancer Risk[2] ($x 10^{-6}$)	Acute Hazard Index	Chronic Hazard Index
Orchard Burning	2.69	10.70	0.58
Biomass Facility – Off Site			
Orchard	1.84	nc[1]	nc
Transit	0.09	nc	nc
Off Site Total	1.93	nc	nc
Biomass Facility – On Site			
Facility	0.55	0.00	0.00
Transit	0.09	nc	nc
On Site Total	0.65	0.00	0.00

[1] Acute and Chronic Hazard Indices were not calculated since there is no risk factor or the risk factor is so low that it has been determined to be insignificant for this type of unit.
[2] 9 year exposure used.

Figure 5-3
Acute Respiratory Risk Isopleths for Open Burning of Prunings (24 hr exposure)

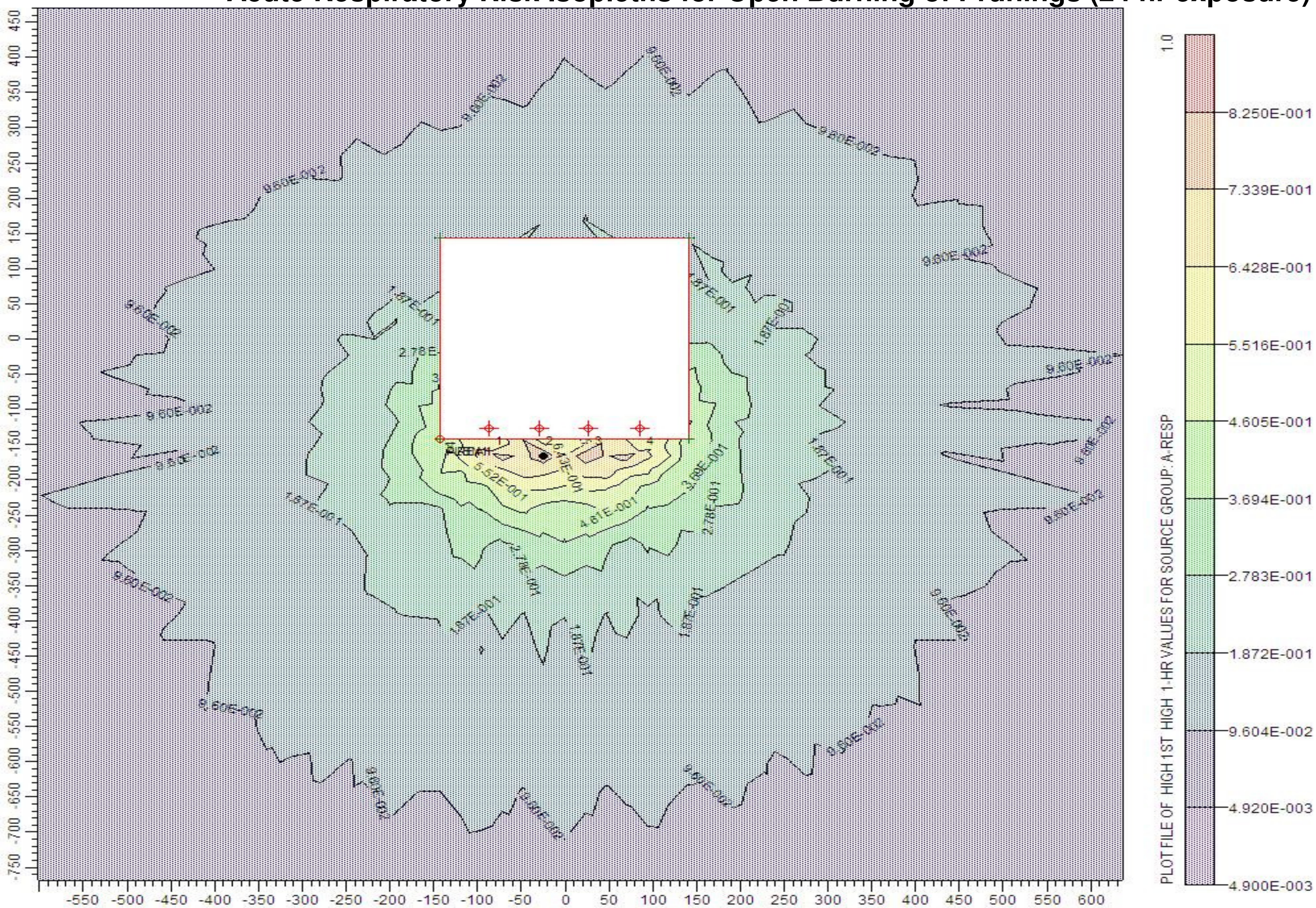
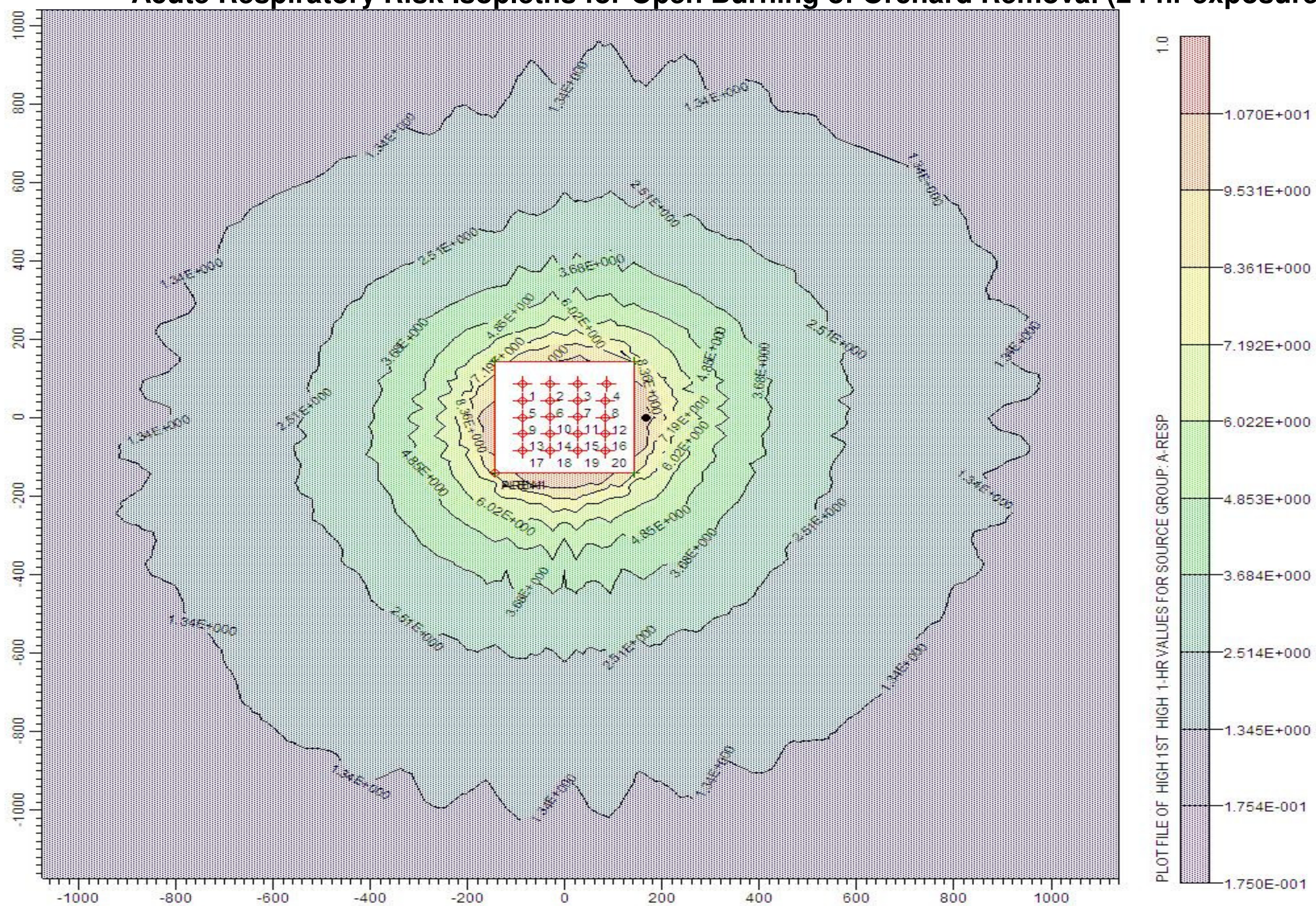


Figure 5-4
Acute Respiratory Risk Isopleths for Open Burning of Orchard Removal (24 hr exposure)



There are a number of practices currently employed by District Compliance staff under the policy for Rule 4103 that are designed to minimize the potential health hazard of orchard removal burnings of this scale. The Appendix A (p. 7) from the Rule 4103 District Policy identifies the conditions that must be satisfied when District Compliance staff conduct their mandatory field site inspections prior to granting approval to proceed with burning:

> **Burn permits issued in rural residential areas**, or in other areas where smoke may affect smoke sensitive areas, must include site-specific instructions and permit conditions. The instructions and/or conditions must limit the possible smoke impact on nearby neighbors and/or smoke sensitive areas.
>
> 1. The permit applicant must be advised that only those materials produced along with the crop and listed on the burn permit may be permitted to burn.
>
> 2. Additional permit conditions may stipulate any or all of the following:
>
>   a. The wind direction required at the time of ignition
>   b. The burn site location on the property
>   c. The day(s) of the week the burning may occur
>   d. The time of day a burn may be ignited
>   e. The time of day to cease burning or cease adding material to the fire
>   f. The size of the burn pile permitted to be burned at one time
>   g. The permit will be issued for the duration of need only.

Compliance Appendix A (p. 35) from the Rule 4103 District Policy also makes explicit limits on burning in smoke sensitive areas with greater population densities or facilities with sensitive individuals:

> **SMOKE SENSITIVE AREAS**: Smoke sensitive areas are populated areas or other areas where smoke and air pollutants can adversely affect public health or welfare. These areas can include cities, towns, communities, campgrounds, trails, recreational areas, hospitals, nursing homes, medical clinics, schools, day-care centers, roads and highways, airports, public events, and shopping centers.
>
> A District on-site inspection is required near dense populations or smoke sensitive areas. If the District determines there is a reason to believe smoke produced from a proposed burn may cause

complaints or create a nuisance, the burning may only be permitted under the following conditions:

A. The District must determine there is no other reasonable method of disposal.

B. The quantities of materials to be burned shall be limited as needed.

C. The days burning may be authorized may be limited. For example, a burn site upwind from a school may have to limit burning to when school is not in session, such as on weekends or during school vacation provided that no other special events or school functions are occurring during these off times.

D. Permittee must establish and provide an at-ready means to extinguish the fire if directed to do so by the District or any public officer.

E. Additional permit conditions may stipulate:

1. The wind direction required at the time of ignition.
2. The burn site location on the property.
3. The day(s) of the week the burning may occur.
4. The time of day a burn may be ignited.
5. The time of day to cease burning or cease adding material to the fire.
6. The size of the burn pile and/or the number of burn piles authorized to burn at one time.
7. The permit will be issued for the duration of need only.

F. If any of the conditions provided above cannot be met, such burning shall not be permitted.

Because of these limitations, excess acute health risks from orchard removals are minimized. As noted above, the overall trajectory of health risks from agricultural open burning has been following a steep downward path since 2004. The results of this health risk assessment underscore the logic of (1) the current balance stuck under the current CH&SC between the economic costs of alternatives to burning on the one hand and the potential health impacts of open burning on the other, as well as (2) the ongoing importance of finding new incentives and technologies for the long-term elimination of open burning of agricultural materials.

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Chapter 6

Cost Impacts of Alternatives to Burning

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Chapter 6: COST IMPACTS OF ALTERNATIVES TO BURNING (for each affected crop/material)

The costs shown in this analysis are borne by growers. Growers typically pay the contractor to burn, chip, or shred the materials. The biomass facilities also pay chipping operators for the chipped material. The District is estimating incremental costs of non-burning alternatives by subtracting the cost of open burning from the total cost of the alternative. The incremental costs are then used in further analysis.

6.1 COSTS FOR OPEN BURNING

6.1.1 Costs for Orchard and Vineyard Removal by Open Burning

Since the entire orchard or vineyard removal process may be affected by the method utilized for disposal of the material, the District examined current costs for the complete removal/burning process including tree or vine extraction, transport/piling and burning. For orchard removals, the trees are typically either pushed over with a dozer or removed from the ground with an excavator. Large trees may require some breaking up for handling. After drying in the field, the downed trees are then moved to burn piles either by dozer or wheel-loader. Vineyards are typically bull dozed into piles for burning with vineyard wire in place (the wire is removed and disposed after burning is complete).

To obtain costs, orchard removal contractors in the SJV were contacted who provided expected average costs for the removal and burning for various orchard types and vineyards. All contractors requested confidentiality with respect to their pricing. Per discussions with the contractors, actual cost for a particular site will vary with specific orchard or vineyard configuration and site conditions.

The agricultural industry also provided estimates for removal/burning operations.

Average pricing provided to the District by the orchard removal contractors as well as estimates provided by the agricultural industry are as follows:

Table 6-1
Prices for Orchard and Vineyard Removals by Open Burning
$ per acre

	Citrus	Average for other Orchards including nuts, stone fruit and general deciduous	Vineyards	Minimum Charge per Burning Project
Average Contractor Pricing	$400	$267	$213	$1,150
Ag Industry Estimates	$314	-	$267	-

The above pricing includes burning of roots, assuming the roots would be extracted from the ground prior to the burning operation. Orchard removal contractors generally indicated citrus orchard removal and burning to be somewhat more difficult than the average for other types of orchards and indicated a higher price for this specific type.

Agricultural industry estimates for open burning did not specifically address orchard removals other than Citrus. For purposes of analysis, the District will assume that the agricultural industry estimate of $314 per acre applies to all orchards. Additionally, agricultural industry estimates did not address a minimum project charge for burning projects. For purposes of analysis, the District will assume that the minimum project charge estimated by orchard contractors will be generally applicable.

6.1.2 Costs for Disposal of Orchard Prunings by Open Burning

Disposal of orchard prunings by open burning requires that the prunings be pushed to the end of each row and then piled for burning. Pruning weights are typically 1 to 1.5 tons per acre on a wet basis (30-35% moisture) for orchards regardless of tree type per information provided both by orchard contractors and the farming industry. To burn the prunings, costs must be incurred to 1) push the prunings to the end of each row and then pile them for burning, 2) obtain a burning permit and 3) then supervise the burn. The farming industry estimates the cost of this activity at approximately $22 per acre. It is assumed that a $500 minimum project cost would be required by a contractor to perform these services consistent with quoted project minimums for smaller chipping operations.

6.2 COSTS OF ALTERNATIVES TO BURNING

6.2.1 Costs for Orchard and Vineyard Removal for fuel at Biomass Power Plants

The District has identified the grinding (or chipping) of orchard removal material followed by utilization of the material as fuel for power generation as a feasible alternative to open burning. In this approach for orchard removal the trees are typically extracted or pushed over and then allowed to dry in the field for approximately four weeks prior to grinding (except for citrus for which a drying time of approximately eight weeks is required to ensure that grinding will produce a usable biomass fuel). After drying, the downed trees are typically loaded on a wheel-loader which transports them to the grinder. The grinder may be either a tub grinder or a horizontal hammer mill, depending upon the contractor and/or the specifics of the job. After grinding, the biomass is normally loaded into heavy haul trucks and transported to the biomass facility.

To obtain costs for conversion of orchard removal matter into biomass fuel, the District contacted several established orchard removal contractors and obtained budgetary quotations for typical orchard removal operations with conversion of the material to biomass. In addition, the agricultural industry provided cost estimates for this activity. Results of the cost survey are presented in the following table:

Table 6-2
Cost for Orchard and Vineyard Removals by Grinding to Biomass Fuel
$ per acre

	Citrus		Other Orchards		Vineyards		Minimum Charge per Project	
	Orchard Contractors	Ag Industry Estimate	Orchard Contractors	Ag Industry Estimate	Orchard Contractors	Ag Industry Estimate	Orchard Contractors	Ag Industry Estimate
Average Contractor Quote/Estimate for Orchard Removal	$525	$580	$388	$400	$225	$380	$5,000	$5,000
Transporting and Composting Roots	$244	$75	$244	$75	$75	$244		
Removal of Vineyard Wire and Trellis	N/A	N/A	N/A	N/A	$650	$775		
Total Evaluated Cost Based on Average Contractor Quote or Ag Industry Estimate	$769	$655	$632	$475	$950	$1,399	$5,000	$5,000
Cost Differential Between Grinding to Biomass and Open Burning	$369	$341	$365	$161	$737	$1,132	$3,850	$3,850

Per discussions with the contractors providing budgetary estimates, the actual cost for a particular site will vary with specific orchard or vineyard configuration, site conditions, haul distance to a biomass power plant and the current price paid for biomass fuel. To ensure that the quoted costs would be comparable to those quoted for open burning, the scope included tree removal, grinding and transport to the biomass facility. The pricing did not include any impact from any federal or other incentive programs aimed at promoting use of agricultural material as biomass fuel (since such programs are considered temporary).

Similar to the pricing obtained for orchard burning, the District's discussions with orchard removal contractors also indicated that the pricing for citrus orchards is higher than the average for other orchard types, primarily due to issues with separation of dirt from the root ball in clay or rocky soil and the lower desirability of citrus as biomass fuel. This is consistent with the estimates provided by the agricultural industry which also indicate a higher pricing for citrus versus other types of orchards. Based on discussions with contractors, a value of 30 tons biomass fuel per acre was assumed for citrus orchards.

In the costs presented in the table above, the District's data assumed that the roots, after drying in the field, will be transported to a composting operation. The following cost estimates were provided by the ag industry for removing root materials: $75 for one ton of roots and $244 for four tons of roots. For orchard removals, District staff estimated the roots to weigh four tons per acre. For vineyard removals, District staff assumed that the roots weigh one ton per acre. Ag industry estimates were based on 1 ton of roots per acre for orchards and 4 tons per acre for vineyards.

As with open burning, the prices listed above do not include extraction of roots from the field and the loading of roots into piles for further handling because as mentioned previously, it is assumed that this cost will be incurred regardless of the approach used for orchard or vineyard removal and thus can be ignored for the District's comparative analysis.

Review of Table 6-2 indicates that the prices obtained by the District for open burning and grinding for biomass are very similar to the estimates provided by the ag industry. In addition, since the pricing differential between grinding to biomass and open burning shown in Table 6-2 is generally greater when based on the quotations obtained by the District rather than on the information provided by the ag industry, the District's cost effectiveness analysis will be performed based only on the quotations obtained by the District since this will provide the most conservative analysis with respect to industry's concerns.

6.2.2 Costs for Disposal of Orchard Prunings by Chipping

Options for chipping and recycle of prunings consist of:

1. Chipping prunings for conversion to biomass fuel
2. In-row chipping of prunings for on-site land incorporation

The practice of chipping prunings for conversion to biomass fuel is less commonly practiced in comparison to in-row chipping for land incorporation and the pricing was found to be variable depending upon the business approach by the contractor. Information provided by an operator with smaller chipping equipment indicated that prunings could be chipped for biomass at a cost of $100 per dry ton with a minimum job charge of $500. An operator with large grinding equipment indicated that under good conditions the cost could be $40 - $60 per ton with a minimum of $6,000 per day when grinding prunings for biomass.

Costs for chipping prunings for land incorporation have been included in a number of recent studies by the University of California Cooperative Extension as presented in Table 6-3:

Table 6-3
Published Costs for In-Row Chipping of Prunings for Land Incorporation

UC Report	Title	Date	Cost per Acre to Shred Prunings
NC-VS-09	Sample Costs to Establish and Produce Nectarines	2009	$41
OL-SV-09	Sample Costs to Produce Olives	2009	$10
PH-VS-09	Sample Costs to Establish and Produce Peaches	2009	$41
WN-VN-07	Sample Costs to Establish and Produce Walnuts	2007	$27
AM-VS-08-1	Sample Costs to Establish and Produce Almonds	2007	$24

In addition, a chipper operator was contacted to obtain a budgetary quotation. This contractor indicated an in-row chipping price of $26 per acre with a $500 project minimum, regardless of tree type. An analysis provided by the farming industry indicated that the in-row chipping operation for almonds would cost $30-$65 per acre depending upon the age of the trees. For purposes of this analysis and based on the information above, the District will assume that the prices for in-row chipping for land incorporation may vary from $30 to $60 per acre.

6.3 COST EFFECTIVENESS OF ALTERNATIVES TO OPEN BURNING

6.3.1 Approach

In general, the reduction of agricultural material from the pruning or the removal of orchards and vineyards by grinding or chipping followed by conversion to either biomass fuel or land incorporation results in fewer emissions when compared to open burning; however, these operations may incur extra costs over those associated with open burning. To examine the cost feasibility of these alternatives, cost effectiveness (CE) in dollars per ton of emission reduction is defined as the cost differential between chipping or grinding and open burning in dollars per acre divided by the difference between burning and chipping in per acre total emissions ($PM_{2.5}$ + NO_x + VOC), or:

$$CE = \left(\frac{(\$/acre)_{chip} - (\$/acre)_{burn}}{(tons\text{-}emissions/acre)_{burn} - (tons\text{-}emissions/acre)_{chip}} \right)$$

The cost effectiveness calculated by the above expression will primarily be a function of the type of tree or plant (which determines the difficulty of removal and the amount and fuel quality of the material, affecting both the denominator and numerator of the above expression) and of the total acreage which affects the numerator of the above expression since operations on smaller acreages cost more per acre due to the project minimums imposed by most orchard contractors.

6.3.2 Emissions Due To Open Burning

Open Burning of Orchard Removals

Emissions of $PM_{2.5}$, NO_x and VOC from open burning operations have been estimated by the District based on the following:

- Emissions estimates for orchard removals include:
  1. Highway vehicle emissions to deliver mobile equipment to the site
  2. Emissions from a dozer used to remove the trees or vines
  3. Emissions from a wheel loader used to stack trees or vines into piles for burning
  4. Tractor emissions for collection and stacking of roots for burning
  5. Emissions from open burning of trees, vines and roots

- Emission factors for open burning are taken from the District's 2008 Area Sources Emission Inventory Methodology (revised 01Jun09) for orchard removals. Values are:

  $PM_{2.5}$ 7.3 lb/ton material burned
  NO_x 5.2 lb/ton material burned
  VOC 5.2 lb/ton material burned

- Highway vehicle emissions for delivery of equipment assumes two 100 mile round-trips for a heavy haul truck to deliver a dozer and a wheel loader.
- Dozer emissions are estimated based on a 300 hp Tier 2 diesel engine requiring one hour of operation for 70 tons for material.
- Wheel loader emissions are estimated based on a 250 hp Tier 2 diesel engine operating at a rate of one hour per acre.
- Tractor emissions required for piling and burning of roots are estimated based on an 80 hp tier 2 diesel engine operating at a rate of one hour per acre.

Open Burning of Orchard Prunings

Emissions of $PM_{2.5}$, NO_x and VOC from open burning operations have been estimated by the District based on the following:

- Emissions estimates for orchard removals include:
  1. Highway vehicle emissions to deliver mobile equipment to the site
  2. Emissions from a wheel loader used to stack trees or vines into piles for burning
  3. Emissions from open burning of prunings
- Emission factors for open burning are taken from the District's 2008 Area Sources Emission Inventory Methodology (revised 01Jun09) for orchard removals. Values are:

  $PM_{2.5}$ 7.3 lb/ton material burned
  NO_x 5.2 lb/ton material burned
  VOC 5.2 lb/ton material burned

- Highway vehicle emissions for delivery of equipment assumes one 100 mile round-trip for a heavy haul truck to deliver a wheel loader to the site.

- Wheel loader emissions are estimated based on a 250 hp Tier 2 diesel engine operating at a rate of one hour per acre.

6.3.3 Emissions Due to Grinding and Conversion of Material to Biomass Fuel

Grinding and Conversion of Material from Orchard Removals to Biomass Fuel

Emissions of $PM_{2.5}$, NO_x and VOC from grinding and conversion have been estimated by the District based on the following:

- Emissions estimates for grinding and conversion of material to biomass fuel include:

  1. Highway vehicle emissions to deliver mobile equipment to the site, deliver ground material to the biomass plant and to deliver roots to a composting operation
  2. Emissions from an excavator or dozer used to remove the trees or vines
  3. Emissions from two wheel loaders used to stack trees, vines, and roots into piles for burning
  4. $PM_{2.5}$ emissions from grinding of trees, vines and roots
  5. Engine emissions (PM2.5, NOx, and VOC) from the grinder
  6. Dozer operation at the biomass facility to receive and handle the fuel
  7. Power plant emissions due to fuel burning

- The $PM_{2.5}$ emission factor for grinding (0.05 lb per ton) was based on a review of existing District permits for grinding wood material and vineyard materials. A review of four existing permits indicated a range of 0.0088 lb/ton to 0.08 lb/ton with an average of 0.03.

- Emission factors for biomass power plant operation are based on reported operation for the Delano plant. Values are:

  $PM_{2.5}$ 0.86 lb/ton material burned
  NO_x 1.92 lb/ton material burned
  VOC 0.38 lb/ton material burned

- Highway vehicle emissions calculations assume four 100 mile round-trips for a heavy haul truck to deliver a tubgrinder, an excavator and two wheel loaders to the site, one (1) 100-mile round trip for every 24 tons of ground material for delivery to the biomass power plant, and one (1) 100-mile round trip for every 24 tons of roots for delivery to composting operation.

- Excavator emissions for orchard removal are estimated based on a 240 hp Tier 1 diesel engine requiring one hour of operation per acre.

- Wheel loader emissions associated with the grinding operation are estimated based on a 250 hp Tier 2 diesel engine operating at a rate of three hours per acre.

- Tub grinder emissions are estimated based on a 1000 hp Tier 2 diesel engine operating at a rate of one hour per acre.

- Dozer emissions for receiving and handling material at the biomass power plant are estimated based on a 300 hp Tier 2 diesel engine requiring two hours of operation for 70 tons for material received.

- Wheel loader emissions required for gathering and loading roots for transport to a composter are estimated based on a 250 hp Tier 2 diesel engine operating at a rate of one hour per acre.

<u>Grinding and Conversion of Orchard Prunings to Biomass Fuel</u>

Emissions of $PM_{2.5}$, NO_x and VOC from grinding and conversion have been estimated by the District based on the following:

- Emissions estimates for grinding and conversion of material to biomass fuel include:

  1. Highway vehicle emissions to deliver mobile equipment to the site and deliver ground material to the biomass plant
  2. Emissions from one wheel loader used to handle prunings
  3. $PM_{2.5}$ emissions from grinding of prunings
  4. Engine emissions (PM2.5, NOx, and VOC) from the grinder
  5. Dozer operation at the biomass facility to receive and handle the fuel
  6. Power plant emissions due to fuel burning

- The $PM_{2.5}$ emission factor for grinding (0.05 lb per ton) was based on a review of existing District permits for grinding wood material and vineyard materials. A review of four existing permits indicated a range of 0.0088 lb/ton to 0.08 lb/ton with an average of 0.03.

- Emission factors for biomass power plant operation are based on reported operation for the Delano plant. Values are:

  $PM_{2.5}$ 0.86 lb/ton material burned
  NO_x 1.92 lb/ton material burned
  VOC 0.38 lb/ton material burned

- Highway vehicle emissions calculations assume two 100 mile round-trips for a heavy haul truck to deliver a grinder and a wheel loader to the site and one (1) 100-mile round trip for every 24 tons of ground material for delivery to the biomass power plant.

- Wheel loader emissions associated with the grinding operation are estimated based on a 250 hp Tier 2 diesel engine operating at a rate of three hours per acre.

- Grinder emissions are estimated based on a 100 hp Tier 2 diesel engine operating at a rate of one hour per acre.

- Dozer emissions for receiving and handling material at the biomass power plant are estimated based on a 300 hp Tier 2 diesel engine requiring two hours of operation for 70 tons for material received.

Chipping of Prunings for Land Incorporation

Emissions of $PM_{2.5}$, NO_x and VOC from grinding and conversion have been estimated by the District based on the following:

- Emissions estimates for chipping of prunings for land incorporation include:

  1. Highway vehicle emissions to deliver mobile equipment to the site
  2. Emissions from a wheel loader used to handle the prunings
  3. $PM_{2.5}$ emissions from grinding of prunings
  4. Engine emissions (PM2.5, NOx, and VOC) from the grinder

- The $PM_{2.5}$ emission factor for grinding (0.05 lb per ton) was based on a review of existing District permits for grinding wood material and vineyard materials. A review of four existing permits indicated a range of 0.0088 lb/ton to 0.08 lb/ton with an average of 0.03.

- Highway vehicle emissions calculations assume two 100 mile round-trips for a heavy haul truck to deliver a grinder or chipper and one wheel loader to the site.

- Chipping or grinding emissions are estimated based on a 415 hp Tier 1 diesel engine requiring one hour of operation per acre.

- Wheel loader emissions associated with the grinding operation are estimated based on a 250 hp Tier 2 diesel engine operating at a rate of one hour per acre.

6.3.4 Per Acre Costs and Per Acre Emissions

Table 6-4 presents the results of the District's evaluation of emissions and per acre costs for converting orchard removal material to biomass fuel by grinding versus open burning for orchards other than citrus. Likewise, Table 6-5 presents the results of the District's evaluation emissions and per acre costs for converting orchard removal material to biomass fuel by grinding versus open burning for citrus orchards. The tables present results for plot sizes between 1 and 20 acres, with the expected emissions and cost for burning per acre, expected emissions and cost for grinding per acre, differential emissions and differential cost per acre. The cost structure shown in the tables reflects a $5,000 minimum charge required for orchard removals by grinding to biomass and a minimum charge of $1,150 for orchard removal by open burning. The "per acre" charge indicated in Table 6-2 only becomes effective after the minimum project cost is exceeded. As a result, per-acre cost is generally higher for smaller acreages, trending to a lower fixed value for larger acreages as would be expected. Per acre emissions are also somewhat higher for smaller acreages primarily due to the emissions associated with mobilization of equipment at the site.

Table 6-6 presents a similar analysis for vineyard removals with a pricing structure similar to Tables 6-4 and 6-5. As with orchards, per-acre costs and cost effectiveness value is generally higher for smaller acreages, trending to a lower fixed value for larger acreages.

Table 6-4
Per Acre Emissions and Costs Using District Data
Open Burning versus Grind and Haul for Orchards other than Citrus

Cost Basis: Chipper Contractor Quotations Jan 2010

Orchard Removal Size	Open Burning				Grind & Haul				Difference			
	Emissions Tons per Acre			Cost $/acre	Emissions Tons per Acre			Cost $/acre	Emissions Reduction Tons per Acre			Cost $/acre
	NO_x	$PM_{2.5}$	VOC		NO_x	$PM_{2.5}$	VOC		NO_x	$PM_{2.5}$	VOC	
1	0.0945	0.1240	0.1075	$1,150	0.0575	0.0145	0.0065	$5,244	0.0370	0.1095	0.1010	$4,094
2	0.0925	0.1243	0.1073	$575	0.0503	0.0143	0.0065	$2,744	0.0422	0.1100	0.1008	$2,169
3	0.0918	0.1242	0.1072	$383	0.0480	0.0142	0.0065	$1,911	0.0438	0.1100	0.1007	$1,527
4	0.0915	0.1241	0.1073	$288	0.0468	0.0141	0.0065	$1,494	0.0447	0.1100	0.1008	$1,207
5	0.0913	0.1242	0.1072	$267	0.0465	0.0141	0.0065	$1,244	0.0448	0.1101	0.1007	$977
6	0.0912	0.1242	0.1072	$267	0.0460	0.0141	0.0065	$1,077	0.0452	0.1101	0.1007	$810
7	0.0911	0.1241	0.1072	$267	0.0459	0.0141	0.0065	$958	0.0452	0.1100	0.1007	$691
8	0.0910	0.1242	0.1072	$267	0.0456	0.0141	0.0065	$869	0.0454	0.1101	0.1007	$602
9	0.0909	0.1242	0.1072	$267	0.0456	0.0141	0.0065	$800	0.0453	0.1101	0.1007	$533
10	0.0909	0.1242	0.1072	$267	0.0453	0.0141	0.0065	$744	0.0456	0.1101	0.1007	$477
12	0.0908	0.1242	0.1072	$267	0.0450	0.0140	0.0065	$661	0.0458	0.1102	0.1007	$394
14	0.0908	0.1242	0.1072	$267	0.0450	0.0141	0.0065	$632	0.0458	0.1101	0.1007	$365
15	0.0908	0.1242	0.1072	$267	0.0449	0.0141	0.0065	$632	0.0459	0.1101	0.1007	$365
16	0.0908	0.1242	0.1072	$267	0.0448	0.0141	0.0065	$632	0.0460	0.1101	0.1007	$365
18	0.0907	0.1242	0.1072	$267	0.0448	0.0141	0.0065	$632	0.0459	0.1101	0.1007	$365
20	0.0907	0.1242	0.1072	$267	0.0447	0.0141	0.0065	$632	0.0460	0.1101	0.1007	$365

Basis:

30 BDT/acre for other orchard
4 BDT/acre for roots
Roots are burned in burning case
Roots are transported to composting operation for grinding case
Grind & haul cost includes $244 for root composting

Table 6-5
Per Acre Emissions and Costs Using District Data
Open Burning versus Grind and Haul for Citrus

Cost Basis: Chipper Contractor Quotations Jan 2010

Orchard Removal Size	Open Burning Emissions Tons per Acre NO_x	Open Burning Emissions Tons per Acre $PM_{2.5}$	Open Burning Emissions Tons per Acre VOC	Open Burning Cost $/acre	Grind & Haul Emissions Tons per Acre NO_x	Grind & Haul Emissions Tons per Acre $PM_{2.5}$	Grind & Haul Emissions Tons per Acre VOC	Grind & Haul Cost $/acre	Difference Emissions Reduction Tons per Acre NO_x	Difference Emissions Reduction Tons per Acre $PM_{2.5}$	Difference Emissions Reduction Tons per Acre VOC	Difference Cost $/acre
1	0.0945	0.1240	0.1075	$1,150	0.0575	0.0145	0.0065	$5,244	0.0370	0.1095	0.1010	$4,094
2	0.0925	0.1243	0.1073	$575	0.0503	0.0143	0.0065	$2,744	0.0422	0.1100	0.1008	$2,169
3	0.0918	0.1242	0.1072	$400	0.0480	0.0142	0.0065	$1,911	0.0438	0.1100	0.1007	$1,511
4	0.0915	0.1241	0.1073	$400	0.0468	0.0141	0.0065	$1,494	0.0447	0.1100	0.1008	$1,094
5	0.0913	0.1242	0.1072	$400	0.0465	0.0141	0.0065	$1,244	0.0448	0.1101	0.1007	$844
6	0.0912	0.1242	0.1072	$400	0.0460	0.0141	0.0065	$1,077	0.0452	0.1101	0.1007	$677
7	0.0911	0.1241	0.1072	$400	0.0459	0.0141	0.0065	$958	0.0452	0.1100	0.1007	$558
8	0.0910	0.1242	0.1072	$400	0.0456	0.0141	0.0065	$869	0.0454	0.1101	0.1007	$469
9	0.0909	0.1242	0.1072	$400	0.0456	0.0141	0.0065	$800	0.0453	0.1101	0.1007	$400
10	0.0909	0.1242	0.1072	$400	0.0453	0.0141	0.0065	$769	0.0456	0.1101	0.1007	$369
12	0.0908	0.1242	0.1072	$400	0.0450	0.0140	0.0065	$769	0.0458	0.1102	0.1007	$369
14	0.0908	0.1242	0.1072	$400	0.0450	0.0141	0.0065	$769	0.0458	0.1101	0.1007	$369
15	0.0908	0.1242	0.1072	$400	0.0449	0.0141	0.0065	$769	0.0459	0.1101	0.1007	$369
16	0.0908	0.1242	0.1072	$400	0.0448	0.0141	0.0065	$769	0.0460	0.1101	0.1007	$369
18	0.0907	0.1242	0.1072	$400	0.0448	0.0141	0.0065	$769	0.0459	0.1101	0.1007	$369
20	0.0907	0.1242	0.1072	$400	0.0447	0.0141	0.0065	$769	0.0460	0.1101	0.1007	$369

Basis:

30 BDT/acre for citrus
4 BDT/acre for roots
Roots are burned in burning case
Roots are transported to composting operation for grinding case
Grind & haul cost includes $244 for root composting

Table 6-6
Per Acre Emissions and Costs Using District Data
Open Burning versus Grind and Haul for Vineyards/Kiwis

Cost Basis: Chipper Contractor Quotations Jan 2010

Orchard Removal Size	Open Burning				Grind & Haul				Difference			
	Emissions Tons per Acre			Cost $/acre	Emissions Tons per Acre			Cost* $/acre	Emissions Reduction Tons per Acre			Cost $/acre
	NO_x	$PM_{2.5}$	VOC		NO_x	$PM_{2.5}$	VOC		NO_x	$PM_{2.5}$	VOC	
1	0.0210	0.0220	0.0190	$1,150	0.0305	0.0030	0.0020	$5,725	0.0000	0.0190	0.0170	$4,575
2	0.0193	0.0220	0.0190	$575	0.0233	0.0028	0.0018	$3,225	0.0000	0.0192	0.0172	$2,650
3	0.0185	0.0220	0.0190	$383	0.0210	0.0027	0.0017	$2,392	0.0000	0.0193	0.0173	$2,008
4	0.0183	0.0220	0.0190	$288	0.0199	0.0026	0.0016	$1,975	0.0000	0.0194	0.0174	$1,688
5	0.0180	0.0220	0.0190	$230	0.0195	0.0026	0.0016	$1,725	0.0000	0.0194	0.0174	$1,495
6	0.0179	0.0220	0.0190	$213	0.0190	0.0026	0.0016	$1,558	0.0000	0.0194	0.0174	$1,345
7	0.0176	0.0219	0.0190	$213	0.0186	0.0026	0.0016	$1,439	0.0000	0.0193	0.0174	$1,226
8	0.0178	0.0219	0.0189	$213	0.0183	0.0026	0.0016	$1,350	0.0000	0.0193	0.0173	$1,137
9	0.0177	0.0219	0.0189	$213	0.0181	0.0026	0.0016	$1,281	0.0000	0.0193	0.0173	$1,068
10	0.0177	0.0220	0.0190	$213	0.0182	0.0026	0.0016	$1,225	0.0000	0.0194	0.0174	$1,012
12	0.0176	0.0220	0.0190	$213	0.0178	0.0026	0.0016	$1,142	0.0000	0.0194	0.0174	$929
14	0.0175	0.0220	0.0190	$213	0.0176	0.0026	0.0016	$1,082	0.0000	0.0194	0.0174	$869
15	0.0175	0.0220	0.0190	$213	0.0176	0.0026	0.0016	$1,058	0.0000	0.0194	0.0174	$845
16	0.0175	0.0219	0.0190	$213	0.0176	0.0026	0.0016	$1,038	0.0000	0.0193	0.0174	$825
18	0.0175	0.0219	0.0189	$213	0.0175	0.0026	0.0016	$1,003	0.0000	0.0193	0.0173	$790
20	0.0175	0.0220	0.0190	$213	0.0175	0.0026	0.0016	$975	0.0000	0.0194	0.0174	$762

* Grind and haul cost includes $650 per acre for removal of wire and stakes
$75 per acre for composting roots

Basis
5 BDT/acre for Vineyard
1 BDT/acre for roots
Roots are burned in burning case
Roots are transported to composting operation for grinding case

Prunings

For the alternative of grinding orchard prunings for conversion to biomass fuel, the District evaluated the emissions as follows based on one (1) bone-dry ton per acre of prunings and a 20 acre orchard plot size:

Table 6-7
Emissions Comparison
Open Burning versus Grinding for Biomass Fuel

Tons per acre	Acres	Burn - lbs/acre			Grind/Biomass - lb/acre			Emission Reduction for Chipping - lb/acre		
		$PM_{2.5}$	NO_x	VOC	$PM_{2.5}$	NO_x	VOC	$PM_{2.5}$	NO_x	VOC
1	20	7.9	7.7	6.4	1.1	7.6	0.6	6.8	0.1	5.8

For the alternative of chipping orchard prunings for land incorporation, emissions estimates are as follows based on one (1) bone dry ton of prunings per acre:

Table 6-8
Emissions Comparison
Open Burning versus Shredding for Land Incorporation

Tons per acre	Acres	Burn - lbs/acre			Chip/Land Incorporate lb/acre			Emission Reduction for Chipping - lb/acre		
		$PM_{2.5}$	NO_x	VOC	$PM_{2.5}$	NO_x	VOC	$PM_{2.5}$	NO_x	VOC
1	20	7.9	7.7	6.4	0.2	6.2	0.4	7.7	1.5	6.0

Per the above tables, shredding the pruning materials provides the greatest reduction in emissions relative to open burning. Based on the greater emission reductions and reliability of cost data, the District will base further analysis only on the alternative method of shredding the materials in place. As previously mentioned, shredding operations may vary between $30 and $60 per acre depending on the availability of custom shredder and the amount of pruning material, while burning costs $22 per acre. District staff has used the higher costs of shredding as a conservative estimate and determined the incremental cost of shredding to be $38 per acre.

6.4 ADDITIONAL IMPACTS (COST AND AVAILABILITY) OF NEW ARB REGULATIONS ON TRUCKS AND EQUIPMENT

Agricultural representatives note that the costs for the upcoming off-road equipment (Tier 3), which needs to be replaced by 2012, need to be considered. The factors in the previous rulemaking analysis did not include trucks, Heavy Duty Rules, and AB32 (new colors on tractors, turning off AC units). It has been suggested that District staff analyze what has changed for the line items for ‘20 acres or less’ in the 2007 analysis. Agricultural representatives do not believe there has been any decrease in costs and that the new costs will increase for chippers because of the equipment replacements. The additional components of the “Off-Road” rule and the amount ($26/ton instead of $28/ton) the biomass power plants are now paying for the material could also impact the cost analysis. The District’s costs analysis above are based on the most current and best available information from the chipping operator and agricultural industry. District staff will reevaluate any significant impact to the industry as necessary.

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Chapter 7

Biomass Power Plants

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Chapter 7: BIOMASS POWER PLANTS

7.1 CURRENT BIOMASS POWER PLANTS

Currently there are nine biomass power plants operating in the San Joaquin Valley Air Basin (SJVAB), with three biomass power plants that are located outside of the SJVAB. While there are a total of 12 biomass power plants that could accept agricultural materials in the SJVAB, District's data is available only for those facilities located in the SJVAB. Five of the nine biomass power plants are required to burn agricultural material in order to offset emissions as required by conditions on their operating permits with the District. District staff found that biomass facilities generally accept agricultural materials, forestry materials, and urban wood residues to be used as fuel for their boilers. Information from some biomass fuel buyers and operators indicate that biomass power plants will accept any clean and untreated organic material that is free of dirt and other unburnable contaminants like pressure treated and painted wood material. According to CBEA, several plants are now operating above 90% availability and many are in the mid to high 80 percent range, which is recognized in the industry as excellent performance.

Although biomass power plant operations and facilities are unique, they do follow the same general process to produce electricity from biomass fuel. The following biomass process description is a generalized representation of the process the biomass facilities utilize. This description is an aggregate derived from several biomass power plant operational procedures and equipment. Again, it is important to note that this description is not of one particular facility, but a combination of several facilities to provide a general understanding of the processes biomass power plants use to produce electricity from biomass fuel.

Trucks deliver the biomass fuel to the biomass power plant site. Biomass fuel can be agricultural materials, urban wood waste, or forestry materials. Biomass fuel types are discussed further in Section 7.1.2. The material is unloaded using either self-unloading trucks or a trailer tipper. A trailer tipper operates as follows: the truck trailer is driven onto the tipper, then the entire trailer is elevated to an angle such that the material free falls out the back of the trailer. The unloaded fuel is transported to conveyors for direct feed to the boiler or to a fuel storage area.

The first conveyor discharges the biomass material onto another conveyor, which then feeds through a fuel sizing system. The sizing system screens the fuel before delivery to metering bins. The enclosed conveyors are ventilated to fabric collectors. A large magnet removes magnetic materials and the non-metallic material passes to a hog screen and then to the fixed stacker. The material in the storage piles is mixed and fed to the boiler feed conveyor. The blended biomass fuel is then fed to the boiler.

Hot combustion gases flow upward through the boiler, where heat is transferred through water tubes to produce high-pressure steam. The steam is then directed to a steam turbine generator to create electricity. Low-pressure steam discharged from the turbine is condensed and returned to the boiler as boiler feed water. Flyash from the combustor operation is collected from various points in the flue gas system in an enclosed dry mechanical system in order to minimize fugitive dust emissions. After collection, the Flyash is delivered to an ash storage bin, or a silo, for transfer offsite. According to the permit information for biomass facilities, the ash can be disposed of, or used to make soil additives, agricultural fertilizer, for use in the corrals at dairies or for road construction.

Flue gasses pass through the super heater, boiler, multi-cyclones, and economizer before entering the pulsejet baghouse. Alternatively, the boiler flue gas is injected with ammonia for NOx control, injected with limestone for SOx control, and injected with sodium bicarbonate injection for corrosion control, before it is vented to a fabric filter dust collector. Alternatively, exhaust gases are controlled with Non-Selective Catalytic Reduction (NSCR) and an Electrostatic Precipitator (ESP) before discharging through a stack.

All nine power plants in the SJVAB utilize both agricultural wood materials and non-agricultural materials as biomass fuel for their operations. Five of the nine facilities are required to have agricultural fuel offsets per permit conditions with the District. The table below illustrates the permitted mega watt (MW) output capacity at each facility and if the facility is required to have agricultural fuel offsets per permit conditions.

Table 7-1 Facility Megawatt Capacity and Agricultural Offsets Required

Facility ID	Permitted Output Capacity (MW)	Ag Offsets Required
A	12.5	No
B	30	Yes
C	56.5	Yes
D	11.5	No
E	25.8	Yes
F	12.5	No*
G	28.5	Yes
H	9.4	No
I	20.5	Yes

* Language in the permit states that if quarterly actual NOx emissions from this boiler exceed 5,000 lbs, then agricultural offsets are required. If the quarterly NOx emissions from this boiler do not exceed 5,000 lbs, then agricultural offsets are not required.

7.1.1 Locations

District staff expects that prohibition of open burning of additional agricultural material would generate a substantial amount of agricultural material to be dealt with alternatively. A key question to ask is whether biomass power plants have the capacity to handle agricultural material that would otherwise be open burned. Other aspects of that question are: 1) are the power plants located near the crops and 2) are they distributed enough throughout the SJVAB so that they could effectively accept additional agricultural material as biomass fuel. The currently operating biomass plants are located in six of the eight counties within the SJVAB. Table 7-2 below lists each biomass facility and its location.

Table 7-2 Facility Name and Location in the San Joaquin Valley Air Basin

Facility Name	City	County	Region
Rio Bravo Fresno	Fresno	Fresno	Central SJVAB
Covanta Mendota LP	Mendota	Fresno	Central SJVAB
Madera Power, LLC	Firebaugh	Madera	Central SJVAB
Ampersand Chowchilla Biomass LLC	Chowchilla	Madera	Central SJVAB
Covanta Delano	Delano	Kern	South SJVAB
Sierra Power Corporation	Terra Bella	Tulare	South SJVAB
Dinuba Energy	Reedley	Tulare	South SJVAB
Merced Power LLC	EL Nido	Merced	North SJVAB
Thermal Energy Dev Partnership LP	Tracy	San Joaquin	North SJVAB

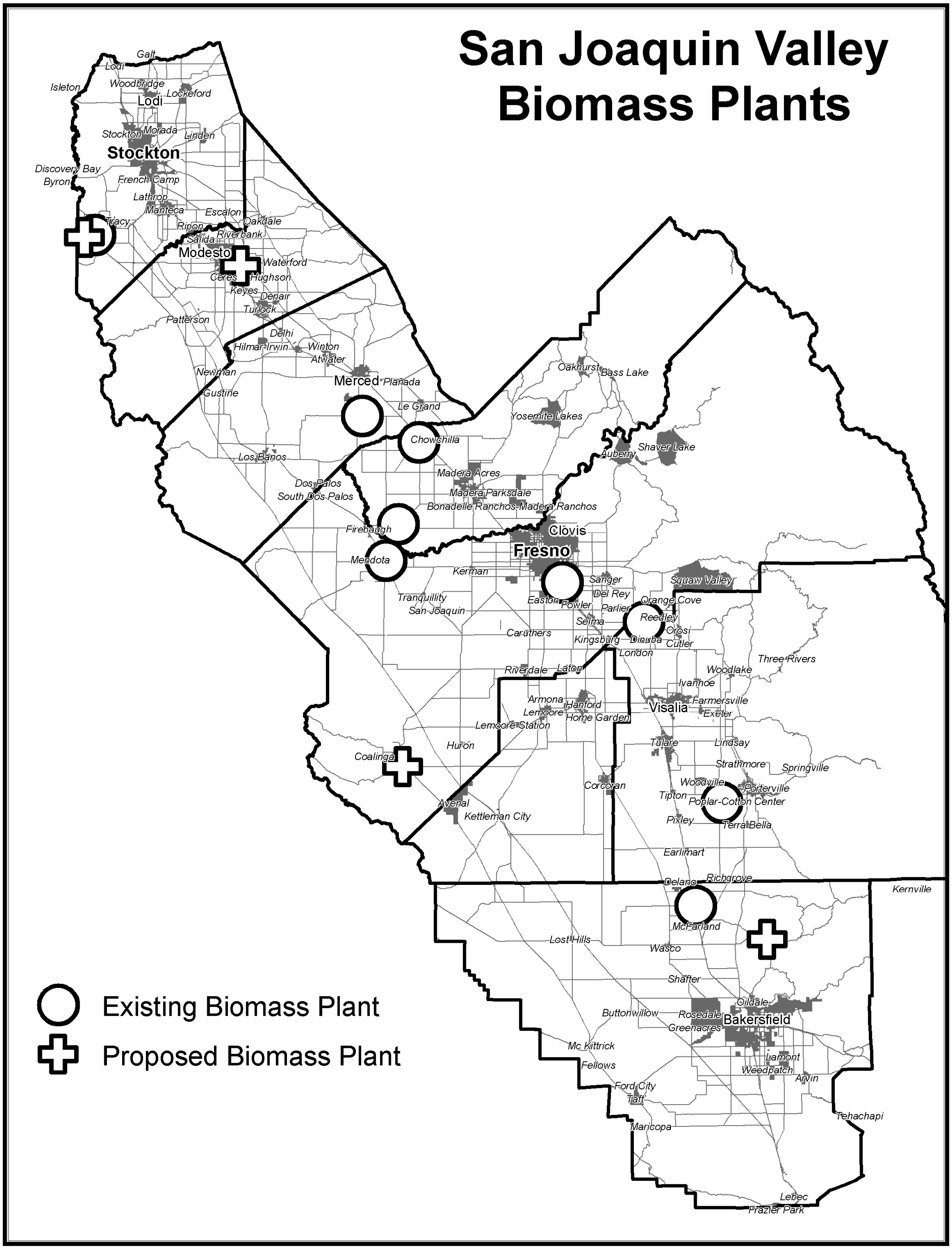
The California Biomass Energy Alliance (CBEA) is a trade association representing 33 biomass energy facilities located in 19 counties throughout California generating more than 650 MW of renewable electric power. CBEA has brought to the attention of District staff that there are three, biomass power plants located outside of the District boundaries that also accept agricultural materials from the SJVAB as fuel. The three plants identified by the CBEA are the Chinese Station power plant and Sierra Pacific Sonora power plant in Tuolumne County, and the Sierra Pacific Lincoln power plant in Placer County. However, staff does not have the five-year history through quarterly reports for these plants as to operating hours, or how much bone dry tons (BDT) per year they accept and burn or how much of the BDT used is agricultural material from the SJVAB. Therefore, these plants were not included in the analysis later in this chapter, or in other chapters of this report.

To better illustrate the locations of the biomass power plants, staff have included a map, as Figure 7-1, on the next page. As illustrated in the map, the nine existing biomass power plants are located at various locations throughout the

SJVAB. The locations of the three biomass power plants that are not in the SJVAB that accept agricultural materials as biomass fuel. All three plants are located north of the SJVAB.

Also illustrated in Figure 7-1 are the locations of four of the potential future biomass power plants. These future power plants are currently undergoing the permitting process with the District and further discussed in Section 7.2.6. Not illustrated on the map on the following page are the two biomass power plants in Stockton that may potentially accept agricultural material as biomass fuel in the future. These six plants are discussed further in Section 7.2.6.

Figure 7-1 Map of the San Joaquin Valley Air Basin with Locations of Existing and Potential Biomass Plants


San Joaquin Valley
Biomass Plants
Existing Biomass Plant
Proposed Biomass Plant
Galt
Lodi
Isleton
Woodbridge
Lockeford
Stockton
Morada
Linden
Discovery Bay
Byron
French Camp
Lathrop
Manteca
Escalon
Tracy
Ripon
Oakdale
Salida
Riverbank
Modesto
Waterford
Ceres
Hughson
Keyes
Denair
Turlock
Patterson
Delhi
Hilmar-Irwin
Winton
Atwater
Newman
Gustine
Merced
Planada
Le Grand
Oakhurst
Bass Lake
Yosemite Lakes
Chowchilla
Auberry
Shaver Lake
Los Banos
Madera Acres
Dos Palos
South Dos Palos
Madera
Parksdale
Bonadelle Ranchos-Madera Ranchos
Firebaugh
Clovis
Fresno
Mendota
Kerman
Sanger
Squaw Valley
Tranquillity
San Joaquin
Easton
Fowler
Del Rey
Parlier
Orange Cove
Reedley
Selma
Orosi
Caruthers
Kingsburg
Dinuba
Cutler
London
Three Rivers
Riverdale
Laton
Woodlake
Ivanhoe
Armona
Hanford
Lemoore
Farmersville
Visalia
Exeter
Home Garden
Lemoore Station
Huron
Tulare
Lindsay
Coalinga
Strathmore
Springville
Corcoran
Woodville
Porterville
Tipton
Poplar-Cotton Center
Avenal
Kettleman City
Pixley
Terra Bella
Earlimart
Delano
Richgrove
Kernville
McFarland
Lost Hills
Wasco
Shafter
Oildale
Buttonwillow
Rosedale
Bakersfield
Greenacres
Mc Kittrick
Lamont
Fellows
Weedpatch
Arvin
Ford City
Taft
Tehachapi
Maricopa
Lebec
Frazier Park

7.1.2 Fuel Use and Storage Capacities

The percentage of agricultural material fuel versus non-agricultural material fuel that a biomass power plant accepts is constantly changing. Upon reviewing District database information and snapshot data of biomass power plant activities provided by the Compliance Department, it appears the percentage of agricultural material accepted generally varies greatly; from as little as 0% of accepted fuel to as high as 70%.

Biomass power plants accept urban waste materials and some forestry materials in addition to agricultural materials as fuel. Non-agricultural fuels include such materials as mill chips, cedar bark, forest slash/cull, hog fuel (mill residue), sawdust, construction wood waste, landfill derived wood, landscape tree trimmings, pallet/bin wood, and urban development clearing trees. Urban wood waste must contain less than 1% by weight of plastic, rubber, metals, roofing felt paper, and other non-wood contaminants other than dirt or ash. No asbestos-containing materials are approved as fuel.

SJVAB biomass power plants have very broad acceptance policies for agricultural wood fuel. This includes citrus and grape wood along with the other commonly accepted wood types. The limitation the biomass power plants have are that all treated wood posts, wire and drip line must be removed from the grape wood prior to grinding. CBEA states that the biomass power plants do have the ability to accept vines and that the removal of the wiring from the vineyard wood is a relatively minor issue in terms of the plants' ability to accept those materials.

Biomass power plant operators have indicated that previous concerns regarding certain materials have been alleviated over the past few years as the operators have improved the methods in processing the materials to better suit the needs of the plant. For example, in the past citrus materials caused concern for plant operators because the stringy citrus materials have the tendency to bind on the fuel handling conveyors and plug the fuel metering bins and this upsets the combustion process resulting in higher emissions and equipment deterioration due to temperature cycling. The operator also indicated that citrus wood ground to about 3-inch size screen poses minimal plugging problem. Now, due to considerable changes in the processing of the citrus materials, it has been reported that the operators no longer believe this is the case. Biomass power plant operators have indicated that they now mix citrus chips with chips from other crops to promote better flow of the materials through the equipment. Conversations with biomass plant operators and comments from the California Citrus Mutual indicate that the biomass power plants that do accept citrus materials can blend up to 25% citrus chips with other biomass fuel for combustion. It is important to note however, that it is relatively more affordable for the biomass power plants to accept urban waste than agricultural materials because the residents of the community typically subsidize urban waste.

The combined storage capacity for the biomass facilities in the SJVAB at the time this report is about 266 acres. It is important to note that the available storage capacity at any given facility at any given time can vary. The primary factors affecting the amount of available storage are the amount of fuel previously received, and the tons of fuel stored per acre combined with the tons of fuel burned each day. Another source for uncertainty regarding the storage capacity of a facility is that the tons of material stored per acre could vary from one acre to the next. Conversations with biomass power plant operators indicated the amount of tons of material stored per acre varies by factors including: (1) if the material is received green or bone dry, (2) if the material is urban or agriculture, and (3) how high and wide the material is piled when it is received. Due to the variability of tons/acre storage capacity, it would be difficult to calculate that amount of material that the biomass plants can actually store the remaining crop type.

District staff received additional information from CBEA regarding the storage capacity at the 12 biomass power plants. According to CBEA, the wood fuel storage capacity, using current storage practices, from the 12 biomass plants is summarized below. The current storage capacity of Covanta Delano alone is 125,000 green tons. The total maximum storage capacity at all 12 facilities that use SJ Valley Ag Waste is 782,500 tons. Further, the majority of these facilities can store 60-175 operating days of fuel. This large storage capacity allows the use of wood fuel such as citrus and other types of fuel that may be stockpiled at significantly higher amounts and percentages than the actual fuel mix to the boiler (i.e. Covanta Delano may receive 50% citrus in the total agriculture deliveries for several months and then blend the fuel later to achieve an ideal mix to the boilers of 30% citrus). CBEA also indicated that many of the larger orchard removal contractors have storage capabilities. For example, one northern District contractor regularly stores as much as 20,000 tons of agriculture waste at its truck re-load facility.

Table 7-3 Fuel Storage Capacity for 12 Existing Biomass Plants That Use Ag Waste From SJVAD

		Daily Fuel	Maximum Fuel Storage Capacity		
Facility Name	Region Served	Use (GT)	Acres	Tons	Days
Rio Bravo Fresno	Central	850	8	35,000	41
Covanta Mendota	Central	800	35	54,000	68
Madera Power	Central	830	80	145,000	175
Ampersand Chowchilla	Central	360	2	6,000	17
Subtotal/Average		2,840	125	240,000	85
Covanta Delano	South	1,625	77	125,000	77
Dinuba Energy	South	415	20	45,000	108
Sierra Power	South	295	4	20,000	68
Subtotal/Average		2,335	101	190,000	81
Merced Power	North	360	10	19,000	53
Thermal Energy	North	631	28	24,000	38
SPI Sonora	North	250	5	7,500	30
Chinese Station	North	710	15	45,000	63
SPI Lincoln	North	600	20	36,000	60
Subtotal/Average		2,551	78	112,500	44
	TOTAL ALL	7,726	304	542,500	70

7.1.3 Historical Fuel Usage

All nine power plants in the SJVAB utilize both agricultural wood materials and non-agricultural materials in their operations. The power plants generate electricity by burning the biomass fuel in combustors or boilers to produce steam. The steam is used to spin turbines, which in turn generate electricity.

District staff analyzed the historical fuel usage of the annual bone dry tons (BDT) burned at the nine biomass facilities in the SJVAB. In order to do so, staff reviewed quarterly reports submitted to the District for the past five years (2005-2009) from the biomass plants. It is important to note that at the time of this analysis, two of the facilities had not been in operation for five full years.

For the analysis, staff made the following assumptions:

1. For facilities with data from one or two quarters of a year unavailable at the time of this report, staff assumed the unavailable data to be equivalent to the average of the other quarters for the same facility for the same year.

2. Facilities reporting agricultural fuel received instead of burned, staff assumed the facility burned the total quantity of agricultural fuel received.

3. For facilities that only reported agricultural offset records, staff assumed the agricultural offsets burned is the total agricultural fuel burned.

4. For the two facilities in operation for less than five full years, staff assumed the average information for total time of operations to be equivalent to a five-year average.

Facility A: Staff assumed the fuel usage by using data provided by the facility as a snapshot of activity (273 BDT/day) provided by the District Compliance Department. Staff applied this snapshot number to the total operating days for each quarter to estimate the total annual BDT burned. Staff assumed agricultural fuel by using data provided by the facility as a snapshot of activity (219 BDT/day). Staff applied this snapshot number to the total operating days for each quarter to estimate the total agricultural fuel used.

5. Facility B: Staff estimated the total annual BDT burned by assuming the facility operated at the high-end BDT capacity of 213,609 BDT/yr. However, historical data indicates this facility operates an average 82% of the time. Therefore, staff adjusted the estimated BDT to 82% totaling in an annual BDT of 175,159 BDT/year (213,609 BDT/year x 0.82). Agricultural fuel records were available.

6. Facility C: This facility advertises on it's website that it has a capacity of 1293 tpd of BDT biomass fuel. For purposes of this analysis, staff assumed the plant is operational 365 days per year, giving it an annual fuel capacity of 471,945 BDT (1,273 BDT/day x 365 days). Staff assumed 70% of the total BDT/year was agricultural fuel based on a snapshot of fuel use provided by the District compliance department.

7. Facility D: Staff assumed that of the total BDT (84,589 BDT/year) burned, 25% is agricultural fuel based on a snapshot of usage for this facility provided by the District Compliance department. The total BDT of agricultural material fuel burned is 21,147 BDT/year (84,589 BDT/year x 0.25).

8. Facility F: Staff assumed total annual BDT burned to be equivalent to the low-end BDT capacity, as presented later in this report. Agricultural fuel records were available.

9. Facility I: District staff estimated the total annual BDT fuel burned by assuming the snapshot data of BDT fuel burned and Fuel percentages provided by the Compliance department is indicative of activities for an entire year. Staff multiplied the snapshot data (468 BDT/day) by the 5-year average operating days/year (347). Staff estimated the total annual agricultural material fuel burned by assuming the snapshot data of BDT fuel burned (234 BDT/day) and Fuel percentages provided by the Compliance department is indicative of the entire year. Staff multiplied the Snapshot data (234 BDT/day) by the 5-year average operating days/year (347). The total annual

BDT agricultural material fuel burned is 81,198 BDT/year (234 BDT/day x 347 days).

Table 7-3 Average Annual Historical BDT Fuel Use (2005-2009)

Biomass Facility	Annual BDT Agricultural Material Burned (tpy)	Annual BDT Urban Waste Burned (tpy)	Total Annual BDT Burned (tpy)
A	49,584	12,227	61,811
B	125,838	49,321	175,159
C	330,362	141,583	471,945
D	21,147	63,442	84,589
E	41,028	88,655	129,683
F	8,660	83,367	92,027
G	117,202	106,590	223,793
H	21,992	50,674	72,666
I	81,198	81,189	162,378

District staff reviewed the five-year historical fuel usage of the biomass power plants to determine if the ratio of agricultural material to urban waste has varied due to the housing market boom and subsequent economic downturn. Presented in Table 7-4 is the average annual percentage of agricultural material burned at the biomass plants from the plants that reported the total BDT and agricultural material BDT in their quarterly reports. In 2008, the use of agricultural material at the biomass power plants was twenty-five percent of the total fuel used, in 2009 the use of agricultural materials increased to forty-three percent. Staff attributes this fluctuation in percentage of agricultural fuel used to the construction industry boom and the following economic downturn. However, CBEA has submitted comments stating that there was a shortage of agricultural fuel in 2006.

Table 7-4 Average Annual Percentage of Agricultural Material Burned

Year	2005	2006	2007	2008	2009
Ave % Ag Material	58%	24%	41%	25%	43%

Historically, there have been occasions when biomass plants had to turn away agricultural materials. During the fall of 2007, several biomass power plants in the District had to temporarily shut down plant operations due to equipment failures or maintenance purposes. In addition, some biomass power plants had to refuse chipping material because storage space was not available. Issues such as lack of storage space and equipment failure can create situations when the biomass power plant operators must turn away agricultural materials. This inability to guarantee that a facility can accept agricultural biomass at all times creates uncertainty in the ability of the biomass plants to accept increased amounts of agricultural fuel that would be generated by a complete prohibition of open burning.

It is important to note that the reason the plants were off-line for several months during the period of 2007 was due to plant improvements and refurbishments. One of the South Valley plants did an $18 million refurbishment of the plant in the third quarter of 2007, which lasted for several months. A Central SJVAB power plant invested over $14 million in refurbishing their facility and came back on-line in December 2008. In October 2008 another Central SJVAB plant invested over $10 million to refurbish the combustor, which improved its operational availability by 20%. One North SJVAB plant has invested $4 million on refurbishments over the past 2.5 years, and plans to invest another $2 million in 2009-2010.

Although there have been periods of inoperation at the facilities, the nine facilities averaged 6,029 operating hours per year, out of a possible 8,760 hours per year. Converting operating hours into days translates to mean that the biomass power plants were in operation for an average of 251 of 365 days per year, or 69% of the time. Staff evaluated the operating hours as reported to the District by the biomass power plants in the quarterly reports. Again, for the two facilities that have not been in operation for the full five years, staff assumed the average of total operating time to be equivalent to a five-year average.

7.1.4 Emissions and Emission Controls

7.1.4.1 Emissions

Criteria Pollutant Emissions
The 2009 emission data reports are not due the District from the biomass power plants until June of 2010; therefore, an emission inventory for 2009 is unavailable at the time of this report. Of the nine facilities, two facilities were not in operation for the full year of 2008; therefore, staff did not include emissions data from these facilities in this emission inventory. Additionally, data is unavailable at the time of this report for one of the facilities for the year 2008. However, the 2009 emissions data is available for this facility. Staff substituted the 2009 emission inventory from this facility for the 2008 emission inventory.

Table 7-5 2008 Emissions Inventory for SJVAB Biomass Facilities

Pollutant	VOC	NOX	PM10	SOX
Emissions (tons per year)	48.34	567.16	191.26	101.18

For purposes of the emission inventory for biomass facilities for the SJVAB for 2008, District staff made the following assumptions:

1. The 2009 emission inventory for the one facility with an unavailable inventory for 2008 is equivalent to the 2008 inventory.

2. The best available inventory for one facility only includes NOX emissions. To determine VOC, PM, and SOX emissions, staff assumed the ratio of VOC, PM, and SOX to NOX emissions is equivalent for this facility to the ratio reported by another facility with similar NOX emissions.

Green House Gas Emissions

As discussed in the CEQA analysis and report, Global Climate Change (GCC) is now generally accepted by the scientific community to be caused by Greenhouse Gases (GHGs). GHGs are gases that trap heat in the atmosphere. Some greenhouse gases such as water vapor occur naturally and are emitted to the atmosphere through natural processes while others are emitted through human activities. The most common GHG that results from human activity is carbon dioxide, followed by methane and nitrous oxide.

The analysis in this report identifies biomass facilities as one of the feasible alternatives to open burning. The identified alternatives have the potential to result in changes in GHG emissions because of possible increased fuel consumption associated with equipment used to grind/chip and transport agricultural biomass. District staff examined the recommendations to determine their potential to have a cumulatively significant impact on global climate change, results of which are presented below. The analysis demonstrates that implementation of the recommended alternatives to open burning will not have a cumulative significant impact on global climate change.

Potential Greenhouse Gas Impacts

Staff is exploring alternatives to the existing practice for disposing of orchard removal material by burning it in place (open burning). The alternative to open burning of orchard removal materials is chipping the organic matter and using the chipped material as fuel in a biomass plant to produce electricity. Sources of GHG emissions from this alternative include fuel consumed in chipping the plant material; fuel consumed in transporting the chipped material to a biomass plant; fuel consumed in processing the chipped material at the biomass plant; and combustion of the chipped material to produce electricity at the biomass facility.

The alternative practice of burning chipped material in a biomass power plant would not result in an increase in GHG emissions compared to open burning the material. In fact, burning the material in a biomass plant would produce a net GHG benefit by producing electric power from a renewable source of energy rather than a fossil fuel. This concept is one of the strategies adopted by the

State of California to reduce GHG emissions to 1990 levels by the year 2020 by requiring the state's load serving entities to meet a 33 percent renewable energy target by 2020 (Executive Order S-21-09). Biomass fuels burned in existing facilities are currently transported from various locations outside and within the San Joaquin Valley Air Basin. Use of locally produced fuel could reduce VMT associated with transporting materials, and thus result in a net GHG benefit. GHG emissions associated with chipping orchard removal material are expected to be offset by the benefits associated with displacing fossil fuels and reducing VMT.

The District concludes, GHG emissions resulting from alternatives to open burning of orchard removal materials and prunings are expected to have a net positive benefit on global climatic change compared to the status quo of open burning. Therefore, the District concludes that implementation of the recommendations would have a less than cumulatively significant impact on global climatic change. For further discussion regarding GHGs please see the published CEQA analysis report.

7.1.4.2 Emission Controls

Although biomass power plant operations and facilities are unique, they do follow the same general process to reduce emissions from the processing of biomass fuel. The following is a description of methodologies and technologies the biomass facilities use, or could use, to reduce emissions. District staff researched information on solid fuel-fired boilers by examining the District's Permit database, California Air Resources Board (ARB) Best Available Control Technology (BACT) Clearinghouse, other air districts' BACT Clearinghouses. District staff also researched the United States Environmental Protection Agency (EPA) BACT Clearinghouse, European Commission Integrated Pollution Prevention and Control (IPPC) Best Available Techniques, other local air districts and other states' regulations, and technical documents published in the internet. District staff also reviewed the Permit-to Operate (PTO) for each biomass facility.

NOx Emission Control Technologies

Common fuel types for solid fuel-fired boilers are agricultural material (biomass), coke, coal, wood wastes, paper, walnut shells, pistachio shells, tire-derived fuel, municipal solid waste, and other solid waste. For the purpose of this analysis, NOx emission limits are based on the fuel type, and are divided into three categories based on their composition. The categories include municipal solid waste, biomass, and others. Each solid fuel is either homogeneous or heterogeneous. Under a homogeneous condition, the fuel meets specific criteria and is sorted by content. Examples of homogeneous fuels are walnut shells, coke, and woodchips. Heterogeneous fuel is unsorted, and untreated. An example is municipal solid waste, which contains a wide variety of combustible materials having widely varying heat content values. The fuel type is important when considering the emission reduction effectiveness of an emission control technology. Unlike gaseous fuel-fired units, solid fuel-fired units present more difficult technological challenges in controlling NOx, PM, and SOx emissions to a much lower because of varying fuel composition.

NOx emission control techniques generally fall into two categories: (a) combustion modifications; and (b) post combustion modifications (add-on controls). Typically, these control systems are successful in simultaneously attaining low NOx and CO emission levels. Most of the NOx formed during combustion of natural gas is from high temperature reaction of nitrogen (N_2) with oxygen (O_2). NOx formed this way is referred to as “thermal NOx” and is considered a function of flame temperature and oxygen concentration. Studies of combustion processes indicate that significant amounts thermal NOx are formed when the flame temperature is above 2,300°F.

Combustion Modification

Combustion modification systems are designed to reduce thermal NOx formation by changing the flame characteristics to reduce peak flame temperature. Combustion controls include low excess air operation, staged combustion, over fire air ports, biased firing, and burners out of service.

Combustion modification is also achieved by different burner designs such as Low NOx and Ultra Low NOx burners. Some of the design principles used in Ultra low NOx and Low NOx burner include staged air burners, staged fuel burners, pre-mix burners, internal recirculation, and radiant burners.

Combustion control systems may be used by itself or in combination with Flue Gas Recirculation (FGR). FGR recycles a portion of the exhaust stream back into the burner wind box, mixing low oxygen air with combustion air prior to entering the combustion chamber. This technique reduces thermal NOx formation by reducing the peak temperature and by reducing oxygen in the combustion zone.

Low Excess Air

Low excess air is a comparatively simple and easy to implement operational measure for reducing NOx emissions. By reducing the amount of oxygen available in the combustion zone to the minimum amount needed for complete combustion, fuel-bound nitrogen conversion and to the less extent thermal NOx formation are reduced. There is no additional energy required for low excess air firing, and if properly operated, no reduction in availability of the power plant should result from this type of emission control technique. As the oxygen level is reduced, however, combustion may become incomplete and the amount of unburned carbon in the ash may increase. Reducing the amount of oxygen in the combustion zone in the primary zones to very low amounts can also lead to high levels of carbon monoxide. The results of such changes can be a reduction in the boiler efficiency, slagging, corrosion, and counteractive overall impact on the boiler performance.

Air Staging
NOx reduction by air staging is based on the creation of two divided combustion zones: a primary combustion zone with a lack of oxygen, and a secondary combustion zone with excess oxygen in order to ensure complete burn-out. Air staging reduces the amount of available oxygen (in 70 – 90% of the primary air) in the primary combustion zone. The sub-stoichiometric condition in the primary combustion zone suppresses the conversion of fuel-bound nitrogen to NOx. In addition, the formation of thermal NOx is reduced to some extent by resulting lower peak flame temperature. In the secondary zone, 10-30% of the combustion air is injected above the combustion zone. Combustion is completed at this increased flame volume. Therefore, the relatively low-temperature secondary stage limits the production of thermal NOx.

In boilers, the following options exist for achieving air-staging:

- Biased Burner Firing

  Biased burner firing is frequently used as a retrofit measure at existing installations (only for vertical boilers) as it does not require major alteration of the combustion installation. The lower burners operate fuel-rich whereas upper burners are supplied with excess air.

- Burners Out of Service (BOOS)

  Since putting some burners out of service does not require a major alteration of the combustion installation, it is frequently used as a retrofit measure at existing vertical boilers. The lower burners are operated under fuel-rich conditions, whereas the upper burners are not in use, injecting only air. The effect is similar to over fire air, but NOx reduction by BOOS is not as efficient. Problems may arise with maintaining the fuel input, because the same amount of thermal energy has to be supplied to the unit with fewer operating burners. Therefore, this control technique is generally restricted to gas- or oil-fired combustion processes.

- Over Fire Air (OFA)

  For over fire air operation, air ports (wind boxes) are installed in addition to existing burners. A part of the combustion air is injected through these separate ports, which are located above the top row of burners. Burners can then be operated with low excess air, which inhibits NOx formation, the over fire air ensuring complete burn-out. Typically 15-30% of the total combustion air that would normally pass through the burners is diverted to the over fire ports. Retrofitting over fire air to an existing boiler involves applying water-wall tube modifications to create the ports for the secondary air nozzles and the addition of ducts and wind box.

Flue Gas Recirculation
The recirculation of flue gas results in a reduction of available oxygen in the combustion zone, and since it directly cools the flame, in a decrease of the flame temperature; therefore, both fuel-bound nitrogen conversion and thermal NOx formation are reduced. The recirculation of the flue gas into the combustion air has proven to be a successful method for NOx abatement in high temperature combustion systems such as wet bottom boilers and oil-or-gas-fired units.

Reduced Air Preheat
The combustion air preheat temperature has a significant impact on NOx formation mainly for gas and oil firing systems. For these fuels, the main part of NOx is determined by thermal NO mechanism, which depends on the combustion temperature. Reducing air preheat temperature results in lower flame temperatures (peak temperatures) in the combustion zone. There are two major drawbacks of this technology. First, in several boilers, e.g., in coal burning, high combustion temperatures are required and accordingly high air preheater temperatures are essential for the proper functioning of the combustion installation. Secondly, lowering the air preheat temperature results in a higher fuel consumption, since the higher portion of the thermal energy contained in the flue gas cannot be utilized and ends up leaving the plant via the stack. This can, however, be counterbalanced by utilizing certain energy conservation methods, such as increasing the size of the economizer.

Fuel Staging
Fuel staging (also called reburning) is based on the creation of different zones in the boiler by staged injection of fuel and air. The aim is to reduce back to nitrogen the nitrogen oxides that have already been formed. Reburning involves combustion in three zones. In the primary combustion zone, 80-85% of the fuel is burned in an oxidizing or slight reducing atmosphere. This primary burn-out zone is necessary in order to avoid the transfer of excess oxygen in the reburning zone, which would otherwise support possible NOx formation. In the second combustion zone (often called reburning zone), secondary or reburning fuel is injected in a reducing atmosphere. Hydrocarbon radicals are produced, reacting with the nitrogen oxides already formed in the primary zone; other unwanted volatile nitrogen compounds like ammonia are generated as well. In the third zone, the combustion completes through the addition of final air into the burn-out zone. Different fuels can serve as reburning fuel (pulverized coal, fuel oil, natural gas, etc.), but natural gas is generally used due to its inherent properties.

Low NOx Burner (LNB)
Low NOx burners modify the means of introducing air and fuel to delay the mixing, reduce the availability of oxygen, and reduce the peak flame temperature. LNBs retard the conversion of fuel-bound nitrogen to NOx and the formation of thermal NOx, while maintaining high combustion efficiency. The pressure drop in the ducts increases, causing more operational expenses. There could also be some corrosion problems especially if the process is not properly controlled. The low NOx burning techniques requires, at least, the burners to be changed and installation of OFA. If existing burners are classical burners, then changing the burners can usually be done very cost-effectively. However, if the burners are delayed combustion low NOx burners (old type), the benefits of retrofitting such burners into rapid injection low NOx burners can only be effectively assessed on a case-by-case basis.

Dilution-based Combustion Control
Dilution-based combustion control strategies reduce thermal NOx formation by introducing inert material into the flame. The injected inert absorbs heat without reacting, thereby reducing peak flame temperature and reducing the potential for NOx formation. Water or steam injection reduces flame temperatures by using a portion of the flame's heat to convert water from liquid to vapor. The disadvantage of this control technique is that the heat efficiency of the device is reduced by one to four percent. In flue gas recirculation (FGR), about 10% to 25% of the flue gas is siphoned off from the combustion exhaust stream to be used as combustion air for the burner. Since the flue gas has less oxygen than atmospheric air, the additional nitrogen in the flue gas acts as an inert component in the combustion process, reducing peak flame temperature. Flue gas recirculation may not be a feasible retrofit technology for many devices due to size or layout constraints.

Post Combustion Controls (Flue Gas Treatment)
Selective Non-Catalytic Reduction (SNCR)
SNCR involves direct injection of ammonia or urea at the flue gas temperatures of about 1600^0F to 1900^0F. Ammonia or urea reacts with NOx in the flue gas to produce N_2 and water. The reactions in the SNCR are due to the thermal decomposition of ammonia or urea and the subsequent NOx reduction. A simplified NOx reduction reaction in SNCR is shown below.

Ammonia: $4NH_3 + 4NO + O_2 \rightarrow 4N_2 + 6H_2O$

Urea: $CO(NH_2)_2 + 2NO + 1/2O_2 \rightarrow 2N_2 + CO_2 + 2H_2O$

The temperature of the flue gas at the point of ammonia or urea injection and the amount of unreacted NH_3 (ammonia slip) that will pass through the SNCR can significantly affect the efficiency of NOx reduction. At temperatures below the desired operating range, the reduction reactions diminish and ammonia slip increases. Above the desired temperature range, NH_3 is oxidized to NOx, which results in decreased NOx reduction efficiencies.

An important factor to the performance of SNCR is the mixing of the reactant and the flue gas within the reaction zone. Design considerations include delivering the reagent in the proper temperature window, and allowing sufficient residence time of the reagent and flue gas in the proper temperature window. Additionally, other factors such as reagent to NOx ratio and fuel sulfur content also influence the performance and reduction efficiency of SNCR.

Selective Catalytic Reduction (SCR)
SCR involves injecting ammonia into the flue gas in the presence of a catalyst to reduce NOx to elemental nitrogen (N_2) and water. The overall SCR reactions are shown below.

$$4NH_3 + 4NO + O_2 \rightarrow 4N_2 + 6\ H_2O$$

$$8NH_3 + 4NO_2 + O_2 \rightarrow 6N_2 + 12H_2O$$

Flue gas temperature, SCR inlet NOx concentration, catalyst surface area, volume, and age of the catalyst, and acceptable amount of ammonia slip influence the performance of the SCR. The catalyst lowers the activation energy of the NOx decomposition reaction and allows NOx reduction to proceed at a lower temperature that is required by SNCR. Depending on the type of catalyst used, the optimal temperature range is typically between 650^0F to 800^0F. Below this temperature range ammonium sulfate can form which causes catalyst deactivation. Above the optimum temperature, the catalyst will sinter and rapidly deactivate. SCR is considered technological feasible for control of NOx from solid fuel-fired units.

Regenerative Selective Catalytic Reduction (RSCR)
The following information is an extract from a technical document published by Babcock Power Environmental: “RSCR is a regenerative selective catalytic device achieving NOx reductions of >80%, applied to the cold gas (after the boiler and particulate removal equipment) prior to discharge to the stack achieving NOx reductions of >80%. RSCR is a combination of two established and proven technologies: Regenerative Thermal Oxidizer (RTO) and SCR. By utilizing the direct contact regenerative heater technology (usually associated with an RTO, in which cycling beds of ceramic media used to transfer heat, the low temperature issue is resolved. NOx reduction takes place in SCR catalyst modules positioned above the heat transfer bed, where the flue gas has been heated to around 600^oF and the proper amount of ammonia has been added upstream of the canisters. Either anhydrous or aqueous ammonia can be used.

The primary application of RSCR is the reduction of NOx emissions in the flue gas found at the tail end of the biomass boiler where the gas temperatures are cool, typically 300°F to 400°F. In an RSCR, the temperature of the flue gas is temporarily elevated for optimal catalyst performance and the heat is recovered before sending the cleaned flue gas to the stack. The main advantage of RSCR is its high thermal temperature versus standard tail-end solutions in which the heat exchanger and duct is used. The RSCR thermal efficiency can be guaranteed as high as 95% in contrast to the standard tail end solutions that typically achieve 70 to 75% efficiency.

Hybrid Selective Reduction (HSR)
HSR is a combination of SNCR and SCR that is designed to provide the performance of full SCR with significantly lower costs. In HSR, an SNCR is used to achieve some NOx reduction and to produce a controlled amount of ammonia slip that is used in a downstream in-duct SCR reactor for additional reduction. HSR has been demonstrated to reduce NOx emissions by 50% to 98% on a 320 MMBtu/hr coal fired boiler; therefore, it is considered technologically feasible for control of NOx from solid-fuel fired boilers. Currently, the District has received an application for an operating permit for biomass fuel fired boilers where the applicant is proposing to install and operate both SNCR and SCR on four boilers to achieve 0.012 lb NOx/MMBtu (about 9.8 ppmv at 3% oxygen) . It is important to mention that the District has recently received a permit application from a company that intends to operate four biomass fired boilers that will utilize SCR and SNCR to achieve a NOx emission level of 0.012 lb/MMBtu.

Particulate Matter Control Technologies
Particulate matter (PM) in solid fuel-fired unit is formed due to the inert solids contained in the fuel, the unburned hydrocarbon fuels, as well as byproducts of limestone injection, which accumulate to form particles. District staff reviewed the EPA BACT Clearinghouse to determine technologies to control PM emissions from solid fuel-fired units. PM control technologies that were listed in the database include electrostatic precipitators, fabric filter/baghouses, wet scrubbers, and mechanical separators. The PM and SOx control technologies and emission limits of the permitted units operating in the SJVAB are shown in the Table on the next page. It is important to note that one of the biomass power plants has two boilers and both are included in this list. As such, there are ten boilers listed here for the nine facilities.

Table 7-6 Permit PM10 and SOx Limits of Solid Fuel-Fired Biomass Units in the District

Unit Size MMBtu/hr	Existing PM and SOx Control Technology	Permit PM10 Limit	Permit SOx Limit lb/MMBtu	Fuel Type
171.2	Multicyclone and ESP	0.016 gr/dscf @ 12% CO_2	0.061	Biomass and construction wood waste
185	Multicyclone and baghouse; limestone injection	0.04 lb/MMbtu	0.04 lb/MMbtu	Biomass
185	Baghouse and limestone injection	0.04 lb/MMbtu	0.04 lb/MMbtu	Biomass, construction wood waste, and urban wood waste
11.5 MW (189 MMBtu/hr)	Multicyclone and ESP; Lime and soda ash injection	0.0144 gr/dscf @ 12% CO_2	9.9 lb/hr	Biomass, construction wood waste, and urban wood waste
259	ESP and Lime injection	8.75 lb/hr	6.25 lb/hr	Biomass
400	Multicyclone and Fabric Filter	0.010 gr/dscf @ 12% CO_2	23 ppmv @ 3% O_2	Biomass, construction wood waste, and urban wood waste
315	Fabric Filter and lime and $NAHCO_3$	0.045 lb/MMbtu	23 ppmv @ 3% O_2	Biomass, construction wood waste, and urban wood waste
317	Baghouse	0.010 gr/dscf @ 12% CO_2	247 lb/day	Biomass
352	ESP	17.4 lb/hr for condensable and 5.8 lb/hr for filterable	10 lb/hr	Biomass, construction wood waste, and urban wood waste
460	Multicyclone and Baghouse	0.03 lb/MMBtu	1.2 lb/MMBtu	Biomass, construction wood waste, and urban wood waste

Electrostatic Precipitator (ESP)

An ESP is a particle control device that uses electrical forces to move the particles out by flowing gas stream onto collector plate. The particles are given electrical charge by forcing them to pass through a corona, a region in which gaseous ions flow. The electrical field forces the charged particles to the walls comes from electrodes maintained at high voltage in the center of the flow lane. One the particles are collected on the plates, they must be removed from the plates without re-entraining them into the gas stream. This is done by knocking them loose from the plates and allowing the collected layer to slide down into a hopper. Some ESPs remove the particles by intermittent or continuous washing with water. ESPs are configured in several ways. Some of these configurations have been developed for special control action, and others have evolved for economic reasons. The types of

ESPs are plate-wire precipitator, flat plate precipitator, tubular precipitator, and two-stage precipitator.

Units using limestone injection in a dry scrubber for control of SOx rarely use ESPs because the use of flue gas desulfurization/baghouse combination significantly increases control of SOx emissions while achieving comparable PM control. When flue gas passes through the filter cake, additional SOx is removed by unreacted limestone and CaO in the filter cake. Also, due to the high resistivity of the PM10 (mostly CaO and $CaSO_3$), a large ESP plate area would be required to match the control efficiency of baghouses, which makes ESP more expensive than baghouses.

Fabric Filter/Baghouse
A fabric filter consists of one or more isolated compartments containing rows of filter bags in the form of round, flat, or shaped tubes, or pleated cartridges. Particle-laden gas passes up along the surface of the bags then radially through the fabric. Particles are retained on the upstream face of the bags, and the cleaned gas stream is vented to the atmosphere. The filters are cyclically operated, alternating between relatively long periods of filtering and short periods of cleaning. During cleaning, dust that has accumulated on the bags is removed from the fabric surface and deposited in a hopper for subsequent disposal.

Fabric filters collect particles with sizes ranging from submicron to several hundred microns in diameter, with efficiencies in excess of 99 percent. The layer of dust or dust cake collected on the fabric is primarily responsible for such high efficiency. As the flue gas passes the filter cake additional SOx is removed. Gas temperatures up to about 500^{o}F with surges to about 550^{o}F can be routinely accommodated in some configurations. Most of the energy used to operate the system appears as pressure drop across the bags and associated hardware and ducting. The primary disadvantage of baghouses compared to ESPs is the higher-pressure drop across the baghouse resulting in increased fan power requirements for the system.

Wet Scrubber
A wet scrubber is a control device that removes PM and acid gases from waste gas streams of stationary point sources. The pollutants are removed primarily through impaction, diffusion, interception, and/or absorption of the pollutants onto droplets of liquid. Collection efficiencies for wet scrubbers vary with particle size and distribution of the waste stream. Generally, collection efficiency decreases as the particle size decreases. Collection efficiencies also vary with scrubber type. The efficiency ranges from greater than 99% for venture scrubbers to 40-60% (or lower) for simple spray towers. It is important to note that none of the permitted solid fuel-fired units in the SJVAB currently operates wet scrubbers.

SOx Control Technologies

SO_2 is formed during the combustion process because of thermal oxidation of the sulfur contained in the fuel. A portion of the sulfur is further oxidized to SO_3. At temperatures below approximately 600°F, sulfur trioxide readily combines with moisture in the flue gas or in the atmosphere to form sulfuric acid (H_2SO4). These sulfur compounds are acidic and can be controlled using the same technology. SO_2 and H_2SO_4 control technologies are discussed below.

Dry Flue Gas Desulfurization

The use of a dry flue gas desulfurization system such as lime spray drying followed by a baghouse has the potential to reduce Sox emissions by 75% to 90%. The lowest permitted SO_2 emission rate for a biomass-fired boiler using lime spray scrubbing technology is 0.10 lb/MMBtu.

Circulating Dry Scrubber (CDS)

The CDS is a once-through dry technology where flue gas, ash, and lime sorbent form in a fluidized bed in an adsorbent vessel. The flue gas is humidified in the vessel to assist the adsorption reactions between lime and SOx. The by-products leave the absorber in a dry form with the flue gas and are subsequently captured in a downstream particulate collection device. It is important to note that CDS have only been domestically applied to two coal fired boilers.

Wet Scrubber

Wet scrubber is a one-through control technology where a reagent is slurried with water and sprayed into the flue gas stream in an absorber vessel. The SO_2 is removed from the flue gas by sorption and reaction with the slurry. The by-products of the sorption and reaction are in a wet form upon leaving the system and must be dewatered prior to transport and disposal. Wet scrubbers can be classified on the basis of the reagents used and the by-products generated. The typical reagents used in this process are lime and limestone. Additives, such as magnesium, may be added to the lime or limestone to increase the reactivity of the reagent. The reaction by-products are calcium sulfite and calcium sulfate. Calcium sulfite to calcium sulfate reaction is a result of oxidation, which can be inhibited or forced depending on the desired by-product. The most common wet scrubber application uses limestone as the reagent and forced oxidation of the reaction by-products to form calcium sulfate. Wet scrubbers are commercially available and are generally only applied on coal-fired boilers.

Regenerable Wet Scrubber (RWS)

RWS technology uses sodium sulfite, magnesium oxide, calcium carbonate, amine, or ammonia as the sorbent for removal of SO_2 from the flue gas. The spent sorbet is regenerated to produce concentrated streams of SO_2 or other sulfur compounds, which may be further processed to produce other products. This technology may require additional flue gas treatment prior to SO_2 absorption process to remove other flue gas constituents such as hydrogen chloride and hydrogen fluoride that may affect the sorbent and/or final by-product. Sodium sulfite and ammonia-based technologies are commercially available and have control efficiencies ranging from 90% to 95%.

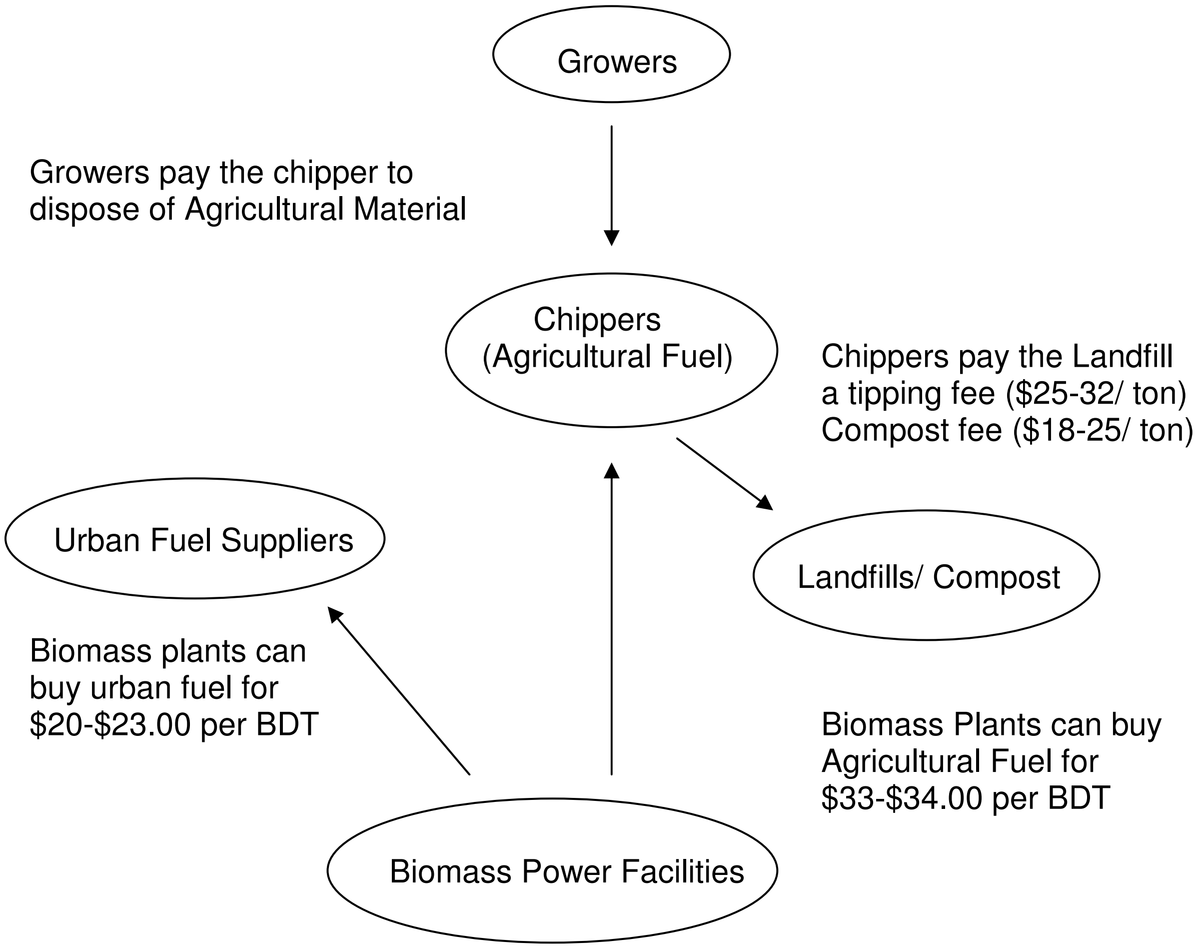
7.1.5 Economics – Agricultural Fuel vs. Urban Fuel

In the SJVAB, several biomass power plants are required to burn agricultural material in order to offset emissions under permit with the District. Before this permit requirement, biomass power plants received agricultural material to burn for free. Today, however, selling agricultural material to biomass plants is a source of revenue for chipping operators.

A grower that needs to remove agricultural material off-site will hire a chipping operator. In the SJVAB, the chipping companies typically propose an initial contract with growers to chip their orchard removal material. The contract is written prior to the job and establishes a tentative agreement, which includes an estimated cost for the removal, chipping and transportation of the material to a biomass power plant. The contract usually includes a line item that states the terms of the contract based on when a local biomass power plant accepts the chipped material. A grower's final cost of chipping orchard removals can vary due to the presiding condition of each contract that all material is accepted and paid for by a biomass power plant. If the biomass power plant rejects the chipped materials, then the chipping company would likely return the materials back to the grower.

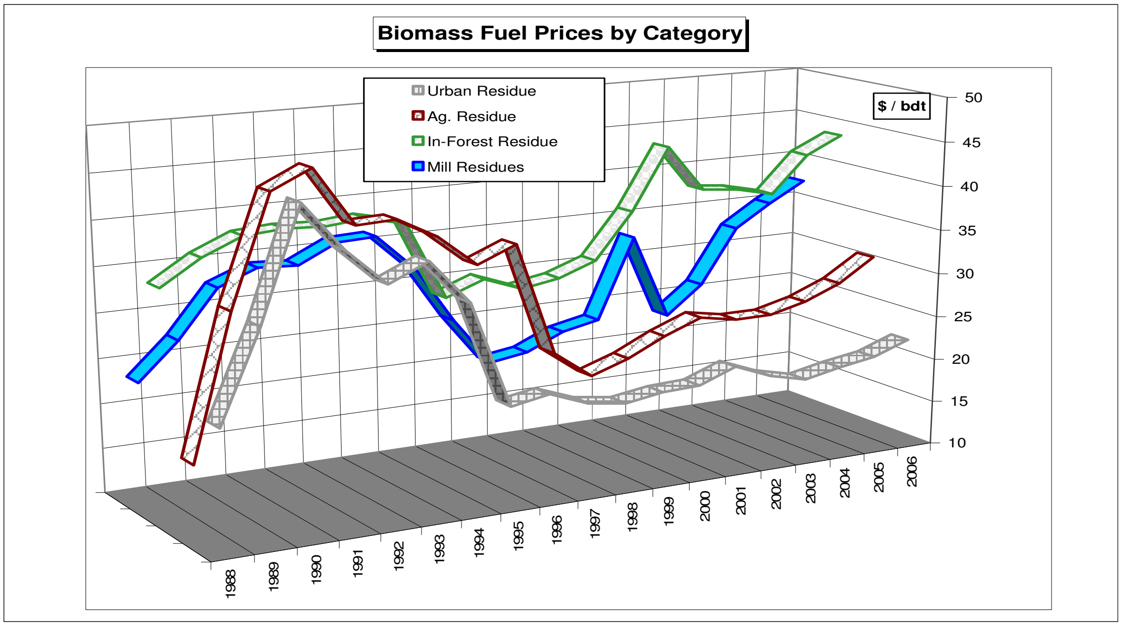
If the agricultural material is sent to a landfill, the chipper must pay a tipping fee of about $25.00 to $32.00 per ton to the operator. If sent to a compost facility, the cost is less for the chipper, ranging from $18.00 to $25.00 per ton for the tipping fee. However, if sent to a biomass power plant, the biomass operators pay the chipper around $34.00 per BDT. Considering the availability of agricultural, forestry, and urban residues, it is relatively more affordable to accept urban residues at the biomass power plants. The Figure 7-2, diagrams the movement of money through a SJVAB biomass market.

Figure 7-2 Current Biomass Fuel Market: Movement of Money



Within the biomass fuel market, there is a considerable price difference between the cost of urban fuels and agricultural fuels. Data throughout the state shows an average price difference of about $12 per BDT of fuel between urban fuel and agricultural fuel. Figure 7-3 diagrams the price difference between biomass fuel markets, showing a consistent gap between agricultural fuel and urban fuel.

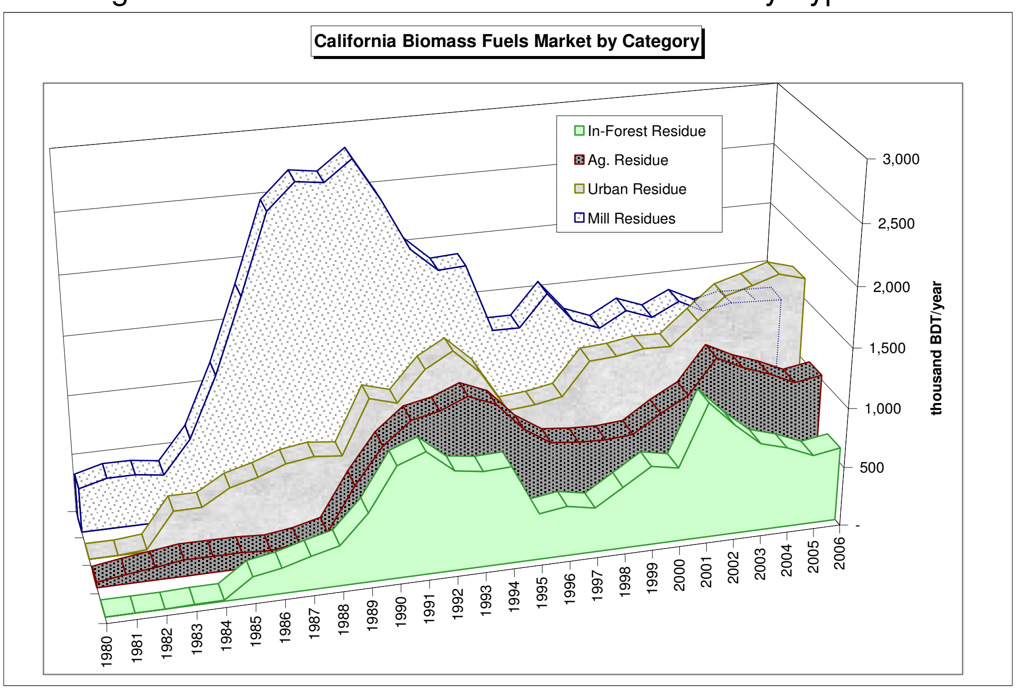
Figure 7-3 Biomass Fuel Prices by Category



Morris, G., *Biomass Energy Production in California 2006: Update of the California Biomass Database*, report of the Green Power Institute, December 2006.

While prices may vary, the price difference between agricultural fuel and urban fuel of the SJVAB has maintained consistent as illustrated by the Figure 7-4.

Figure 7-4 California Biomass Fuels Market by Type of Fuel

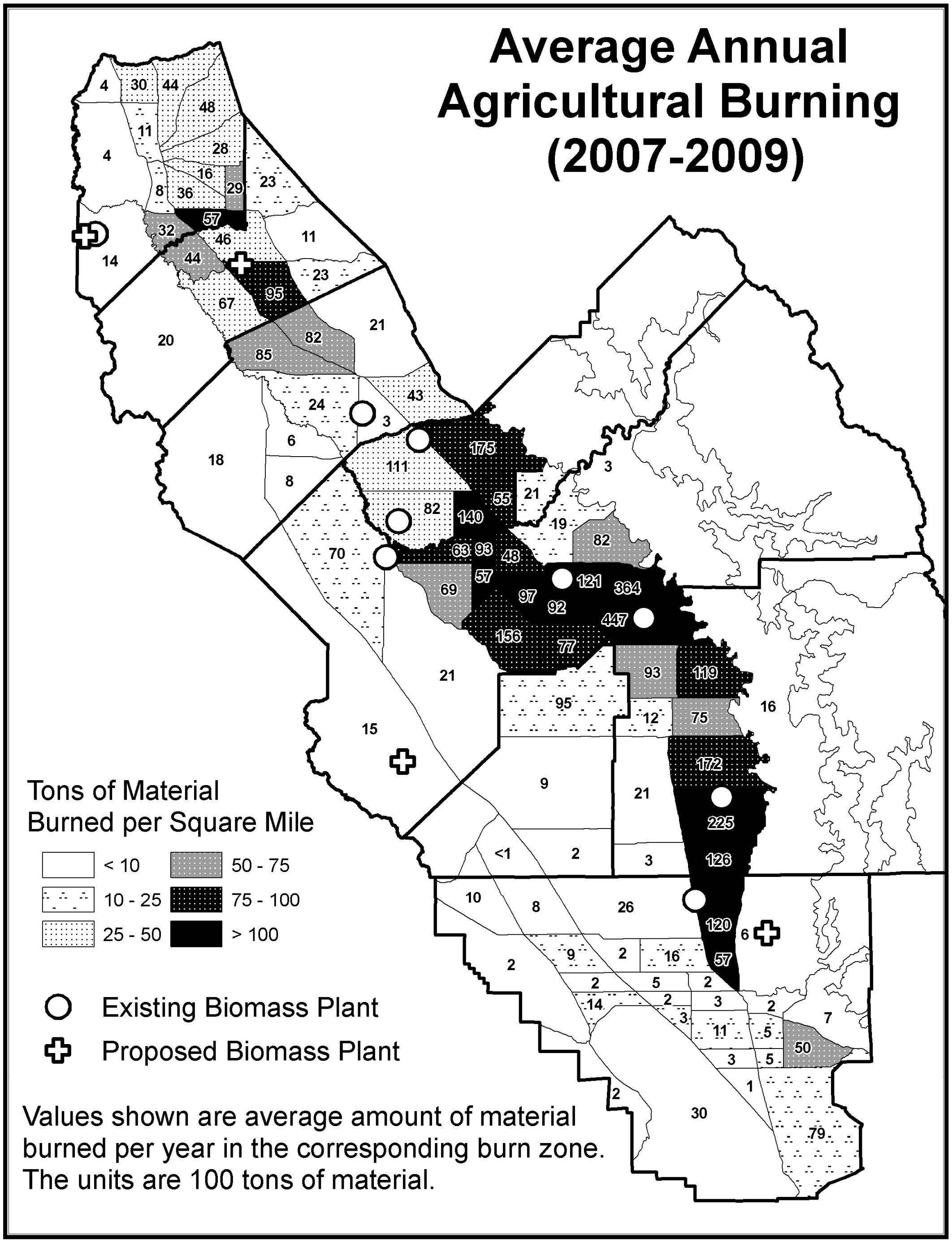


Morris, G., *Biomass Energy Production in California 2006: Update of the California Biomass Database*, report of the Green Power Institute, December 2006.

7.2 OUTLOOK

7.2.1 How Much More Agricultural Material Do We Anticipate?

Figure 7-5 Map of Annual Agricultural Burn Tons in the San Joaquin Valley Air Basin



Current analysis indicates that of the crops that may possibly be prohibited from further open burning activities, three of those crops would most likely be sent to biomass facilities as an alternative to open burning. The three crops include fig orchard removal, <20 acre orchard removal reduced to <15 acre orchard removal, and citrus orchard removal. Based on this information, District staff analyzed the current burn tons of material for each crop type and activity to determine how much more agricultural material would be generated and sent to the biomass plants as a result of prohibition of open burning.

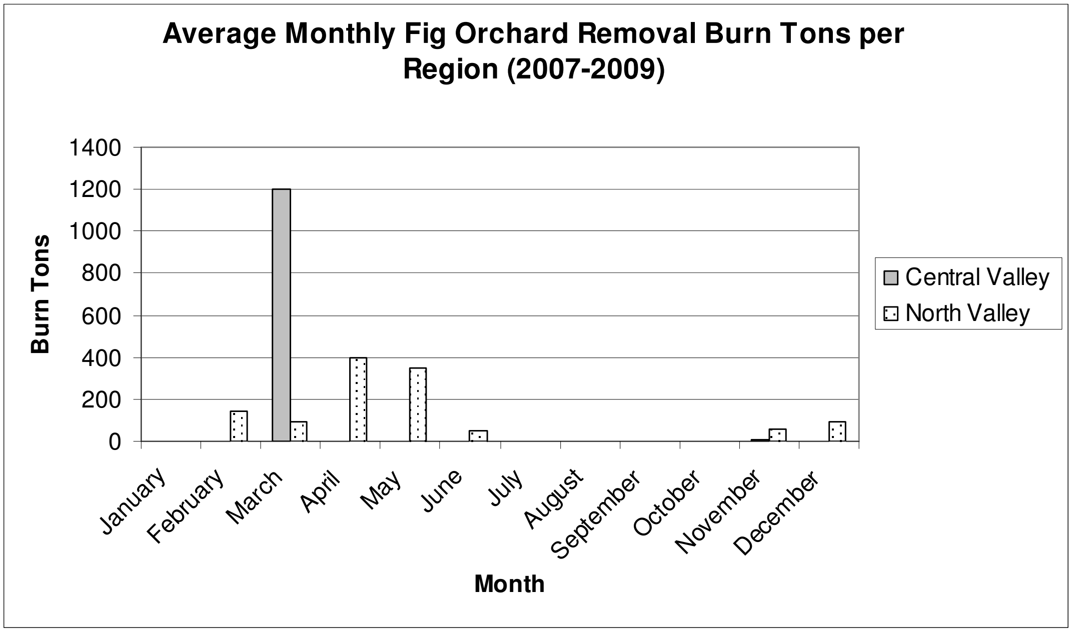
For purposes of this analysis, staff reviewed a three-year history of each crop and activities with those crops using the best available information from the District Smoke Management System (SMS). The reviewed information included the acreage and tonnage of material open burned. Staff averaged the three-year data to create an outlook as to crop and burn activities. Staff assumes the three-year average to be indicative of future activities.

Fig Orchard Removal

Staff is recommending that fig orchard removals would be prohibited from open burning acreage greater than 15 acres. Staff assumes that the total annual tonnage of material previously burned at amounts greater than 15 acres will be sent to biomass facilities as fuel.

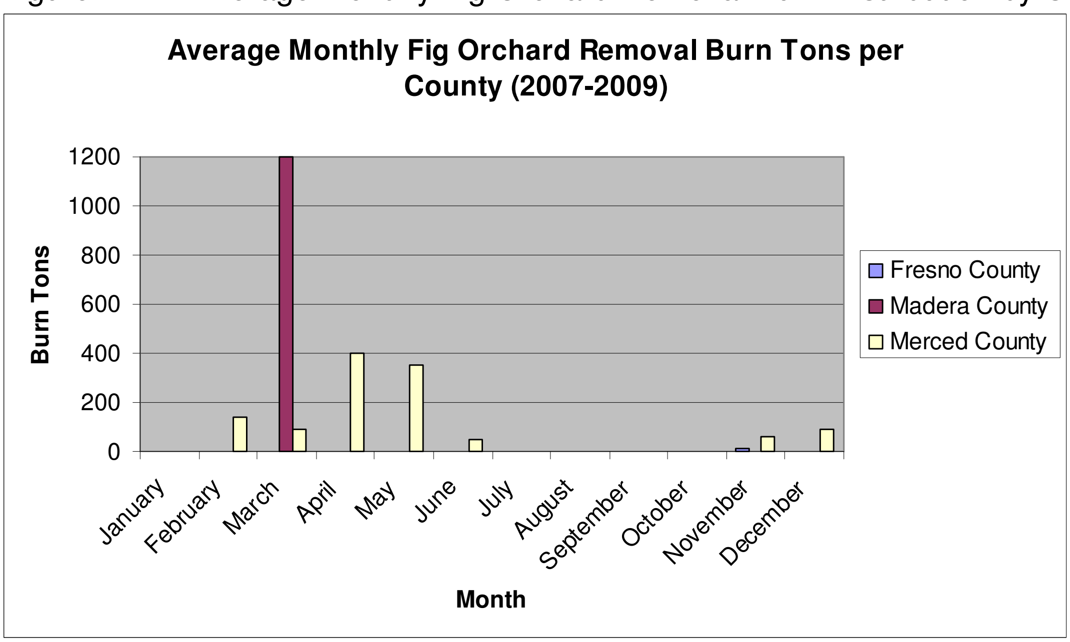
The trend for the burning of fig orchard removal material appears to be from November through June in the North SJVAB and November through March in the Central SJVAB. There is no data indicating fig orchard removal burning in the South SJVAB for the three years averaged for this analysis. The Central SJVAB region peaked for fig orchard removal tons burned in the month of March at 1,200 tons of material burned, with ten tons burned in October. The North SJVAB peaked for fig orchard removal tons burned in April at 400 tons of material burned. Little to no burning of fig orchard removal material occurs in the late summer months and early fall months of July through October. Figure 7-6 is an illustration of the average monthly fig orchard removal burn tons in the SJVAB, distributed by region, for the years of 2007 through 2009.

Figure 7-6 Monthly Fig Orchard Removal Burn Distribution



To further analyze the quantity and location of fig orchard removal material burned the chart below illustrates the monthly average fig orchard removal material burn tons by county (2007-2009). As seen in the chart below, Madera County has the highest average quantity of burn tons of fig orchard removal materials at 1,200 tons for the month of January.

Figure 7-7 Average Monthly Fig Orchard Removal Burn Distribution by County

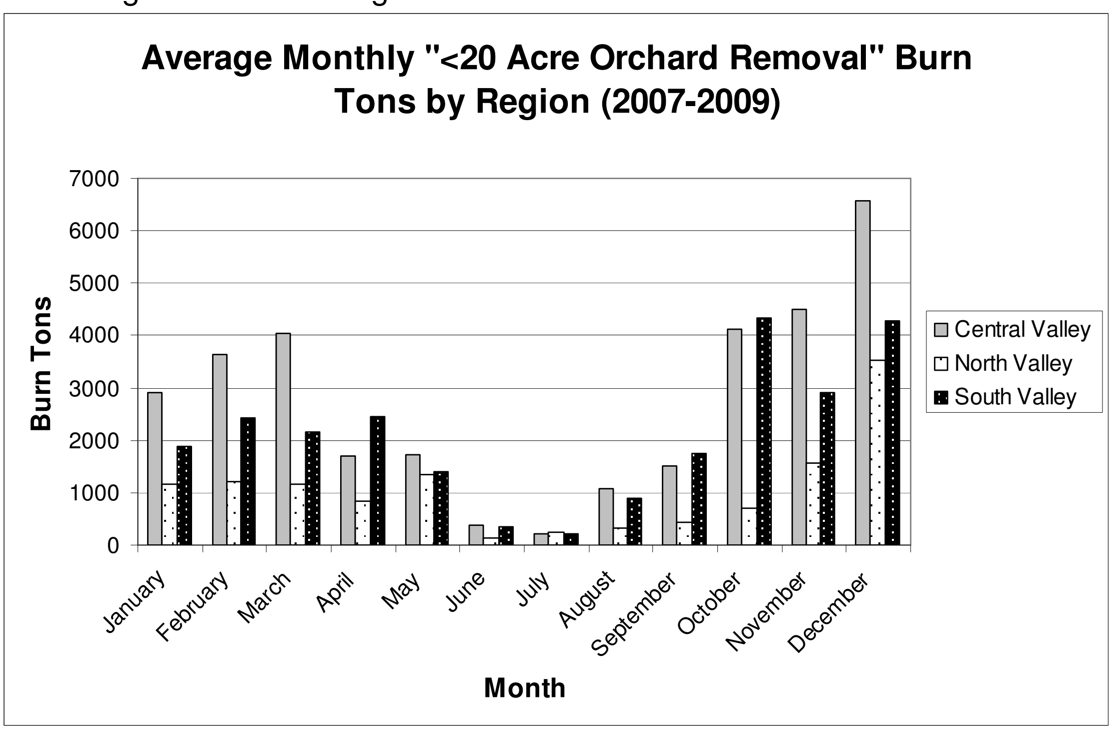


For purposes of this analysis, staff assumes the fig orchard removal acreage that was burned that were greater than 15 acres in size would no longer burn, but would find an alternative method of disposal of the material. Staff added each individual approved burn of fig orchard removal from the three years (2007-2009) to determine the average number of burns greater than 15 acres. Of the average 80 burn acres, 61 acres would no longer be allowed to burn. Converting acres to tons, translates into 1,830 tons of fig orchard removal material that would be forwarded to the biomass plants per year for the entire SJVAB.

<20 Acre Orchard Removal

Staff analyzed the average monthly burning of <20 acre orchard removals to illustrate a comprehensive look at this crop category. The burning trends were calculated using a three-year average of the best available information from the District SMS. The trend for the burning of <20 acre orchard removal appears to occur throughout the year, through out the SJVAB with peak times ranging from October to May. The Central SJVAB region peaks for <20 acre orchard removal burning in the month of December at 6,582 tons of material burned. The South SJVAB region peaks for <20 acre orchard removal burning in the month of October at 4,331 tons of material burned. While the North SJVAB peaks in December 3,531 tons of material burned. Figure 7-8 illustrates the average monthly <20 acre orchard removal burn ton distribution by region of the SJVAB.

Figure 7-8 Average <20 Acre Orchard Removal Burn Distribution

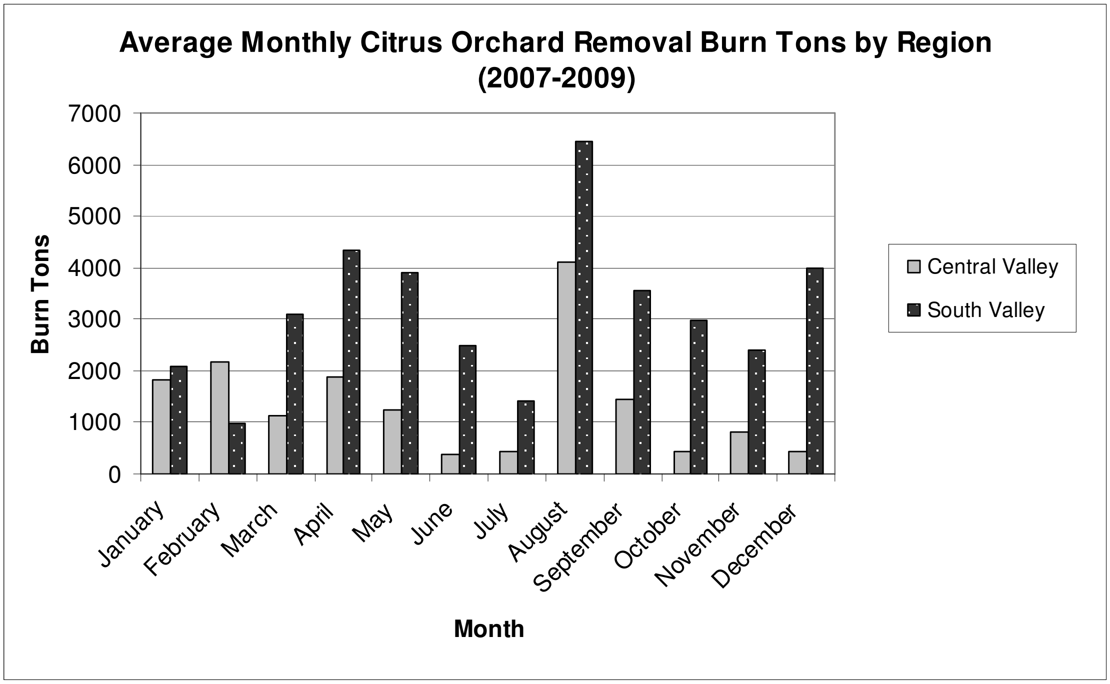


Current analysis indicates that it would be feasible to reduce burning of orchard removals from <20 acres to <15 acres. Staff determined the increase in agricultural material sent to the biomass plants by first calculating the amount of crop burns that occurred in sizes ranging from 15 acres to 20 acres. Staff did this by reviewing the SMS database for approved burn sizes and quantities for a three year average from 2007-2009.

For purposes of this analysis, staff assumes the crops that were burned that were greater than 15 acres in size would continue to burn in the future, but at 15 acres. Staff subtracted the 15 acres from each approved burn greater than 15 acres to determine the quantity of acres that would no longer be approved for burning. For example, a burn that in the past would have been for 50 acres would be allowed to burn 15 acres in the future, leaving a difference of 35 acres that would no longer be allowed to burn and would be sent to the biomass power plants as fuel. Staff applied this methodology to each burn over 15 acres during the three years (2007-2009) to determine the average. Of the average 2,334 burn acres, 254 acres would no longer be allowed to burn. Converting acres to tons, translates into 7,620 tons of orchard removal material that would be forwarded to the biomass plants per year for the entire SJVAB.

Citrus Orchard Removal
Staff analyzed the average monthly burning of citrus orchard removals to illustrate a comprehensive look at this crop category. The burning trends were calculated using a three-year average of the best available information from the District SMS. The trend for the burning of citrus orchard removal appears to occur throughout the year, through out the Central and South SJVAB. The Central SJVAB region appears to peak for citrus orchard removal burning in the month of August at 4,120 tons of material burned. The South SJVAB region appears to peak for citrus orchard removal burning also in the month of August at 6,442 tons of material burned. Data indicates that there was no burning of citrus orchard removal materials in the North SJVAB during the three years that were averaged for this analysis. Figure 7-9 illustrates the average monthly citrus orchard removal burn distribution through the SJVAB by region.

Figure 7-9 Average Monthly Citrus Orchard Removal Burn Distribution



7.2.2 Could the Current Biomass Power Plants Physically Handle the Increase in Materials?

The 2010 and future capacity of biomass fuel rate, from nine biomass power plants located in the SJVAB, is estimated to be between 1,409,360 and 1,909,141 bone dry tons (BDT's) per year[1]. These estimates were calculated using the following assumptions:

1. Size of each boiler unit, in MMBtu/hr, is based on the district permitted solid fuel-fired boiler units subject to Rule 4352.

2. The lower bound capacity is calculated using Biomass heat content value of 0.008805 MMBtu/lbm Higher Heating Value (HHV). The value is based on ultimate analysis from 1999 source testing (page 47 in a technical support document submitted with project S-1010053). Using the 1999 ultimate analysis, nitrogen was lower, heat content value of the fuel was higher. This results in considerably less fuel consumed with a higher yield of airflow.

[1] It should be noted that the CBEA estimates that the capacity of the biomass power plants (including those plants just outside the Valley) is estimated to be 945,000 BDT to 1,000,000 BDT with an average availability ranging from 80% to 85%. Since the CBEA's estimates are less than the District's estimate, the District will utilize the District estimates as the more conservative values.

3. The heat content value of 0.0065 MMBtu/lbm (HHV) is used to estimate the upper bound fuel rate capacity. The value is based on heat content values reported in the Phyllis database, the United States Department of Energy, Energy Efficiency and Renewable Energy (DOE/EERE) feedstock database, and selected literature sources.

District staff acknowledges that the use of difference heat content values will result in differences, particularly when fuel rate capacity is calculated. The following table illustrates the calculations used to determine the lower and upper bound capacities of the facilities based.

Table 7-7 Illustration of Calculations Used to Determine Annual Boiler BDT Capacity

Facility ID	Power Production	Permitted Output Capacity	Lower Bound				Upper Bound			
			0.008805 [1]	0.0005	24	365	0.0065 [2]	0.0005	24	365
	(MW)	(MMBtu/hr)	(lb/hr)	(ton/hr)	(ton/day)	(ton/year)	(lb/hr)	(ton/hr)	(ton/day)	(ton/year)
A	12.5	185	21,011	11	252	92,027	28,462	14	342	124,662
B	30	317	36,002	18	432	157,690	48,769	24	585	213,609
C	56.5	715	81,204	41	974	355,673	110,000	55	1,320	481,800
D	11.5	189	21,465	11	258	94,017	29,077	15	349	127,357
E	28.5	460	52,243	26	627	228,825	70,769	35	849	309,969
F	13	185	21,011	11	252	92,027	28,462	14	342	124,662
G	28.5	352	39,977	20	480	175,101	54,154	27	650	237,194
H	9.4	171.2	19,443	10	233	85,163	26,338	13	316	115,362
I	20.5	259	29,415	15	353	128,838	39,846	20	478	174,526
					Total:	**1,409,360**			**Total:**	**1,909,141**

1. The value was based on ultimate analysis from 1999 source testing. Using the 1999 ultimate analysis, nitrogen was lower, heating value of the fuel was higher. This results in considerably less fuel being consumed with a higher yield of air flow.

2. The value is based on 6500 Btu/lb in the past project for biomass facility C.

For purposes of determining if the biomass power plants have the capacity to accept the additional agricultural materials that would be generated by the prohibition of open burning of specific crops, District staff analyzed the agricultural material increase by region of the SJVAB rather than by county. To analyze if the biomass power plants have the capacity to accept the additional agricultural material, staff made the following assumptions:

1. The average monthly burn tons per region (2007-2009) will remain constant in future years.

2. The biomass facilities would burn 100% of agricultural materials received each month.

Data presented in Table 7-7 indicates that the biomass power plants in the Central SJVAB have a combined capacity ranging from 653,643 BDT/yr to 885,439 BDT/yr. Historical data shows that these facilities have been operating at 590,401 BDT/yr. If the Central SJVAB biomass plants increase use of the boilers up to the potential capacity, as presented in Table 7-7, they could increase biomass fuel consumption by up to 295,038 BDT/yr. Divided into monthly increments, the biomass plants have the ability to increase fuel consumption by up to 24,586 BDT per month. Another option for biomass power plants would be to increase the percentage of agricultural materials accepted and burned instead of increasing overall consumption and energy production.

Data presented in Table 7-7 indicates that the biomass power plants in the North SJVAB have a combined capacity ranging from 220,865 BDT/yr to 299,188 BDT/yr. Historical data shows that these facilities have been operating at 287,040 BDT/yr. If the North SJVAB biomass plants increase use of the boilers up to the potential capacity they could increase biomass fuel consumption by up to 12,148 BDT/yr. Divided into monthly increments, the biomass plants have the ability to increase fuel consumption by 1,012 BDT per month. Another option for biomass power plants would be to increase the percentage of agricultural materials accepted and burned instead of increasing overall consumption and energy production.

Data presented in Table 7-7 indicates that the biomass power plants in the South SJVAB have a combined capacity ranging from 534,853 BDT/yr to 724,519 BDT/yr. Historical data shows that these facilities have been operating at 639,055 BDT/yr. If the South SJVAB biomass plants increase use of the boilers up to the potential capacity they could increase biomass fuel consumption by up to 85,464 BDT/yr. Divided into monthly increments, the biomass plants have the ability to increase fuel consumption by 7,122 BDT per month. Another option for biomass power plants would be to increase the percentage of agricultural materials accepted and burned instead of increasing overall consumption and energy production.

Fig Orchard Removal

Decreasing allowed open burning of fig orchard removal materials to <15 acres would generate an increase of 1,830 tons of agricultural material throughout the SJVAB to the biomass plants per year. The following analysis was performed assuming the 1,830 tons of agricultural material from fig orchard removal would be forwarded to the biomass power plants. Because there are no historical burns in the South SJVAB for this crop category staff assumes the additional tonnage would be sent to biomass power plants in the Central and North SJVAB.

Analysis, as illustrated in Figure 7-6, indicates that 51% of the fig orchard removal burn tons occur in the Central SJVAB. Staff assumes the burn acreage from this crop category above 15 acres is distributed throughout the SJVAB parallel to the total acreage from this crop category. Therefore, staff applied the 51% to the 1,830 tons of material to determine the increase of agricultural material forwarded to the biomass plants (1,830 BDT x 0.51).

Staff estimate by reducing allowed burns of fig orchard removals to <15 acres results in an increase of 933 tons of material to be forwarded to the biomass plants in the Central SJVAB per year. Therefore, staff believes the biomass facilities have the capacity to accept the additional agricultural biomass fuel generated by decreasing the allowed open burning of fig orchard removal materials to <15 acres in the Central SJVAB.

Analysis, as illustrated in Figure 7-6, indicates that 49% of the fig orchard removal burn tons occur in the North SJVAB. Staff assumes the burn acreage from this crop category above 15 acres is distributed throughout the SJVAB parallel to the total acreage from this crop category. Therefore, staff applied the 49% to the 1,830 tons of material to determine the increase of agricultural material forwarded to the biomass plants (1830 BDT x 0.49).

Staff estimate by reducing allowed burns of fig orchard removals to <15 acres results in an increase of 897 tons of material to be forwarded to the biomass plants in the North SJVAB per year. Therefore, staff believes the biomass facilities have the capacity to accept the additional agricultural biomass fuel generated by decreasing the allowed open burning of fig orchard removal materials to <15 acres in the SJVAB.

Less Than 20 Acre Orchard Removal

Decreasing allowed open burning of orchard removals from <20 acres to <15 acres would generate an increase of 7,620 tons of agricultural material throughout the SJVAB to the biomass plants per year.

Analysis indicate that 46% of the <20 acre orchard removal burn tons occur in the Central SJVAB. Staff assumes the burn acreage from this crop category above 15 acres is distributed throughout the SJVAB parallel to the total acreage from this crop category. Therefore, staff applied the 46% to the 7,620 tons of material to determine the increase of agricultural material forwarded to the biomass plants. Staff estimate by reducing allowed burns of orchard removals from <20 acres to <15 acres results in an increase of 3,505 tons of material to be forwarded to the biomass plants in the Central SJVAB per year.

Analysis indicate that 18% of the <20 acre orchard removal burn tons occur in the North SJVAB. Staff assumes the burn acreage from this crop category above 15 acres is distributed throughout the SJVAB parallel to the total acreage from this crop category. Therefore, staff applied the 18% to the 7,620 tons of material to determine the increase of agricultural material forwarded to the biomass plants. Staff estimate by reducing allowed burns of orchard removals from <20 acres to <15 acres results in an increase of 1,371 tons of material to be forwarded to the biomass plants in the North SJVAB per year.

Analysis indicate that 36% of the <20 acre orchard removal burn tons occur in the South SJVAB. Staff assumes the burn acreage from this crop category above 15 acres is distributed throughout the SJVAB parallel to the total acreage from this crop category. Therefore, staff applied the 36% to the 7,620 tons of material to determine the increase of agricultural material forwarded to the biomass plants. Staff estimate by reducing allowed burns of orchard removals from <20 acres to <15 acres results in an increase of 2,744 tons of material to be forwarded to the biomass plants in the South SJVAB per year.

Based on the analysis presented above staff believes the biomass power plants have the capacity to accept the additional tonnage of agricultural material generated by the reduction of allowed burns of orchard removal materials from <20 acres to <15 acres in all three regions of the SJVAB.

Citrus Orchard Removal

Assuming the total citrus orchard removal burn tons would be forwarded to the biomass power plants rather than be burned, this would cause an increase of citrus orchard material to the biomass power plants of more than 54,000 tons per year. More specifically, in the peak citrus orchard removal burn month of August, the quantity of agricultural material forwarded to the biomass power plants would increase by up to 4,120 tons in the Central SJVAB and by 6,442 tons in the South SJVAB. This would be an increase that is above and beyond what the power plants are currently accepting.

It is important to note citrus is a unique crop that faces unique challenges regarding biomass consumption. Biomass facilities consider citrus material to be the least desirable of all fuel types. Due to the stringy nature of the material, biomass power plants do not burn citrus material by itself. Rather, they blend it with other biomass fuels. Citrus material is blended with other biomass fuels in ratios up to 25%.

Additionally, comments from the California Citrus Mutual stated that not all biomass facilities accept citrus materials. Staff reviewed quarterly reports submitted to the District by the biomass plants, and could only confirm definitively that two of the nine biomass plants in the SJVAB accepted citrus wood products in the past five years. The California Citrus Mutual comments, mentioned a third biomass facility that accepts citrus wood material. Based on this information, staff can verify that three biomass facilities accept and use citrus material as biomass fuel. One facility is located in each region of the SJVAB. However, CBEA has indicated that all 12 biomass power plants have very broad acceptance policies for wood fuel, which include citrus orchard and vineyard removals.

Based on best available data at the time, staff has analyzed the capacity of the facility in the South SJVAB that staff can definitively verify accepts citrus material. In order to analyze a worst case scenario, this analysis is specific to the month of August, which is the peak burn month for citrus orchard removal materials. The facility in the South SJVAB is known to blend up to 30% of citrus material into its fuel blend. This is the only facility in the SJVAB to blend at this high a level. This facility has advertised on it's website that it has a rated capacity of 1,293 tpd of biomass fuel. The five-year historical data indicates that the boilers at this facility are operational on an average of approximately 25 days per month of the third quarter of each year. District staff assumes the average of the historical data is indicative of future activities. Therefore, staff assumes this facility is operational 25 days for the month of August giving it a biomass fuel capacity of 32,325 tons.

For purposes of this analysis, staff conservatively estimated that the plant will use a fuel blend with 15% citrus material during all hours of operation and will accept the corresponding amount of citrus material for storage, since a fuel blend using 30% of citrus material could vary by amount and availability of the material. Using the previously stated assumptions, staff estimates the biomass plant could use 4,848 tons of citrus material in the month of August. The five-year historical data indicates that this facility accepts an average of 24,265 tons of non-almond agricultural orchard material each August. Assuming 15% of that orchard material is citrus orchard material, staff would assume this plant is currently accepting 3,637 tons of citrus material each August. As previously stated, each August the South SJVAB biomass plant would see an increase of 6,442 tons of citrus orchard removal material in addition to what is currently being accepted.

Using the data above for the following analysis. Each August, the plant has a capacity of 4,848 tons of citrus material, and is currently accepting about 3,637 tons of citrus material resulting in an available capacity of 1,211 tons of additional citrus material. Meaning, there would be a surplus of 5,231 tons of citrus material in the South SJVAB if citrus orchard removal burning is prohibited.

According to CBEA, this biomass power plant currently has the capacity to accept approximately 130,000 BDT of citrus annually, but only took in 34,000 BDT for the year of 2009. CBEA also stated that biomass plants are seeking additional agricultural material at this time. The accepted 34,000 tons of citrus material for 2009 supports the staff analysis that the plant is accepting about 3,637 tons of citrus material each August. CBEA has also indicated that citrus handling and grinding practices have changed resulting in a wood product that may be used in higher percentages than in past years. For example, Covanta Delano alone may now burn up to 100,000 Bone Dry Tons (BDT's) of this fuel in any one year. Rio Bravo Fresno and Covanta Mendota are capable of burning up to 40,000 BDTs and 20,000 BDTs of citrus annually, respectively. It is important to note, however, that all these facilities received considerably less than 10,000 BDTs of citrus in 2009. All of the facilities continue to fall short of their goals for more citrus orchard waste, where a number of plants continue to be extremely short of wood fuel and are currently curtailed or operating at reduced loads. The Biomass plants are in need of more fuel at this time. The District looks forward to working with the biomass industry to achieve long-term commitments toward the extensive use of agricultural biomass.

7.2.3 Policies for Renewable Energy

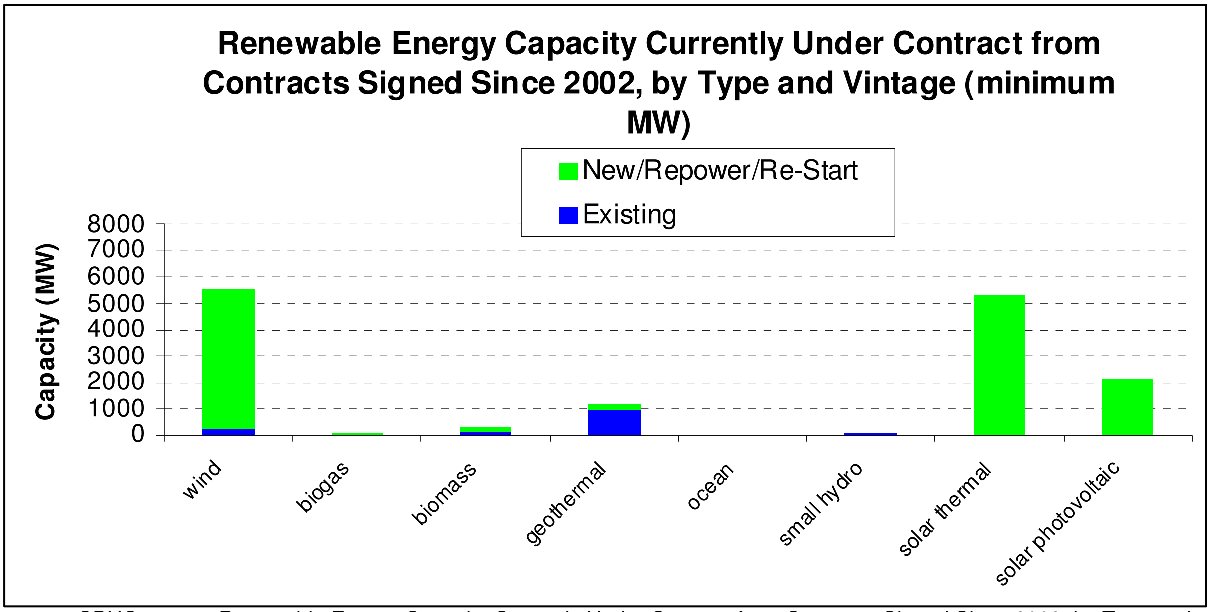
The California Renewable Portfolio Standard (RPS) program was established by Senate Bill 1078, effective January 1, 2003. It requires that a retail seller of electricity such as Pacific Gas and Electric (PG&E) purchase a certain percentage of electricity generated by Eligible Renewable Energy Resources (ERR). Each utility is required to increase its total procurement of ERRs by at least 1% of annual retail sales per year so that 20 percent of its retail sales are supplied by ERRs by 2017.

The State's Energy Action Plan (EAP) called for acceleration of this RPS goal to reach 20 percent by 2010. This was reiterated again in the Order Instituting Rulemaking (R.04-04-026) issued on April 28, 2004, which encouraged the utilities to procure cost-effective renewable generation in excess of their RPS annual procurement targets (APTs), in order to make progress towards the goal expressed in the EAP. On September 26, 2006, Governor Schwarzenegger signed SB 107, which officially accelerates the State's RPS targets to 20 percent by 2010. The bill took effect on January 1, 2007.

According to CBEA, there are current developments in increasing the requirement to 33%. The Governor's Executive Order S-21-09, September 2009, directs the ARB, under its AB 32 authority, to adopt a regulation consistent with the 33 percent renewable energy target established in Executive Order S-14-08 by July 31, 2010. The Legislature is also actively pursuing its own 33% RPS policy with SB 722 (Simitian). There is a high likelihood that one of these two policy making bodies will have enacted a 33% RPS standard into law by the end of this year.

ERRs include such sources as wind power, biogas, biomass, geothermal, ocean, small hydro, solar thermal, and solar photovoltaic. Charts on the CPUC website indicate that biomass is one of the smallest contributors of ERR utilized by electric companies to meet the RPS standards.

Figure 7-10 Renewable Energy Capacity Currently Under Contract



CPUC.ca.gov. Renewable Energy Capacity Currently Under Contract from Contracts Signed Since 2002, by Type and Vintage.

District staff explored the specific PPA contracts that PG&E currently has to determine the distribution of ERRs in the SJVAB. Biomass power plants make up approximately 2% of PG&E's RPS portfolio. The ERRs contracted with PG&E as a larger portion of the RPS portfolio include solar thermal power (38%), solar photovoltaic power (23%), and wind power (26%).

According to CBEA, Biomass actually represents 30% of PG&E RPS existing RPS procurement portfolio, more than any other utility in the State.

7.2.4 Contracts with Utilities

District's staff's analysis below was based on the nine biomass facilities in the SJVAB and did not account for the three facilities located outside of the SJVAB at the time. Of those nine facilities, seven have contracts with investor owned utility (IOU) companies. District staff surveyed the California Public Utilities Commission (CPUC) website and found the following facilities have approved projects online as a part of the RPS program. Power Purchase Agreement (PPA) Contracts that were scheduled to terminate, per contract agreement have been extended through additional terms with the utility companies. At the time of this report, staff was unable to confirm if the Delano contract has also been extended to more terms.

Table 7-8 Approved Operational Projects for Contracts

Projects Approved and Online	Investor Owned Utility	Min Expected GWh/yr	Contract Term (years)	Term Number	Online Date/ Contracted Delivery Date
AES Delano	SDG&E	386	5	unknown	1/1/2003
Madera Power	PG&E	160	5	2	7/9/2009
Dinuba Energy	PG&E	90	5	3	7/9/2009
Sierra Power Corp.	PG&E	75	5	3	7/9/2009
AES Delano	SDG&E	365	10	1	1/1/2008
Global Common's Chowchilla	PG&E	72	15	1	12/12/2008
Global Common's El Nido	PG&E	72	15	1	2/21/2009

The table above indicates that at least six biomass power plants have PPA contracts with IOUs for up to fourteen yeas in the future. Historical data indicates that PG&E will continue to extend its five-year PPAs with Dinuba Energy and Sierra Power Corp, for as long as the RPS requires renewable energy to be a part of its portfolio.

Staff reviewed the CPUC web page regarding renewable energy capacity currently under contract for Pacific Gas and Electric. Based on information presented there it appears to staff that biomass fuel makes up a mere 2% of the total capacity of renewable energy capacity currently under contract. Staff chose to review PG&E’s information because they are the primary utility company purchasing power from the SJVAB’s biomass power plants, as presented in Table 7-8 above. Other technologies PG&E have under contract for renewable energy include wind, biogas, geothermal, small hydro, solar thermal and solar photovoltaic.

Table 7-9 shows additional information from CBEA for the 12 biomass power plants that use agricultural material in the SJVAB for fuel. According to CBEA, the 12 member biomass power plants generates over 240 MW of renewable capacity and are all under contract with California’s investor owned utilities.

Table 7-9 Biomass Power Plants and Contracts

Facility Name	Region Served	Contracting Utility	Contract Length	Online Date
Rio Bravo Fresno	Central SJVAB	PG&E	30	7/15/88
Covanta Mendoa	Central SJVAB	PG&E	25	1/1/90
Community Recycling Madera Power	Central SJVAB	PG&E	10	6/1/01
Ampersand Chowchilla	Central SJVAB	PG&E	15	12/12/08
Covanta Delano	South SJVAB		10	1/1/08
Community Recycling Dinuba Energy	South SJVAB	PG&E	11	7/1/03
Sierra Power	South SJVAB	PG&E	15	2001
Ampersand Merced Power	North SJVAB	PG&E	15	12/12/08
Thermal Energy Tracy Power	North SJVAB	PG&E	30	3/31/90
SPI Sonora	North Valley	Merchant	n/a	1999
Covanta Chinese Station	North Valley	PG&E	30	1/31/87
SPI Lincoln	North Valley	PG&E	30	1985

Source: CBEA

7.2.5 Legislative Platform

On January 21, 2010, the District Governing Board adopted the Districts 2010 Legislative Platform. On that Legislative Platform are two 2010 Legislative Priorities that will affect biomass facilities. These legislative priorities will provide policy guidance for legislative action and recognize the unique needs of the District during the upcoming legislative session. The District supports legislation that will encourage, promote, and facilitate alternative uses for agricultural material.

7.2.5.1 Cost-Effective Alternatives to Agricultural Burning

The District has been phasing out agricultural burning based upon the schedule outlined in the CH&SC. State law specifies that if there are no economically feasible alternatives to burning, the burning can continue. In implementing the latest phase of the CH&SC, District staff has analyzed the amount of agricultural material that are currently and has been historically accepted by the biomass power plants and other related information.

District staff released a Draft Feasibility Study on Biomass Incentives in December 2008. In that study, District staff analyzed past incentive programs and determined that the programs appeared to be cost-effective; however, there was no long-term incentive funding available to support this conclusion.

7.2.5.2 Energy

The District has identified energy efficiency and renewable energy as part of its effort to attain air quality standards as expeditiously as possible. When utilized properly, biomass to generate energy is a viable alternative to open burning of these materials. The District supports policies and initiatives that encourage renewable energy and energy efficiency including supporting legislation that provides additional biomass capacity utilizing agricultural materials.

7.2.6 New Facilities

There are currently four biomass facilities undergoing the permitting process through the District. These biomass facilities are mentioned in this report for purposes of completeness of the report. The four potential facilities are spread throughout the SJVAB as illustrated in the maps presented in Section 3.1 and again in Sections 7.1 and 7.2. Conversations with an operator from one of the potential biomass facilities in the North SJVAB revealed that the facility has no intention to accept agricultural materials from orchard removals or prunings.

According to CBEA, there are additional Greenfield or new biomass plants under development, which includes San Joaquin Solar/Thermal Biomass, Modesto Bioenergy, and Buena Vista Biomass Power. These plants could require an additional 800,000 to 1,000,000 BDTs of wood fuel resources within a two to five year development timeframe.

The California Biomass Energy Alliance (CBEA) also brought to the attention of District staff that there are several existing coal fired plants in the District that are undergoing conversions to co-fire up to 50% or convert to 100%. CBEA indicated that the three plants are Millenium Mt. Poso, Stockton AP Cogen, and POSDEF. Staff researched the District database and confirmed that the Air Products plant has applied for an ATC to install and operate an ag derived biomass fuel handling system with a max amount of biomass to be received of 300 tons per day. According to CBEA, most of the fuel used in the three facilities mentioned above will be agricultural waste from the SJVAB.

At this time, staff will not include these facilities as an alternative option to open burning of agricultural materials. Future reports will reexamine if the new facilities will be a viable alternative to open burning and if they will increase the overall biomass capacities for agricultural fuel.

7.3 STATE AND FEDERAL COMMITMENTS FOR CONTINUED OPERATION

Tax credits are available to biomass power plants, and five of the nine existing plants in the SJVAB are required to have agricultural offsets. However, there are no long-term federal or state funding commitments for the biomass facilities in the SJVAB.

District staff found that there are no long-term federal or state funding commitments for biomass power plants in place at this time. Staff was successful in identifying one short-term federal program that is currently in place, one short-term state-funding program that is currently in place, and one short-term program that is expired.

7.3.1 Renewable Electricity Production Tax Credit

The short-term federal program is called the Renewable Electricity Production Tax Credit (PTC). The PTC is a federal corporate tax credit that provides a per-kilowatt-hour (kWh) tax credit for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year. The PTC offers the tax credit for short periods and the in-service deadline to qualify for the tax credit is set to expire on December 31, 2013.

The applicable sectors for the PTC tax credit are commercial and industrial using technologies such as wind, biomass, hydroelectric, geothermal electric, municipal solid waste, and hydrokinetic power among others. The tax credit amount is 2.1¢ for wind, geothermal, closed loop biomass, and 1.1¢kWh for other eligible technologies. However, this tax credit is only available to a facility for the first ten years of operation.

Originally enacted in 1992 by the Energy Policy Act of 1992, the PTC has been renewed and expanded numerous times, the most recent amendments being in February 2009. The tax credit amount is 1.5¢kWh in 1993 dollars (indexed for inflation) for some technologies and half that amount for others. The rules governing the PTC vary by resource and by facility type. In addition, the tax credit is reduced for projects that receive other federal tax credits, grants, tax-exempt financing, or subsidized energy financing. Table 7-10 outlines two of the most important characteristics of the tax credit: the in-service deadline and the credit amount as they apply to each type of biomass facility.

Table 7-10 In-Service Deadline and Credit Amount for PTC

Resource Type	In-Service Deadline	Credit Amount
Closed-Loop Biomass	December 31, 2013	2.1¢/kWh
Open-Loop Biomass	December 31, 2013	1.1¢/kWh

The duration of the credit is generally, ten years after the date the facility begins service, however, there are two exceptions. (1) Open-loop biomass, geothermal, small irrigation hydro, landfill gas and municipal solid waste combustion facilities placed into service after October 22, 2004, and before enactment of the Energy

Policy Act of 2005, on August 8, 2005, are only eligible for the credit for a five-year period. (2) Open-loop biomass facilities placed in service before October 22, 2004, are eligible for a five-year period beginning January 1, 2005.

7.3.2 Existing Renewable Facilities Program

The Existing Renewable Facilities Program (ERFP) is a short-term state funding program. The California Energy Commission (CEC) has developed and currently administers renewable energy incentive programs, and the ERFP is one of several program elements within the renewable energy incentives program.

The ERFP was implemented to allocate state funds to increase the competitiveness of existing in-state renewable generating facilities and to help achieve the California Renewable Portfolio Standard's (RPS) goal of 20% of retail electricity generated from renewables by 2010.

ERFP eligible technologies include solid-fuel biomass, solar thermal electric, and wind power. Facilities must have commenced commercial operations as a renewable energy facility, consistent with the requirements of the federal Public Utility Regulatory Policies Act of 1978 and Section 292.204, Subdivision (b), of Title 18 of the Code of Federal Regulations, on or before September 26, 1996. For the purpose of the ERFP, self-sustainability refers to the ability of these facilities to continue operation without public funding by no later than December 31, 2011.

To qualify for ERFP funding, a facility's electrical generation must satisfy the following criteria:

- The energy must be generated after 1/1/07.
- The energy must be sold to customers within the State of California.
- The energy must not receive monthly energy payments at a price equal to or greater than the applicable target price as determined by the Energy Commission for the entire year.
- Eligible generation is net-metered generation.
- The energy must not be sold to customers of local publicly owned electric utilities.
- The energy must not receive incentive payments or funding from any other state program.

In addition, the facility must be located either within the state or near the state's border with its first point of interconnection to the transmission systems within the state. The facility must not be owned by an electrical corporation or local publicly owned electric utility and must be certified by the CEC as eligible for payment, the generation must not be sold at an energy price that is above the applicable target price, or be used on-site.

The existing renewable facilities are considered for incentives by the ERFP based on individual need and market price. Facilities receive funding based on production incentives (cent(s) per kWh). A target price and incentive cap is assigned to each facility based on need. If the market price of energy of a facility drops below the target price, then the CEC will incentivize the facility for each kilowatt-hour generated up to a maximum incentive cap.

Funding tiers for facilities participating in the ERFP have been created and are based on the facility's renewable energy resource type, average annual energy price or contract type, and utility power purchase contract under which the generation is sold.

Table 7-12 Existing Renewable Facilities Program Funding Tiers

	Energy Resource	Average Annual Energy Price	Investor-Owned Utility Contract
Tier 1	Solar Thermal Electric	Facilities with power purchase contracts receiving fixed or variable monthly average energy prices for a majority of their generation at 4.0 cents/kWh or less	PG&E, SCE and SDG&E
Tier 2	Biomass	Facilities with power purchase contracts receiving fixed or variable monthly average energy prices for a majority of their generation at 5.0 cents/kWh or less	PG&E and Sierra Pacific Power Company
Tier 3	Biomass	Facilities with power purchase contracts receiving fixed or variable monthly average energy prices for a majority of their generation at 5.0 cents/kWh or less.	SCE, SDG&E
Tier 4	Biomass and Solar Thermal Electric	Facilities with power purchase contracts receiving variable monthly energy payments based on the short-run avoided cost (SRAC) or facilities with contracts receiving fixed monthly average energy prices for a majority of their generation greater than 5.0 cents/kWh but less than or equal to 6.5 cents/kWh or facilities receiving all-in prices.	SCE, SDG&E
Tier 5	Biomass and Solar Thermal Electric	Facilities with power purchase contracts receiving variable monthly energy payments based on the SRAC or facilities with contracts receiving fixed monthly average energy prices for a majority of their generation greater than 5.0 cents/kWh but less than or equal to 6.8 cents/kWh or facilities receiving all-in prices.	PG&E and Sierra Pacific Power Company

The predetermined target prices and incentive caps for each tier are shown in the table below. The CEC may adjust the target prices and incentive caps, if appropriate, to reflect changing market and contractual conditions and to account for inflation.

Table 7-13 Existing Renewable Facilities Program Target Prices

	Target Price	Production Incentive Cap
Tier 1	6.2 cents/kWh	2.0 cents/kWh
Tier 2	6.5 cents/kWh	1.5 cents/kWh
Tier 3	6.2 cents/kWh	1.5 cents/kWh
Tier 4	6.2 cents/kWh	1.5 cents/kWh
Tier 5	6.5 cents/kWh	1.5 cents/kWh

The ERFP appropriates 20% of deposited funds into the Renewable Resource Trust Fund per Senate Bill 1036. It is estimated that approximately $75 million would be allocated to the ERFP by the CEC for calendar years 2007 through 2011.

7.3.3 Biomass-to-Energy Incentive Grant Program

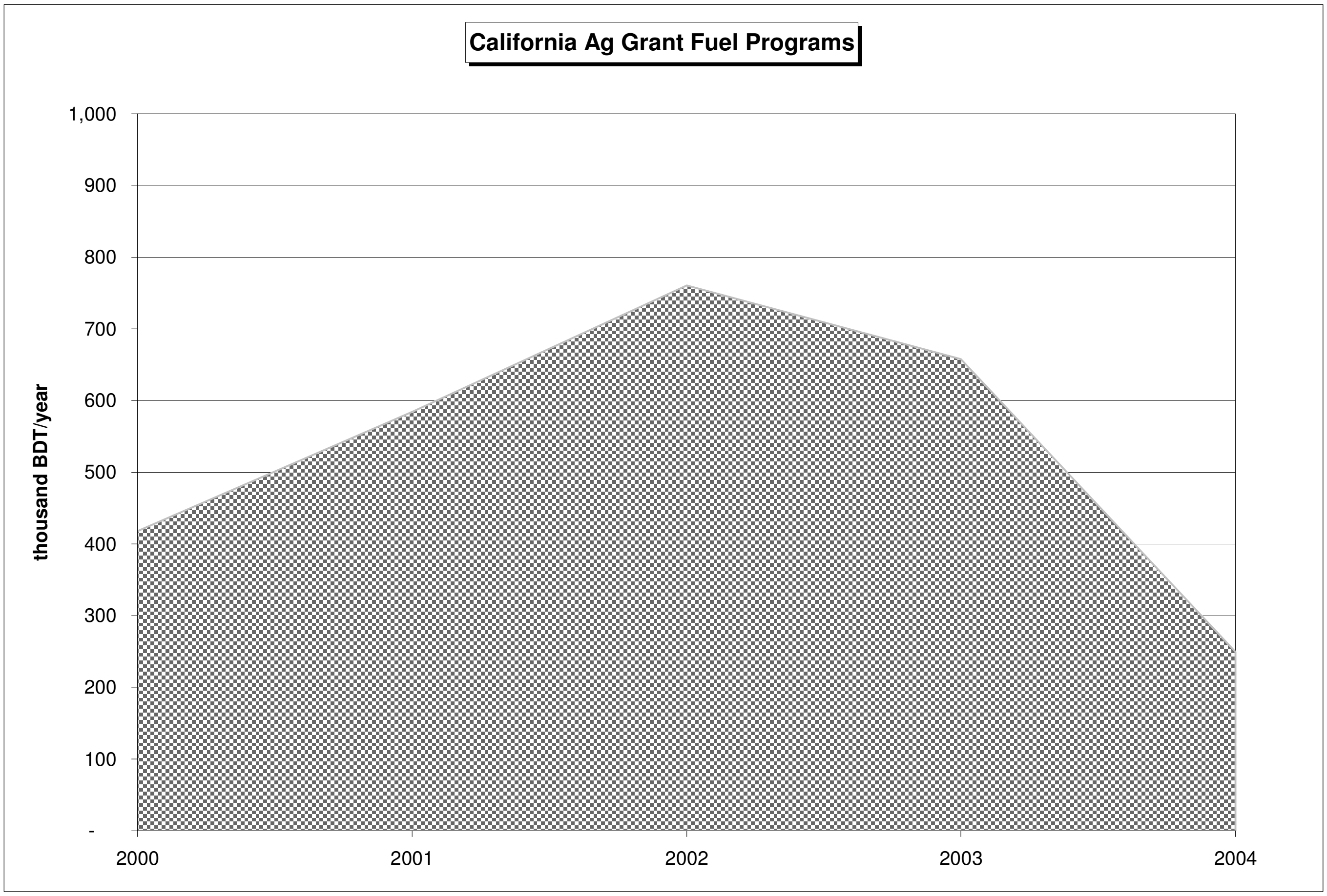
The Biomass-to-Energy (BTE) Incentive Grant Program was a state funded program in operation from 2000 to 2003 that promoted the increased use of agricultural materials. The State allocated $6 to $7.7 million per year to qualified biomass power plant applicants. The BTE incentive program allocated about ten-dollars ($10) per ton for the qualified agricultural biomass purchased by biomass power plants. District staff estimated that emissions reductions achieved from this program were over 5,200 tons of emissions in FY 2000/2001 and over 6,400 tons of emissions in FY 2001/2002. District staff believes that the Biomass-to-Energy incentive program provided a cost-effective alternative method for the growers and contributed to the increased use of agricultural materials for biomass fuel.

One northern SJVAB biomass power plant, while participating in the BTE incentive program, was burning 109,500 tons of agricultural material, up from around 87,000 tons of agricultural material in 1999 before the beginning of the program. As of the December of 2008, the plant has dropped back down to about 83,000 tons burned; hovering around permit offset requirements of 75-85,000 tons of agricultural material. The graph below demonstrates this shift from the end of the BTE incentive program in 2003 to 2007. At full capacity, this biomass power plant could burn up to 115,000 tons of agricultural material annually. There is a similar trend seen in a Southern SJVAB power plant that by permit is not required to offset emissions. At this facility agricultural material use went from 45,000 BDT burned in 2003 down to zero burned in 2008.

Under the BTE grant program the District saw a significant increase in the quantity of agricultural materials burned. Before the program, from 1994-1999, an average of 483,000 tons of agricultural materials was burned in the SJVAB. In 2000, the average agricultural material use increased to 636,469 tons for the year. The second year of the program (2001) showed an even bigger increase in agricultural materials burned with an average of 961,247 tons for the SJVAB with $7.7 million in funding.

Figure 7-11 further demonstrates this trend of more agricultural material consumed during the two years of the BTE. The figure illustrates a four-year period; the third year only had partial funding.

Figure 7-11 Agricultural Biomass from 2000 to 2004



Morris, G., *Biomass Energy Production in California 2006: Update of the California Biomass Database*, report of the Green Power Institute, December 2006.

According to CBEA, the Biomass Crop Assistance Program is also a short term incentive program, which was authorized by the 2008 Farm Bill. Under this program, owners of all types of agricultural material can receive a dollar-for-dollar matching payment for agricultural material sold to a Qualified Bioenergy Facility. This program is intended to be a direct payment to growers and chipping operators to encourage use of the material to produce bioenergy. This program does not include biomass facilities. The BCAP went into effect toward the end of 2009 and is expected to continue funding for five years.

7.4 DISCUSSION

Biomass facilities have no firm commitment for how much agricultural materials they will accept in the future. The lower cost of urban versus agricultural fuel for biomass facilities, combined with the historical overview of fuel usage, creates uncertainty for staff about biomass operators willingness increase and maintain the use of agricultural materials in the future, particularly when the construction industry recovers. Although there are regulations and policies in place for renewable energy use for the utility companies, there are several other sources of renewable energy fuels besides biomass fuel that the utility companies are using. Therefore, there is no guarantee that biomass facilities will obtain and maintain contracts with utility companies to encourage continued and increased use of agricultural materials as a renewable fuel.

Biomass power plants are unlikely to increase agricultural fuel usage to one hundred percent of their fuel usage. Historical data shows that the biomass plants accept more than fifty percent of the fuel from urban or other sources rather than from agricultural material suppliers. The recent decline in the construction industry has limited the amount of urban fuel available from that industry and which may explain why biomass facilities have increased their intake of agricultural materials as fuel. When the construction industry recovers with the recovery of the economy, it is likely that the lower cost urban waste will again cause it to increase as a larger percent of the biomass fuel source.

Renewable energy contracts between the biomass plants and utility companies exist but research was only able to find a few of the biomass facilities have such contracts. There are several other sources of renewable energy, such as wind and solar power, available to the utility companies and they are taking full advantage of those opportunities. The deadline for utilities to meet the 20% requirement for renewable energy is 2010. The utilities are meeting this requirement with a mix of renewable energies. This makes the possibility of increased biomass production to meet increased demand from utilities uncertain, at this time.

There are currently no long-term federal or state funding commitments for biomass power plants. There are currently short-term state and federal commitments that are scheduled to expire within the next few years. Research indicates that the federal Renewable Energy Production Tax Credit program is set to expire in 2013, and the state Existing Renewable Facilities Program is set to expire in 2011. District staff is unaware of any other Federal or State programs currently in place or in the planning stages. Both of these programs indirectly subsidize the growers through reduce costs for chipping and hauling the agricultural materials instead of open burning. Given the narrow operating margin common to agricultural operations, loss of such subsidies could increase the removal costs for crops that are currently banned from open burning and those that are being considered for such a prohibition. Therefore, reliance on biomass facilities as a primary, long-term alternative method to open burning is not possible since there are no long-term federal or state funding commitments for the biomass facilities in the SJVAB.

Chapter 8

Air Quality Impacts of Continued Open Burning and Alternatives

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Chapter 8: Air Quality Impacts of Continued Open Burning & Alternatives

8.1 SMOKE MANAGEMENT SYSTEM

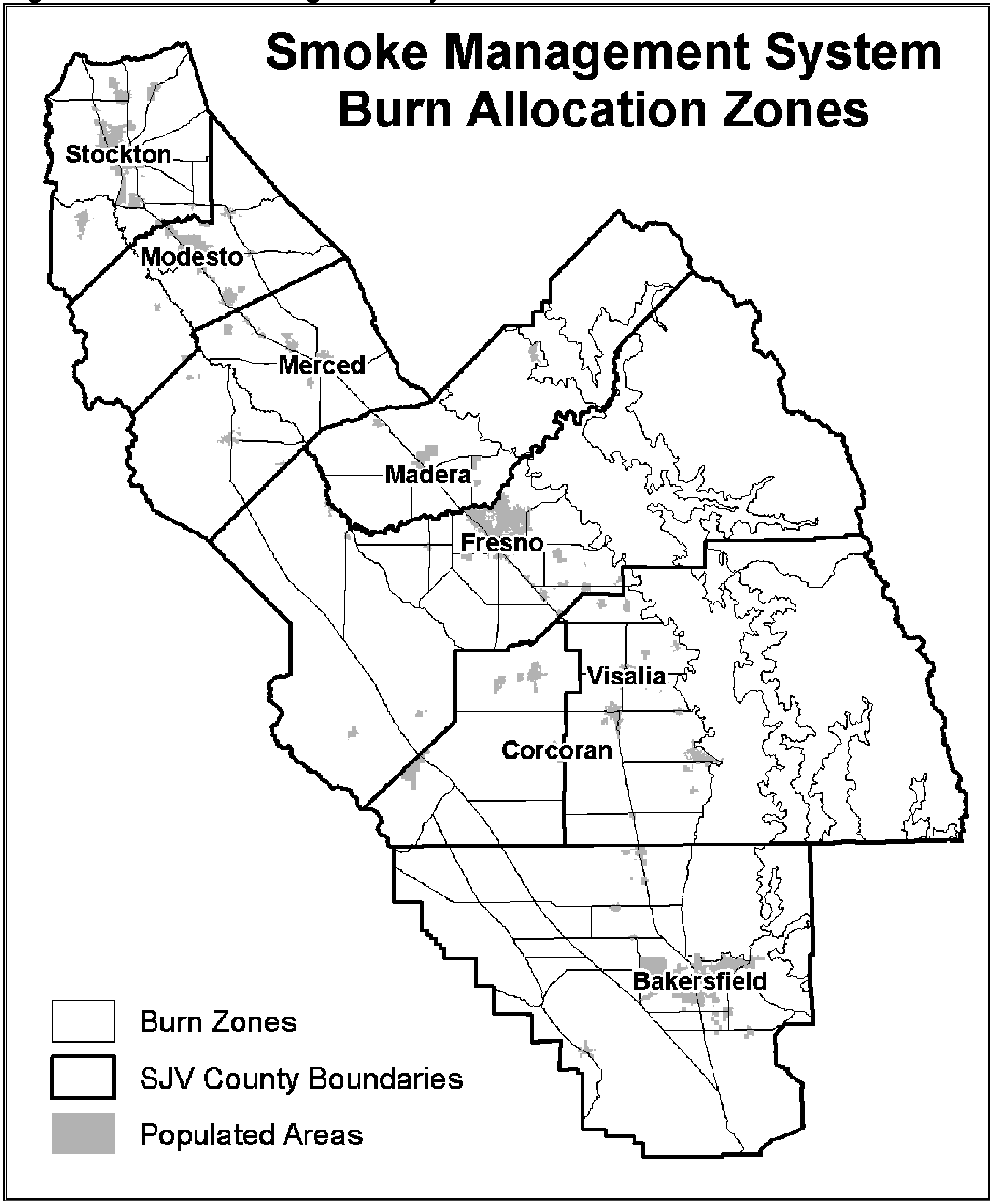
Open burning of agricultural crops and materials is managed by the District's Smoke Management System (SMS). The SMS uses a combination of real-time meteorological information and computer modeling to determine the allowable amount and location of agricultural burning. Under the SMS, the amount of burning allowed to take place on any given day would be based on several factors such as the local meteorology, the air quality conditions, the atmospheric holding capacity, the amount of burning already approved in a given area, and the potential impacts on downwind populations. The District's use of the SMS is intended to limit emissions to levels below the federal ambient air quality standards and to better distribute emissions temporally and spatially for flexibility of burn days for growers while minimizing the impact on the public.

Under the SMS, the SJVAB is classified into three regions (north, central, and south), the number of which will be determined by the topographical, geological and meteorological conditions in the San Joaquin Valley Air Basin (SJVAB). Burning is allocated by region, depending upon each region's carrying capacity for smoke on each day. Not every burner who wants to burn on a given day may be able to do so. Therefore, the District established a system for prioritizing burning within each region. The SMS analyzes the daily impact of open burning on air quality in 103 zones in the SJVAB.

Because of the general locations where agricultural and prescribed burning activities tend to occur, combined with the topography, geology, and weather conditions in the SJVAB, it is expected that the regions will fall into three categories: (a) regions where only prescribed burning will occur; (b) regions where only agricultural burning will occur; and (c) regions where both prescribed and agricultural burning will occur. In regions where only agricultural burning will occur, the allocation will be on a first come, first served basis. However, burners who do not receive an allocation on a particular day will be placed on a waiting list for the following day(s). The District has established a procedure whereby burners on the waiting list receive notification when their allocation is going to be available. Properly managed burning allocations under the existing District SMS ensures that air quality and health impacts of open burning of agricultural materials, prescribed burning, and hazard reduction burning are minimized to the fullest extent.

Figure 8-2 shows the burn allocation zones in each of the eight counties in the SJVAB

Figure 8-2 Smoke Management System Burn Allocation Zones



8.2 2007 OZONE PLAN

Air monitoring data in the San Joaquin Valley Air Basin (SJVAB) indicates ozone levels that exceed the eight-hour ozone National Ambient Air Quality Standards (NAAQS) set by the federal government to protect public health and welfare. As a result, the United States Environmental Protection Agency (EPA) has classified the Valley as serious nonattainment. In accordance with the requirements of the federal Clean Air Act, nonattainment areas must develop plans to achieve attainment of the NAAQS. Consequently, the San Joaquin Valley Unified Air Pollution Control District (District), adopted the 2007 Ozone Plan. The Ozone Plan contains a comprehensive and exhaustive list of regulatory and incentive-based measures to reduce emissions of ozone and particulate matter precursors throughout the Valley. Additionally, the Plan calls for major advancements in pollution control technologies for mobile and stationary sources of air pollution, and a significant increase in state and federal funding for incentive-based measures to create adequate reductions in emissions to bring the entire Valley into attainment with the federal ozone standard.

In preparing the Ozone Plan, consistent with the District's guiding principle, the control strategy in the Plan is developed with the utmost consideration to future needs for the PM2.5 Attainment Plan discussed below. Both Plans' focus is based on NOx reduction strategy. Consequently, the control strategy to attain the federal 8-hour ozone standard produces NOx emissions reductions that are close to what is needed for attainment of the 1997 PM2.5 standards by the maximum statutory attainment date of April 15, 2015. This suggests that the ozone strategy will provide most – if not all – of the reductions needed to attain the PM2.5 annual standard, based on simple modeling exercises. There is a possibility that that some additional NOx emissions reductions from incentive-based measures may be needed to demonstrate attainment of the 19977 annual PM2.5 standard.

Appendix I of the Ozone Plan listed the Control Measures that are needed to achieve attainment of the standards. One of these Control Measures is S-AGR-1 Open Burning, which addressed the phased-down prohibitions of burning agricultural materials mandated by the state Health and Safety Code Sections 41855.5 and 41855.6. District Rule 4103 (Open Burning) in conjunction with the District's "Staff Report and Recommendations on Agricultural Burning" is the mechanism by which the District is implementing the agricultural materials open burn prohibition.

8.3 2008 PM2.5 PLAN

In 1997, EPA sets two PM2.5 standards: a 24-hour standard (65 $\mu g/m^3$) to protect short term health impacts, and a 12-month (annual) standard (15 $\mu g/m^3$)

to protect against long-term impacts. The San Joaquin complied with the 24-hour standard, based on data from 2004 through 2006. In 2006, EPA revised the 24-hour standard to lower the standard (35 µg/m^3). It is estimated that that attainment plans for this new standard may be required by 2012 or 2013.

EPA has designated the San Joaquin Valley Air Basin as nonattainment of the federal PM2.5 standards. In April 2008, the District Governing Board adopted the PM2.5 Plan that demonstrates the strategies the District will pursue in order to achieve attainment of the federal PM2.5 standards. The 2008 PM2.5 Plan builds upon the comprehensive strategy adopted in the District's 2007 Ozone Plan to bring the San Joaquin Valley Air Basin into attainment of the federal PM2.5 standards. In preparing the 2007 Ozone Plan, the control strategy was developed with utmost consideration to future needs for the PM2.5 attainment plan. An evaluation of the District's ozone control strategy to attain the federal 8-hour ozone standard has determined that the ozone plan included NOx emissions reductions that are close to what is needed for attainment of the 1997 PM2.5 standards by the maximum statutory date attainment date of April 5, 2015. Based on simplified modeling exercises performed at the time of the ozone plan was completed, the ozone control strategy was determined to have a design value that would provide most – if not all – of the reductions needed to attain the PM2.5 annual standard.

Appendix I of the PM2.5 Plan listed the Control Measures that are needed to achieve attainment of the standards. One of these Control Measures is S-AGR-1 Open Burning, which addressed the phased-down prohibitions of burning agricultural materials mandated by the California Health and Safety Code (CH&SC) Sections 41855.5 and 41855.6. District Rule 4103 (Open Burning) in conjunction with the District's "Staff Report and Recommendations on Agricultural Burning" is the mechanism by which the District is implementing the agricultural materials open burn prohibition.

8.3.1 Annual PM2.5 Standard

As discussed in the District 2008 PM2.5 Plan, attainment of the annual standard is projected by 2014 by the regional photochemical model and all receptor evaluations. The predicted value is within one microgram of the standard; therefore, a weight of evidence evaluation is appropriate. The predictions of these models are compared, along with air monitoring data, trends and other technical information, to establish a weight of evidence assurance that attainment will be achieved. The weight of evidence evaluation supports acceptance of the regional and receptor modeling predictions. Evaluation of the receptor modeling identifies that attainment will not occur by 2009 with the expected achievable reductions and will require the extensive NOx reductions proposed by ARB for 2014. Reductions achieved by the District and current ARB efforts for all directly emitted and secondary particulate sources are important to achieving attainment. The proposed NOx reductions for 2014 would not be sufficient to achieve attainment without these other reductions. The strategy for attainment includes reduction of directly emitted PM2.5 (geologic, mobile, organic carbon and vegetative burning) as well as reductions from SOx and NOx as precursors to ammonium sulfate and ammonium nitrate. Secondary organic aerosol particulate formation is also included in the modeling evaluation of motor vehicle and organic carbon contributions.

8.3.2 24-Hour PM2.5 Standard

As discussed in the District 2008 PM2.5 Plan, attainment of the prior 24-hour 65 microgram standard is projected to occur prior to 2014 and with much less reductions required than are needed to attain the annual standard. This means that the annual standard identifies the amount of reductions needed to achieve attainment. ARB used the regional model to evaluate the top 25% of days modeled to provide the annual analysis. Based on design values for 2005, ARB projected a 2014 value of 45 micrograms or less at all sites. Due to concerns that the last two years have experienced slightly higher 24-hour values, the District also performed a screening assessment with estimated design values for 2007 (based on incomplete and uncertified data). Evaluation by the District projected a 2014 value of 53 micrograms. Both of these projections are well below the 65 microgram standard and do not require a weight of evidence evaluation.

Unmonitored area evaluation for the year 2014 was conducted by ARB and provides confirming evidence for the attainment demonstration. The unmonitored area evaluation requires examination of regional modeling results for the entire Valley. ARB has provided a screening assessment produced from the regional model results for the year 2014 to determine if any portion of the modeling domain predicts concentrations greater than the monitored locations. This initial analysis did not identify any grid squares that have higher values. ARB has committed to conduct further evaluation in accordance with EPA guidance should this be determined to be necessary; however, the screening assessment indicates that it is unlikely that any areas will be identified that require subsequent evaluation or temporary monitoring. The District and ARB will confer with EPA to ensure that the unmonitored area evaluation provides sufficient confirmation for the attainment demonstration.

8.4 OPEN BURNING EMISSIONS INVENTORY

The prohibition of open burning of certain materials has been implemented by adopting Rule 4103 in June 1992. The rule was subsequently amended in December 1992, December 1993, June 2001, September 2004, May 2005, and May 2007. The emissions inventory from the *2007 Ozone Plan* and the *2008*

PM2.5 Plan for Control Measure S-AGR-1 (Open Burning) are shown in Table 1 below. The projected emission reductions and actual estimated emissions reductions for the 2010 burn prohibition schedule are presented in Table 2 and Table 3 below. Both of the plans did not include the projected emissions reduction from 2007 and 2010 burn prohibition deadlines.

Since District's implementation of the open burning prohibitions of agricultural materials pursuant to the state law requirements, emission of NOx, PM, and VOC from this source category has significantly been reduced. The emissions reductions achieved so far are more than the estimated amount indicated in the *PM2.5 Plan* and *Ozone Plan*. In addition to fulfilling the CH&SC 2010 burn prohibition deadline and the requirements from Rule 4103, the District has also met the State Implementation Plan commitments for this source category.

Table 8 – 1 Emissions Inventory from the PM2.5 and Ozone Plans for Open Burning

Emissions Inventory for Open Burning (S-AGR-1)	**NOx (tpd)**	**PM2.5 (tpd)**	**VOC (tpd)**	**SO_2 (tpd)**
PM2.5 Plan: Emissions Inventory by 2010	5.27	6.94	n/a	0.13
Ozone Plan: Emissions Inventory by 2008[1]	4.8	n/a	5.7	n/a

1. The Ozone Plan does not show projected reductions for 2010.

Table 8 – 2 *PM2.5 Plan* Projected Emissions Reduction for Open Burning

***PM2.5 Plan*: Emissions Reduction**	**NOx (tpd)**	**PM2.5 (tpd)**	**VOC (tpd)**	**SO_2 (tpd)**
PM2.5 Plan: Projected Annual Average Reductions for the Open Burning Control Measure by 2010[1]	1.95	2.57	n/a	0.05
PM2.5 Plan: Estimated Reductions from 2007 Burn Prohibition Deadline (Annual)	3.54	4.57	n/a	0.09
PM2.5 Plan: Estimated Reductions from 2010 Burn Prohibition Deadline (Annual)	0.54	1.79	n/a	0.03
District's Total Estimated Reductions for Open Burning	**4.08**	**6.36**	**n/a**	**0.12**

1. The projected reductions include emissions from the rulemaking projects from the 2007 and 2010 CH&SC deadlines.
*tpd: tons per day; N/A: not applicable to the Plan

Table 8 – 3 *Ozone Plan* Projected Emissions Reduction for Open Burning

***Ozone Plan*: Emissions Reduction**	**NOx (tpd)**	**PM2.5 (tpd)**	**VOC (tpd)**	**SO_2 (tpd)**
Ozone Plan: Projected Annual Average Reductions for the Open Burning Control Measure by 2008[1]	1.1	n/a	1.3	n/a
Ozone Plan: Estimated Reductions from 2007 Burn Prohibition Deadline (Annual)	3.2	n/a	3.7	n/a
Ozone Plan: Estimated Reductions from 2010 Burn Prohibition Deadline (Annual)	0.5	n/a	1.5	n/a
District's Total Estimated Reductions for Open Burning	**3.7**	**n/a**	**5.2**	**n/a**

1. The projected reductions include emissions from the rulemaking projects from the 2007 and 2010 CH&SC deadlines.
*tpd: tons per day; N/A: not applicable to the Plan

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Chapter 9

Determinations Required by State Law

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Chapter 9: DETERMINATIONS REQUIRED BY STATE LAW (for each affected crop/material)

9.1 ECONOMIC FEASIBILITY

The District has determined that there were no economically feasible alternatives for eliminating the material generated from the mentioned crops, which would allow the District to completely prohibit burning.

The table below shows the crop categories and District staff's recommendations.

Table 9-1 - Crop Categories and Recommendations

Crop Categories and Crop type	Current Method	Potentially Feasible Alternative(s)	Economically Feasible?	Recommendations
Vineyard Removal Materials				
Grape and Kiwi Crops	Open Burn	Possibly Biomass. Wire Issue.	No	Allow Burn
Orchard Removal Matter				
Small Other Orchards - 15 acres or less (Currently at 20 acres or less)	Open Burn / Biomass	Biomass	Yes	Reduce Burn to 15 acres or less per location per year. No case by case determinations for additional acreage.
Fig Crops	Open Burn / Biomass	Biomass.	See "Small Other Orchards – 15 acres or less" category.	Reduce Burn to 15 acres or less per location per year. No case by case determinations for additional acreage.
Citrus Crops	Open Burn	Possibly Biomass. Capacity Issue.	No	Allow Burn
Apple, Pear, and Quince Crops	Open Burn	None. Disease Issue.	N/A	Allow Burn
Weed Abatement				
Ponding & Levee Banks	Open Burn	None. Mowing and Herbicide Issues.	N/A	Allow Burn.
Other Materials				
Brooder Paper	Landfill	Landfill	N/A	**Prohibit Burn**
Deceased Goats	Burial	Burial	N/A	**Prohibit Burn**
Diseased Bee Hives	Open Burn	None. Disease Issue.	N/A	Allow Burn
Rice Stubble				
	Baling + Selling / Open Burn	Baling + Selling / Open Burn. Market and Water Issues.	Immediate additional phase-down is not economically feasible: low market for rice straw	Interim phase-down schedule would be modified: • Only 70% of acreage can be burned starting 6/1/08 • 50% limitation (6/1/10) would be removed • Burning is prohibited starting 6/1/15
Prunings				
Apple, Pear, and Quince Crops	Open Burn	None. Disease Issues.	N/A	Allow Burn.
Fig Crops	Soil Incorporation	Soil Incorporation	N/A	**Prohibit Burn.**

*N/A: Not applicable. Practices for these crop types are either already in place or there were no technologically feasible alternatives to open burning for these crop types.

Table 9-1 - Crop Categories and Recommendations (Continued)

Crop Categories and Crop type	Current Method	Potentially Feasible Alternative(s)	Economically Feasible?	Recommendations
Surface Harvested Prunings				
Grape vines – other prunings from grape vines	Soil Incorporation	Soil Incorporation	N/A	**Prohibit Burn**
Grape canes – defined as "Vineyard Materials"	Soil Incorporation	Soil Incorporation	N/A	**Prohibit Burn**
Raisin Trays – defined as "Vineyard Materials"	Open Burn	None. Material Type & Recycling Issues.	N/A	Allow Burn
Almond, Walnut, and Pecan Crops	Open Burn / Shred / Biomass	Shred / Biomass	Yes. if custom shedding services are available and economical for smaller growers	1. Prohibit burning of prunings for each agricultural operation whose total nut acreage (i.e., almonds, walnuts, and pecans) at all agricultural operation sites is 3,500 acres or more. 2. For each agricultural operation whose total nut acreage at all agricultural operation sites is less than 3,500 acres, a. Allow burning of up to 20 acres of prunings per year, and b. Allow burning of additional prunings, provided: i. The operator submits to the APCO before the pruning operation is completed, a representative cost estimate(s) for shredding all prunings generated by the total nut acreage at the agricultural operation site. The cost estimate(s) shall reflect shredding in a time frame that allows the operator to proceed with established post-pruning cultural practices. ii. The APCO determines that either the submitted cost estimate(s) represent(s) an unreasonable financial impact to the operator, or that adequate shredding services are not available in time for the operator to proceed with established post-pruning cultural practices.

*N/A: Not applicable. Practices for these crop types are either already in place or there were no technologically feasible alternatives to open burning for these crop types.

9.2 FEDERAL & STATE COMMITMENTS FOR BIOMASS FACILITIES

The District has determined that there were no long-term federal or state funding commitments for the operation of biomass facilities or development of alternatives to burning. The District supports legislation that will encourage, promote, and facilitate alternative uses for agricultural material. The District also supports policies and initiatives that encourage renewable energy and energy efficiency, including supporting legislation that provides additional biomass capacity utilizing agricultural materials.

Biomass facilities have received funding from short-term programs such as the Existing Renewable Facilities Program (ERFP) through the CEC and federal corporate tax credits from a short-term federal program called the Renewable Electricity Program Tax Credit (PTC). The California State Legislature will determine future funding for biomass facilities.

9.3 AIR QUALITY IMPACTS

The District determined that the continued issuance of burn permits for these crop categories would not cause or substantially contribute to a violation of an applicable federal ambient air quality standard. Burning of agricultural waste materials are managed by the District's Smoke Management System (SMS). The SMS uses a combination of real-time meteorological information and computer modeling to determine the allowable amount and location of agricultural burning. District's use of the SMS would limit combustion emissions to levels below the violation threshold of any applicable federal ambient air quality standard.

9.4 ARB CONCURRENCE

District staff has forwarded this report with the District's recommendations to ARB for review. Prior to the District's Governing Board's consideration of approval of the revised proposed recommendations, District staff has worked with ARB toward a concurrence with the determinations, as required by the CH&SC Section 41855.6. ARB held a Governing Board Hearing on May 27, 2010 to present the staff's report and recommendations. As a result, ARB concurred with the District Governing Board's determinations and requested that the District re-evaluate the determinations within two years.

Chapter 10

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Appendix A

Amended Rule 4103

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RULE 4103 OPEN BURNING (Adopted June 18, 1992; Amended December 17, 1992; Amended December 16, 1993; Amended June 21, 2001; Amended September 16, 2004; Amended May19, 2005; Amended May 17, 2007; Amended April 15, 2010 - Not effective until June 1, 2010)

1.0 Purpose

The purpose of this rule is to permit, regulate, and coordinate the use of open burning while minimizing smoke impacts on the public.

2.0 Applicability

This rule applies to open burning conducted in the San Joaquin Valley Air Basin, with the exception of prescribed burning and hazard reduction burning as defined in Rule 4106 (Prescribed Burning and Hazard Reduction Burning).

3.0 Definitions

3.1 Agricultural Burning:

3.1.1 The open burning of vegetative materials produced wholly from agricultural operations.

3.1.2 The burning of grass and weeds in fence rows, ditch banks, and berms in non-tillage orchard operations and fields being prepared for cultivation.

3.1.3 The burning of materials not produced wholly from agricultural operations but which are essential to agricultural operations, except as prohibited by Section 5.5.7 of this rule. Examples are paper trays for drying raisins, paper hot caps, untreated grape stakes, and pesticide and fertilizer sacks burned in the field where they are emptied.

3.2 Agricultural Operations: the growing and harvesting of crops or the raising of fowl or animals, for the primary purpose of earning a living, or of conducting agricultural research or instruction by an educational institution.

3.3 Agricultural Waste: any vegetative materials produced wholly from agricultural operations, the operation or maintenance of a system for the delivery of water in agricultural operations, or materials described in Section 3.1.3.

3.4 Air Pollution Control Officer (APCO): the Air Pollution Control Officer of the San Joaquin Valley Unified Air Pollution Control District, as defined in Rule 1020 (Definitions).

3.5 Air Quality: the characteristics of the ambient air as indicated by concentrations of the six criteria air pollutants for which Federal and State standards have been established pursuant to section 108 and 109 of the Federal Clean Air Act [i.e., particulate matter, sulfur dioxide, nitrogen dioxide, ozone, carbon monoxide and lead], by State air quality standards, and by visibility in mandatory Federal Class I areas, as specified pursuant to section 169A of the Federal Clean Air Act.

3.6 Allocation System: a system in the smoke management program that limits the amounts, timing, and locations of burning in order to minimize smoke impacts.

3.7 Ambient Air: that portion of the atmosphere, external to buildings, to which the general public has access.

3.8 Ambient Air Quality Standards: the national ambient air quality standards (NAAQS) promulgated by the US Environmental Protection Agency.

3.9 Approved Ignition Devices: those instruments or materials that will ignite agricultural waste and other materials without the production of black smoke by the ignition device. This would include such devices as liquid petroleum gas, butane, propane, or diesel oil burners and flares where the device produces a flame and the flame is then used for ignition, or other devices approved by the Air Pollution Control Officer (APCO).

3.10 ARB or State Board: the California Air Resources Board.

3.11 Board: the Governing Board of the San Joaquin Valley Unified Air Pollution Control District, as defined in Rule 1020 (Definitions).

3.12 Campfire: an attended recreational fire at a designated campground or in a Wildland, as defined in Rule 4106 (Prescribed Burning and Hazard Reduction Burning), when approved by the appropriate land manager. A campfire shall not be larger than three feet in diameter and the fuel must be clean, dry wood with no other debris, trash, garbage or refuse.

3.13 Contraband: any illegal material or prohibited good that has been confiscated within the San Joaquin Valley Air Basin by a law enforcement agency or fire department, including but not limited to explosives, pyrotechnics, and illegal drugs.

3.14 EPA: the United States Environmental Protection Agency or any person designated to act on its behalf.

3.15 Field Crops: includes alfalfa, asparagus, barley stubble, beans, corn, cotton, flower straw, hay, lemon grass, oat stubble, pea vines, peanuts, rice stubble, safflower, sugar cane, vegetable crops, and wheat stubble, and other field crops, as determined by the State Board.

3.16 Fire Hazard: a situation in which a fire could present a threat to the health and/or safety of a person or persons but which does not impose imminent fire danger.

3.17 Fire Protection Agency: any agency with the responsibility and authority to protect people, property, and the environment from fire, and having jurisdiction within the San Joaquin Valley Air Basin.

3.18 Imminent and Substantial Economic Loss: the loss of a planting season or the irreparable harm of a crop.

3.19 Imminent Fire Hazard: a hazard that presents imminent danger to the health and/or safety of a person or persons and for which direct abatement by fire is necessary.

3.20 Metropolitan Area: the sphere of influence of an incorporated city as defined by the Local Agency Formation Commission.

3.21 No-Burn Day: any day on which agricultural burning is prohibited by the ARB, the District, or by a public fire protection agency for purposes of fire control or prevention.

3.22 Noxious Weeds: as defined in Section 403 of the Plant Protection Act (7 USC 7702).

3.23 Open Burning or Open Outdoor Fire: the combustion of any combustible refuse or other material of any type outdoors in the open air, not in any enclosure, where the products of combustion are not directed through a flue. For the purposes of this rule, prescribed burning and hazard reduction burning are not considered to be open burning.

3.24 Orchard Removal Matter: agricultural waste generated by the removal of orchards. This includes leaves, branches, trunks, roots, stumps and untreated branch support sticks.

3.25 Orchard Removals: includes, but is not limited to orchard removal matter, stumps, and untreated sticks.

3.26 Other Materials: includes, but is not limited to brooder paper, deceased goats, and diseased bee hives.

3.27 Other Weeds and Maintenance: includes, but is not limited to, ditch bank work, canal bank work, dodder weed, star thistle, tumbleweed, noxious weeds, pesticide sacks, and fertilizer sacks burned in the fields where they are emptied.

3.28 Permit: as used herein refers to a District Open Burn Permit.

3.29 Prunings: the vegetative material produced from the regularly scheduled removal of any portion of the agricultural crop for the purpose of achieving a desired size, shape, or to promote plant growth for improved cultivation, harvesting, and the maintenance of crop health. The regularly scheduled removal does not include the incidental cuttings of dead or broken branches, water-sprouts or suckers, and other damaged crops. For the purpose of this rule, prunings shall refer to prunings from apple crops, apricot crops, avocado crops, bushberry crops, cherry crops, Christmas trees, citrus crops, date crops, eucalyptus crops, fig crops, kiwi crops, nectarine crops, nursery prunings, olive crops, pasture or corral trees, peach crops, pear crops, persimmon crops, pistachio crops, plum crops, pluot crops, pomegranate crops, prune crops, quince crops, rose crops, and other prunings, as determined by the State Board.

3.30 Religious Ceremonial Fires: any fires conducted to fulfill the doctrinal requirements of an organized religion.

3.31 Residual Rice Stubble: rice stubble remaining on the field that can not be removed completely by the bailing equipment.

3.32 Single Location: a property where burning is conducted, which is under the same or common ownership or operation, and located on one (1) or more parcels. For burn permit and fire reporting purposes, properties separated by rivers, streams, or publicly owned roadways and canals are considered separate locations.

3.33 Smoke Management Program: a District program that utilizes a daily allocation system for the purpose of limiting the amounts, timing, and locations of open burning to minimize smoke impacts. The smoke management program considers several factors including air quality, meteorological conditions expected during burning, locations of smoke sensitive areas, locations of materials to be burned, and types and amounts of materials to be burned.

3.34 Smoke Sensitive Areas: are populated areas and other areas where the District determines that smoke and air pollutants can adversely affect public health or welfare. Such areas can include, but are not limited to, towns and villages, campgrounds, trails, populated recreational areas, hospitals, nursing homes, schools, roads, airports, public events, shopping centers and mandatory Class 1 areas.

3.35 Spot Burning: burning of rice stubble in areas of the field where rice stubble has been compacted or flattened by the harvesting or baling equipment tracks.

3.36 Surface Harvested Prunings: the vegetative material produced from the regularly scheduled removal of any portion of the agricultural crop for the purpose of achieving a desired size, shape, or to promote plant growth for improved cultivation, harvesting, and the maintenance of crop health. The regularly scheduled removal does not include the incidental cuttings of dead or broken branches, water-sprouts or suckers, and other damaged crops. For the purpose of this rule, surface harvested prunings includes, but is not limited to, almond prunings, walnut prunings, pecan prunings, grape vines, and vineyard materials.

3.37 Toxic Substances: substances identified by the manufacturer on the package or in a material safety data sheet as posing health hazards.

3.38 Vineyard Removal Materials: agricultural waste generated by the removal of vineyards. This includes grape vines, grape canes, trunks, roots, untreated grapestakes, and wires, as well as similar materials from kiwi vineyards.

3.39 Vineyard Materials: includes, but is not limited to, grape canes and raisin trays.

3.40 Weed Abatement: the reduction or removal of noxious weeds and grasses. Weed abatement includes, but is not limited to, berms, Bermuda grass, fence rows, grass, pasture, and ponding or levee banks.

4.0 Exemptions

4.1 The requirements of this rule shall not apply to:

4.1.1 Open outdoor fires used solely for the purpose of cooking food for human consumption, campfires, and religious ceremonial fires, where the combustible material is clean, dry wood or charcoal.

4.1.2 The prevention of an imminent fire hazard declared by a fire agency that cannot be abated by any other means.

4.1.3 The setting of backfires necessary to save life, and/or in the defense of assets at risk pursuant to Section 4426 of the Public Resources Code.

4.1.4 The burning, in a respectful and dignified manner, of an unserviceable American Flag that is no longer fit for display.

4.1.5 The burning of agricultural waste or crops pursuant to a lawful abatement order issued by the local county agricultural commissioner as described in Section 5403 and 5404 of the California Food and Agricultural Code.

4.2 The following activity is exempt from rule requirements, but may only be conducted pursuant to Air Pollution Control Officer (APCO) written authorization:

4.2.1 A fire set by or authorized by any public officer authorized in the performance of his official duty to engage in fire protection activities provided that a burn plan, as described in Section 6.2.1, has been previously submitted to and approved by the APCO and such a fire is necessary for the instruction of employees in fire fighting methods.

4.3 The following activities are exempt from the no-burn day restrictions of Section 6.1.8, subject to APCO authorization and permit requirements. These activities are not exempt from the provisions of Sections 5.1 through 5.5:

4.3.1 The burning of empty sacks which contained pesticides or other toxic substances, provided that the sacks are within the definition of agricultural burning in Section 3.1.3.

4.3.2 The burning of paper raisin trays.

4.3.3 Other agricultural burning, if the denial of such burning would threaten imminent and substantial economic loss, and which is conducted pursuant to the following provisions:

4.3.3.1 The APCO may only authorize such burning when downwind metropolitan areas are forecast by the District to achieve the ambient air quality standards and/or a fire agency has not declared a no-burn day due to safety issues.

4.3.3.2 The District shall limit the amount of acreage that can be burned on any one no-burn day in any one county to 200 acres.

4.3.3.3 The granting of an exemption does not exempt the applicant from any other District or fire control regulations.

4.3.3.4 Within fifteen (15) days of the granting of an exemption, the applicant shall return a signed application form that provides the reasons for requesting the exemption and shall pay the required District fee for said exemption.

4.3.4 The burning of contraband is exempt from the no-burn day restrictions of Section 6.1.8, but may only be conducted pursuant to APCO written authorization and the preparation of a burn plan as described in Section 6.2.2. Contraband burning is subject to the provisions of Section 5.7.

5.0 Requirements

5.1 Except as otherwise provided in this rule, no person shall set, permit, or use an open outdoor fire for the purpose of disposal or burning of petroleum wastes; demolition or construction debris; residential rubbish; garbage or vegetation; tires; tar; trees; woodwaste; or other combustible or flammable solid, liquid or gaseous waste; or for metal salvage or burning of motor vehicle bodies.

5.2 The APCO shall allocate burning based on the predicted meteorological conditions and whether the total tonnage to be emitted would allow the volume of smoke and other contaminants to cause a public nuisance, impact smoke sensitive areas, or create or contribute to an exceedance of an ambient air quality standard.

5.3 The APCO shall restrict the time of day when burns are ignited and conducted, as necessary.

5.4 No open burning shall be permitted that will create a nuisance as defined in Section 41700 of the California Health and Safety Code.

5.5 Agricultural Burning

The following conditions are in addition to those requirements specified in Sections 5.1 through 5.4:

5.5.1 No permit shall be issued for the burning of the following categories of agricultural waste, except for crops covered by Section 5.5.2:

5.5.1.1 Field Crops,

5.5.1.2 Prunings,

5.5.1.3 Weed Abatement, except for categories covered by Section 5.5.3,

5.5.1.4 Orchard Removals,

5.5.1.5 Vineyard Removal Materials,

5.5.1.6 Surface Harvested Prunings, and

5.5.1.7 Other Materials.

5.5.2 The District may postpone the prohibitions in Section 5.5.1 and may issue permits for the burning of any agricultural waste, if all of the following criteria are met:

5.5.2.1 The Board determines that there is no economically feasible alternative means of eliminating the waste.

5.5.2.2 The Board determines that there is no long-term federal or state funding commitment for the continued operation of biomass facilities in the San Joaquin Valley or development of alternatives to burning.

5.5.2.3 The Board determines that the continued issuance of permits for that specific category or crop will not cause, or substantially contribute to, a violation of an applicable federal ambient air quality standard.

5.5.2.4 The California Air Resources Board concurs with the Board's determinations pursuant to this section.

5.5.3 Owner/operators shall use at least one of the Best Management Practices for the control of other weeds and maintenance listed in Attachment 1, or other practices as approved by the APCO, for the control of star thistle, dodder weeds, tumble weeds, noxious weeds, and weeds located along ditch banks or canal banks, and the disposal of pesticide sacks or fertilizer sacks. The APCO shall not approve any alternative practice unless it is demonstrated that the alternative is at least as effective in controlling emissions as the listed practices.

5.5.4 Agricultural waste shall not be burned unless it is arranged or loosely stacked in such a manner as to promote drying and insure combustion with a minimum of smoke production.

5.5.5 Agricultural waste to be burned shall be ignited only with an approved ignition device.

5.5.6 Agricultural waste shall not be burned unless it is free of excessive dirt, soil, and visible surface moisture.

5.5.7 Agricultural waste does not include and shall not be burned unless it is free of such items as plastic, rubber, ornamental or landscape vegetation, shop wastes, construction and demolition material, garbage, oil filters, tires, tar paper, broken boxes, pallets, sweatboxes, packaging material, packing boxes or any other material produced in the packing or processing of agricultural products, and pesticide and fertilizer containers (except sacks burned in the field where they were emptied).

5.5.8 Orchard or vineyard removal waste, or any other material, generated as a result of land use conversion from agricultural to nonagricultural purposes shall not be burned.

5.5.9 Agricultural waste shall not be burned unless it has been allowed to dry for the following minimum time periods:

Rice Straw	See Section 5.5.14.4
Prunings and Small Branches	Three (3) Weeks
Large Branches	Six (6) Weeks

5.5.10 Agricultural burning shall be monitored and attended as necessary to prevent smoldering.

5.5.11 No agricultural waste shall be burned except during daylight hours.

5.5.12 No agricultural waste shall be added to an existing fire after 5:00 p.m.

5.5.13 All burning shall be ignited as rapidly as practicable within applicable fire control restrictions.

5.5.14 Field crop burning:

The requirements of Section 5.5.14 do not apply to vines and tree pruning burning.

5.5.14.1 No field crop burning shall commence before 10:00 a.m., or after 2:00 p.m., of any day, unless local conditions indicate that other hours are appropriate.

5.5.14.2 Rice, barley, oat, and wheat straw shall be ignited only by strip firing into-the-wind or by backfiring, except under a special permit issued by the District when and where extreme fire hazards are declared by the public fire protection agency to exist, or where crops are determined by the District not to lend themselves to these techniques.

5.5.14.3 All rice harvesting shall employ a mechanical straw spreader to ensure even distribution of the straw with the exception that rice straw may be left in rows, provided it meets drying time criteria, as specified in Section 5.5.14.4 prior to a burn. Rice straw may also be left standing, provided it is dried and meets the crackle test criteria described in Section 5.5.14.5.

5.5.14.4 After harvesting, no rice straw shall be burned prior to the following drying periods:

5.5.14.4.1 Spread rice straw: three (3) days; or

5.5.14.4.2 Rowed rice straw: ten (10) days.

5.5.14.4.3 Sections 5.5.14.4.1 and 5.5.14.4.2 shall not apply if the rice straw makes an audible crackle when tested just prior to burning with the test method described in Section 5.5.14.5.

5.5.14.5 When checking the field for moisture, a composite sample of straw from under the mat, in the center of the mat, and from different areas of the field shall be taken to insure a representative sample. A handful of rice straw from each area will give a good indication. Rice straw is dry enough to burn if a handful of straw selected as described above crackles when it is bent sharply.

5.5.14.6 After a rain exceeding fifteen hundredths (0.15) inch, notwithstanding Section 5.5.14.3, rice straw shall not be burned unless the straw makes an audible crackle when tested just prior to burning with the test method described in Section 5.5.14.5.

5.5.14.7 The APCO may require additional conditions based on the condition of the materials to be burned.

5.6 Ditch Bank and Levee Maintenance

The following conditions are in addition to those requirements specified in Sections 5.1 through 5.4 for burning on-site grown vegetative material for right-of-way clearing, levee, and ditch bank maintenance by a public entity or utility:

5.6.1 Trash and debris must be removed prior to burning.

5.6.2 The material has been prepared by stacking, drying, or other methods to promote combustion as specified by the District.

5.7 Contraband Materials

The following conditions are in addition to those requirements specified in Sections 5.1 through 5.4 for the disposal of contraband materials by burning:

5.7.1 No contraband confiscated outside the District may be transported into the District for disposal by burning. Only contraband confiscated within the San Joaquin Valley Air Basin boundaries may be disposed of by burning.

5.7.2 Prior to the burn, a written notification of the planned burn must be submitted to the APCO pursuant to Section 6.2.2 of the rule.

5.7.3 Fires shall only be set or allowed by a peace officer or public fire official in the performance of official duty.

5.7.4 To the extent possible, materials must be burned in areas and in conditions limiting the possibility of smoke impacts on nearby neighbors and/or other smoke sensitive areas.

5.8 Russian Thistle (Salsola Kali) (tumbleweeds)

A District Permit is required for the burning of tumbleweeds. The Permit shall be issued in accordance with Sections 5.8.1, 5.8.2, and 6.1 and is only valid when the Permit applicant has received a burn authorization from the APCO that will allow burning on a particular day.

5.8.1 The burn site must be maintained in a fire safe condition according to the local fire protection agency.

5.8.2 The smoke and air contaminants shall not impact smoke sensitive areas, cause or contribute to a nuisance pursuant to Rule 4102 (Nuisance), or create or contribute to an exceedance of an ambient air quality standard. The APCO reserves the right to deny a Permit request if it might create a nuisance.

5.9 Diseased Materials

A conditional burning permit is required for fires set for the purpose of disease or pest prevention. A conditional burning permit shall authorize the burning of only the identified diseased crop, animal, fowl, pest or infected material.

5.9.1 A conditional burning permit will be issued by the APCO, if all of the following criteria are met:

5.9.1.1 The material to be burned is specifically described in the conditional burning permit.

5.9.1.2 The applicant has not been cited for a violation of burning rules or regulations in the past 3 years, unless the violation was of a de minimis nature, as determined by the APCO and the county agricultural commissioner, and

5.9.1.3 The county agricultural commissioner has determined all of the following:

5.9.1.3.1 There is no economically feasible alternative means of eliminating the disease or pest other than burning, and

5.9.1.3.2 There is the presence of a disease or pest that will cause a substantial, quantifiable reduction in yield or poses a threat to the health of adjacent vines, trees, or plants in the field proposed to be burned, during the current or next growing season, or there is the presence of a disease or pest that will cause a substantial, quantifiable reduction in production of animals or fowl.

5.9.2 The holder of a conditional burning permit may not transfer, sell or trade the burning permit to any other individual.

6.0 Administrative Requirements

6.1 Open Burn Permits

6.1.1 No person shall knowingly set or permit open burning unless the person has a valid Permit issued by the APCO and/or the designated agency having jurisdiction in the area where the open burning will take place.

6.1.2 A Permit applicant shall provide information as requested by the APCO and or designated agency. No Permit or authorization shall be deemed valid unless the applicant has provided the required information.

6.1.3 A Permit shall be valid only on the lands specified on the Permit.

6.1.4 No material shall be burned unless it is clearly described and quantified as material to be burned on a valid Permit.

6.1.5 Applications to burn orchard or vineyard removal waste must be reviewed and shall not be granted if the materials were generated in the process of land use conversion to nonagricultural purposes.

6.1.6 No burning shall be conducted pursuant to such a Permit without prior authorization for burning on a specified day from the District.

6.1.7 No burning shall be conducted contrary to the conditions specified on the Permit.

6.1.8 Except for burning conducted pursuant to Section 4.3, a permit shall only be valid on those days not designated as no-burn days and the APCO has authorized the burning as being within a particular day's burn system allocation for the region in which burn site is located.

6.1.9 Any Permit issued by a designated agency shall be subject to the rules and regulations of the District.

6.2 Burn Plans for Fire

6.2.1 Fire Suppression Training

The lead fire agency planning to conduct fire suppression training must submit a burn plan to the APCO for approval a minimum of 15 days prior to the date of the proposed burn. A burn plan is not required for training conducted at stationary fire training structures located at fire training facilities when used for the primary purpose of conducting fire training. The burn plan shall address the following:

6.2.1.1 The location of the fire training.

6.2.1.2 The fire agencies involved with the training, the number of personnel participating with the training, the name(s) and title(s) of personnel who are responsible for the training, and the approximate date the training will occur, including expected burn starting and ending times.

6.2.1.3 If a structure is involved with the fire training, the burn plan shall include an assessment for the presence and removal of asbestos containing materials within the structure(s), subject to the requirements of Rule 4002 and the National Emission Standards for Hazardous Air Pollutants (Subpart M, Part 61, Chapter 1, Title 40, Code of Federal Regulations).

6.2.1.4 Proposed contingencies to prevent a nuisance, per Rule 4102 (Nuisance).

6.2.2 Contraband

Pursuant to the requirements of Section 5.7, a written notification from the law enforcement agency or fire agency conducting the burn shall be submitted to the APCO for approval a minimum of 15 days prior to the planned burn. In special circumstances, the APCO may waive the 15-day notice requirement. The notification shall provide the following information:

6.2.2.1 A description of the contraband, including its origin and the amount of material that will be destroyed by fire.

6.2.2.2 The date and location of the burn.

6.2.2.3 A description of alternative disposal methods other than burning and an explanation of why the contraband must be destroyed by the use of fire.

6.2.2.4 The law enforcement agency and/or fire protection agency involved with the burn.

6.3 The APCO shall prepare the "Staff Report and Recommendations on Agricultural Burning" document (Report) for any Board determination made pursuant to Section 5.5.2 and in accordance with the following:

6.3.1 The Report shall be presented to the Board for review and approval. Board-approved Report shall be submitted to ARB and EPA for inclusion into the State Implementation Plan.

6.3.2 The APCO shall review and update, as appropriate, the Report at least once every five (5) years. Updated Reports shall be approved according to Section 6.3.1.

ATTACHMENT 1 BEST MANAGEMENT PRACTICES FOR THE CONTROL OF OTHER WEEDS AND MAINTENANCE
Star Thistle, Dodder Weeds, Tumbleweeds, Noxious Weeds and Other Weeds Affecting Surface Waterways
1. Use a planting-to-moisture technique that destroys weeds by cultivation then allow the soil to partially dry and plant large seeded crops in the moist soil below the dried soil zone.
2. Use of a buried drip irrigation system to minimize moisture that is available to weed seeds germinating at the surface level.
3. Reduce the amount of weeds that produce seed by performing regular weed control during the growing and off-season.
4. Use corn gluten as a pre-emergence material to suppress weeds as they germinate.
5. Apply conventional chemical herbicides or non-conventional herbicides such as Citric Acid, Vinegar, or Sodium Nitrate.
6. The use of an anaerobic manure digester to reduce weed seeds in composted materials.
7. Apply hot foam to kill weeds with the heat released from the foam, and allow the foam to dissipate after it has been applied.
8. Select crops that out-compete weeds for moisture and soil nutrients.
9. Apply mulching material around crops to block sunlight, which prevents weed germination and growth.
10. Use of animals or fowls to eat weeds. This technique is most effective in range or non-crop areas.
11. Soil solarization covering utilizes plastic sheeting placed on beds during the summer to trap solar energy generating heat that destroys the emerging weeds.
12. Apply a flame to wilt (desiccate) and or remove the desiccated vegetation (sanitation). The application of the flame is limited such that removal of the flame does not result in continued ignition of the vegetation.
13. Mechanically remove weeds by disking and tilling. The mechanical removal up-roots or buries the weeds.
14. Open burning in accordance with the requirements of Rule 4103 (Open Burning)
Other Maintenance (Pesticide Sacks, Fertilizers Sacks)
15. Dispose of the pesticide/fertilizer sacks into a landfill.
16. Purchase pesticide/fertilizer sold in returnable, refillable bulk bags.
17. Open burning in accordance with the requirements of Rule 4103 (Open Burning)

Appendix C

Initial Study and Negative Declaration

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San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

Proposed Recommendations on Agricultural Burning

(District Project # 20100175)

Initial Study and Final Negative Declaration

May 2010

SAN JOAQUIN VALLEY AIR POLLUTION CONTROL DISTRICT
GOVERNING BOARD 2010

CHAIR: TONY BARBA
Supervisor, Kings County

VICE CHAIR: J. STEVEN WORTHLEY
Supervisor, Tulare County

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Supervisor, Madera County

HENRY JAY FORMAN, PH.D
Appointed by Governor

ANN JOHNSTON
Mayor, City of Stockton

MIKE LANE
Councilmember, City of Visalia

RANDY MILLER
Councilmember, City of Taft

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Supervisor, Merced County

WILLIAM O'BRIEN
Supervisor, Stanislaus County

LEROY ORNELLAS
Supervisor, San Joaquin County

JOHN G. TELLES, M.D.
Appointed by Governor

CHRIS VIERRA
Councilmember, City of Ceres

RAYMOND A. WATSON
Supervisor, Kern County

AIR POLLUTION CONTROL OFFICER

SEYED SADREDIN

A. PROJECT BACKGROUND INFORMATION

1. Project Title:

Proposed Recommendations on Agricultural Burning

2. Lead Agency Name and Address:

San Joaquin Valley Unified Air Pollution Control District
1990 E. Gettysburg Avenue
Fresno CA 93726-0244

3. Contact Person:

CEQA: Mark Montelongo
(559) 230-6000

Planning: Koshoua Thao
(559) 230-6100

4. Project Location:

The proposed recommendations apply to open burning conducted with the exception of prescribed burning and hazard reduction burning as defined in Rule 4106 (Prescribed Burning and Hazard Reduction Burning) in the San Joaquin Valley Air Basin. (See Exhibit 1, Map of District Boundaries)

5. Project Sponsor's Name and Address:

San Joaquin Valley Unified Air Pollution Control District
1990 E. Gettysburg Avenue
Fresno CA 93726-0244

6. Assessor's Parcel Number:

Not applicable to this project.

7. General Plan Designation/Zoning:

Not applicable to this project.

Exhibit 1
San Joaquin Valley Unified Air Pollution Control District Boundaries

8. Project Description:

In 2003, California state law required the District to regulate open burning for diseased crops, establish best management practices for other weeds and maintenance, and prohibit open burning for several crop categories. In addition to those requirements, California state law authorizes the District to postpone the burn prohibition dates for specific types of agricultural waste material if the District makes three specific determinations and the Air Resources Board concurs. The determinations are: (1) there are no economically feasible alternatives to open-burning that type of material; (2) open-burning that type of material will not cause or substantially contribute to a violation of a National Ambient Air Quality Standard (NAAQS); and (3) there is no long term federal or state funding commitment for the continued operation of biomass facilities in the Valley or the development of alternatives to burning.

District staff has prepared Proposed *Recommendations on Agricultural Burning Report* (Report) for consideration by the District's Governing Board. The purpose of the Report is to identify economically feasible alternatives to open burning of various agricultural materials and to meet its legal obligation under the California Health & Safety Code (CH&SC). The Report is intended to satisfy the requirements from CH&SC Section 41855.6, by presenting the District's recommended determinations for specified crops and materials, particularly those that don't have an economically feasible alternative to open burning. The proposed recommendations apply to open burning conducted in the San Joaquin Valley Air Basin with the exception of prescribed burning and hazard reduction burning as defined in Rule 4106 (Prescribed Burning and Hazard Reduction Burning).

Adoption of the proposed *Recommendations on Agricultural Burning Report* by the District's Governing Board is a discretionary approval and as such is subject to the provisions of the California Environmental Quality Act (CEQA).

9. Other Agencies Whose Approvals Are Required and Permits Needed:

Adoption of the proposed *Recommendations on Agricultural Burning Report* by the District's Governing Board does not require permits from any agency, however the Air Resources Board must concur with the District's determinations regarding alternatives to open-burning.

10. Name of Person Who Prepared Initial Study:

Mark Montelongo
Air Quality Specialist

B. FINDINGS

District staff has prepared a *Recommendations on Agricultural Burning Report* which considers potential impacts that adoption of the proposed recommendations could have on air quality. Pursuant to CEQA Guidelines §15063(a), District staff prepared an Initial Study for the proposed project, which considers additional environmental impacts. The District finds that there is no substantial evidence, in light of the whole record before the District, that the project may have a significant effect on the environment. District staff has prepared a Draft Negative Declaration for the project. Upon approval of the proposed recommendations by the District's Governing Board, District staff will file a Notice of Determination with each County Clerk within the boundaries of the District, CEQA Guidelines §15075(d).

C. ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED

The environmental factors checked below would be potentially affected by the proposed project, involving at least one impact that is a "Potentially Significant Impact" or "Potentially Significant Unless Mitigated", as indicated by the checklist on the following pages.

☐ Aesthetics	☐ Agriculture Resources	☐ Air Quality
☐ Biological Resources	☐ Cultural Resources	☐ Geology/Soils
☐ Greenhouse Gas Emissions	☐ Hazards & Hazardous Materials	☐ Hydrology/Water Quality
☐ Land Use/Planning	☐ Mineral Resources	☐ Noise
☐ Population/Housing	☐ Public Services	☐ Recreation
☐ Transportation/Traffic	☐ Utilities/Service Systems	☐ Mandatory Findings of Significance

D. DETERMINATION

I certify that this project was independently reviewed and analyzed and that this document reflects the independent judgment of the District.

☐ I find that the proposed project is exempt from CEQA requirements under Public Resource Code 15061 (b)(3), and a Notice of Exemption has been prepared.

☒ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION has been prepared.

☐ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because the mitigation measures described on an attached sheet have been added to the project. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a significant effect(s) on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets, if the effect is a "potentially significant impact" or "potentially significant unless mitigated." An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

Signature: [signature] Date: 5/20/10

Printed name: Tony Barba
Title: Chair

E. ENVIRONMENTAL IMPACT CHECKLIST

I. AESTHETICS Would the proposal:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Affect a scenic vista or scenic highway?				**X**
b) Have a demonstrable negative aesthetic effect?				**X**
c) Create light or glare?				**X**
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect aesthetics, as identified above (a-c).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

II. AGRICULTURE RESOURCES In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?				**X**
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?				**X**
c) Involve other changes in the existing environment, which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?				**X**
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect agricultural resources, as identified above (a-c).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

III. AIR QUALITY Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Conflict with or obstruct implementation of the applicable air quality plan?				**X**

III. AIR QUALITY (Continued)	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?				**X**
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?				**X**
d) Expose sensitive receptors to substantial pollutant concentrations?				**X**
e) Create objectionable odors affecting a substantial number of people?				**X**

Discussion: The San Joaquin Valley Air Basin is classified as serious for 8-hour ozone nonattainment area and is classified as nonattainment for particulate matter 2.5 microns in size (PM2.5) for the health-based air quality standards established by the federal Clean Air Act. The serious ozone classification and nonattainment PM classification are the worst possible categories.

District staff has proposed Recommendations on Agricultural Burning Report (Report) for consideration by the District's Governing Board. The purpose of the report is to identify economically feasible alternatives to open burning of various agricultural materials and to meet its legal obligation under the California Health & Safety Code (CH&SC). The report is intended to satisfy the requirements from CH&SC Section 41855.6, by presenting the District's recommended determinations for specified crops and materials, particularly those that don't have an economically feasible alternative to open burning. The proposed recommendations apply to open burning conducted in the San Joaquin Valley Air Basin with the exception of prescribed burning and hazard reduction burning as defined in Rule 4106 (Prescribed Burning and Hazard Reduction Burning).

Proposed recommendations identify biomass facilities and soil incorporation as feasible alternatives to open burning. The identified alternatives have the potential to result in changes in criteria pollutant emissions. District staff has conducted a preliminary assessment on the potential air emissions associated with proposed alternatives. The analysis demonstrates that implementation of the proposed alternatives to open burning will result in annual net emission reductions of 39.2 tons of NOx; 123.1 tons PM2.5; and 105.2 tons VOC. The analysis demonstrates approval of the proposed recommendations would result in a benefit to air quality.

Thus, the District concludes that the proposed amendments would have a positive impact on air quality as identified above (a-e).

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

IV. BIOLOGICAL RESOURCES Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?				**X**
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, and regulations or by the California Department of Fish and Game or US Fish and Wildlife Service?				**X**
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?				**X**
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?				**X**
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?				**X**
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?				**X**

Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect biological resources, as identified above (a-f).

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

V. CULTURAL RESOURCES Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Cause a substantial adverse change in the significance of a historical resource as defined in '15064.5?				X
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to '15064.5?				X
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?				X
d) Disturb any human remains, including those interred outside of formal cemeteries?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect cultural resources, as identified above (a-d).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

VI. GEOLOGY/SOILS Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				X
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.				X
ii) Strong seismic ground shaking?				X
iii) Seismic-related ground failure, including liquefaction?				X
iv) Landslides?				X
b) Result in substantial soil erosion or the loss of topsoil?				X
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?				X

VI. GEOLOGY/SOILS (Continued)	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?				X
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?				X

Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect geology/soils, as identified above (a-e).

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

VII. GREENHOUSE GAS EMISSIONS Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?			X	
b) Conflict with any applicable plan, policy or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases?			X	

Discussion: Global Climate Change (GCC), which is now generally accepted by the scientific community to be caused by Greenhouse Gases (GHGs), is a widely discussed scientific, economic, and political issue in the United States. Briefly stated, GCC is the cumulative change in the average weather of the earth that may be measured by changes in temperature, precipitation, storms, and wind. GHGs are gases that trap heat in the atmosphere. Some greenhouse gases such as water vapor occur naturally and are emitted to the atmosphere through natural processes as well as through human activities, such as electricity production, vehicle use, etc. The most common GHG that results from human activity is carbon dioxide, followed by methane and nitrous oxide.

District staff has prepared proposed *Recommendations on Agricultural Burning Report* (Report) for consideration by the District's Governing Board. The purpose of the report is to identify economically feasible alternatives to open burning of various agricultural materials and to meet its legal obligation under the California Health & Safety Code (CH&SC). The report is intended to satisfy the requirements from CH&SC Section 41855.6, by presenting the District's recommended determinations for specified crops and materials, particularly those that don't have an economically feasible alternative to open burning. The proposed recommendations apply to open burning conducted in the San Joaquin Valley Air Basin with the exception of prescribed burning and hazard reduction burning as defined in Rule 4106 (Prescribed Burning and Hazard Reduction Burning).

Proposed recommendations identify biomass facilities and soil incorporation as feasible alternatives to open burning. The identified alternatives have the potential to result in changes in GHG emissions because of possible increased fuel consumption associated with equipment used to grind/chip and transport agricultural biomass. District staff examined the proposed recommendations to determine their potential to have a cumulatively significant impact on global climate change, results of which are presented below. The analysis demonstrates that implementation of the proposed recommended alternatives to open burning will not have a cumulative significant impact on global climate change.

<u>Potential Greenhouse Gas Impacts</u>

The primary existing practice for disposing of orchard removal material is to burn it in place (open burning). The proposed alternative to open burning of orchard removal materials is chipping the organic matter and using the chipped material as fuel in a biomass plant to produce electricity. Sources of GHG emissions from this alternative include fuel consumed in chipping the plant material; fuel consumed in transporting the chipped material to a biomass plant; fuel consumed in processing the chipped material at the biomass plant; and combustion of the chipped material to produce electricity at the biomass facility.

Because the current practice is open burning, the alternative practice of burning chipped material in a biomass power plant would not result in an increase in GHG emissions compared to the status quo. In fact, burning the material in a biomass plant would produce a net GHG benefit by producing electric power from a renewable source of energy rather than a fossil fuel. This concept is one of the strategies adopted by the State of California to reduce GHG emissions to 1990 levels by the year 2020 by requiring the state's load serving entities to meet a 33 percent renewable energy target by 2020 (Executive Order S-21-09). Biomass fuels burned in existing facilities are currently transported from various locations outside and within the San Joaquin Valley Air Basin. Use of locally produced fuel could reduce VMT associated with transporting materials, and thus result in a net GHG benefit. GHG emissions associated with chipping orchard removal material are expected to be offset by the benefits associated with displacing fossil fuels and reducing VMT.

The alternative to the open burning of orchard prunings is shredding the material in place and allowing it to remain in the orchard as a land application or mulch. Sources of GHG emissions for this alternative include the fuel consumed to shred the plant material. It is reasonable to conclude, land application of shredded orchard pruning materials will reduce GHG emissions by sequestering some amount of carbon, offsetting any GHG emissions associated with the chipping operation and potentially resulting in a net GHG benefit.

The District concludes, GHG emissions resulting from alternatives to open burning of orchard removal materials and prunings are expected to have a net positive benefit on global climatic change compared to the status quo of open burning. Therefore, the District concludes that implementation of the proposed recommendations would have a less than cumulatively significant impact on global climatic change.

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

VIII. HAZARDS & HAZARDOUS MATERIALS Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?				**X**
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?				**X**
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?				**X**
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?				**X**
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?				**X**
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?				**X**
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?				**X**
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?				**X**

Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect hazards and hazardous materials, as identified above (a-h).

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

IX. HYDROLOGY/WATER QUALITY Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Violate any water quality standards or waste discharge requirements?				**X**
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?				**X**
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner, which would result in substantial erosion or siltation on- or off-site?				**X**
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?				**X**
e) Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff?				**X**
f) Otherwise substantially degrade water quality?				**X**
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?				**X**
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?				**X**
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?				**X**

Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect hydrology/water quality, as identified above (a-i).

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

X. LAND USE/PLANNING Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Physically divide an established community?				X
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?				X
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect land use/planning as identified above (a-c).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

XI. MINERAL RESOURCES Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?				X
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect mineral resources, as identified above (a-b).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

XII. NOISE Would the project result in:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?				X

XII. NOISE (Continued)	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?				**X**
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?				**X**
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?				**X**
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?				**X**
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?				**X**
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect noise, as identified above (a-f).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

XIII. POPULATION/HOUSING Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?				**X**
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?				**X**
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?				**X**
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect population/housing, as identified above (a-c).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

XIV. PUBLIC SERVICES Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				X
Fire protection?				X
Police protection?				X
Schools?				X
Parks?				X
Other public facilities?				X
b) Cumulatively exceed official regional or local population projections?				X
c) Induce substantial growth in an area either directly or indirectly (e.g., through projects in an undeveloped area or extension of major infrastructure)?				X
d) Displace existing housing, especially affordable housing?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect public services, as identified above (a-d).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

XV. RECREATION	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?				**X**
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?				**X**

Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect recreation, as identified above (a-b).

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

XVI. TRANSPORTATION/TRAFFIC Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?				**X**
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?				**X**
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?				**X**
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?				**X**
e) Result in inadequate emergency access?				**X**
f) Result in inadequate parking capacity?				**X**

XVI. TRANSPORTATION/TRAFFIC (Continued)	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect transportation/traffic, as identified above (a-g).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

XVII. UTILITIES/SERVICE SYSTEMS Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?				X
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?				X
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?				X
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?				X
e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?				X
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?				X

XVII. UTILITIES/SERVICE SYSTEMS (Continued)	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
g) Comply with federal, state, and local statutes and regulations related to solid waste?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect utilities/service systems, as identified above (a-g).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

XVIII. MANDATORY FINDINGS OF SIGNIFICANCE	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?				X
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively Considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?				X
c) Does the project have environmental effects, which will cause substantial adverse effects on human beings, either directly or indirectly?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would have adverse environmental impacts as identified above (a-c).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

Appendix C

Initial Study and Negative Declaration

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San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

Proposed Recommendations on Agricultural Burning

(District Project # 20100175)

Initial Study and Final Negative Declaration

May 2010

SAN JOAQUIN VALLEY AIR POLLUTION CONTROL DISTRICT
GOVERNING BOARD 2010

A. PROJECT BACKGROUND INFORMATION

1. Project Title:

Proposed Recommendations on Agricultural Burning

2. Lead Agency Name and Address:

San Joaquin Valley Unified Air Pollution Control District
1990 E. Gettysburg Avenue
Fresno CA 93726-0244

3. Contact Person:

CEQA: Mark Montelongo
(559) 230-6000

Planning: Koshoua Thao
(559) 230-6100

4. Project Location:

The proposed recommendations apply to open burning conducted with the exception of prescribed burning and hazard reduction burning as defined in Rule 4106 (Prescribed Burning and Hazard Reduction Burning) in the San Joaquin Valley Air Basin. (See Exhibit 1, Map of District Boundaries)

5. Project Sponsor's Name and Address:

San Joaquin Valley Unified Air Pollution Control District
1990 E. Gettysburg Avenue
Fresno CA 93726-0244

6. Assessor's Parcel Number:

Not applicable to this project.

7. General Plan Designation/Zoning:

Not applicable to this project.

Exhibit 1
San Joaquin Valley Unified Air Pollution Control District Boundaries

8. Project Description:

In 2003, California state law required the District to regulate open burning for diseased crops, establish best management practices for other weeds and maintenance, and prohibit open burning for several crop categories. In addition to those requirements, California state law authorizes the District to postpone the burn prohibition dates for specific types of agricultural waste material if the District makes three specific determinations and the Air Resources Board concurs. The determinations are: (1) there are no economically feasible alternatives to open-burning that type of material; (2) open-burning that type of material will not cause or substantially contribute to a violation of a National Ambient Air Quality Standard (NAAQS); and (3) there is no long term federal or state funding commitment for the continued operation of biomass facilities in the Valley or the development of alternatives to burning.

District staff has prepared Proposed *Recommendations on Agricultural Burning Report* (Report) for consideration by the District's Governing Board. The purpose of the Report is to identify economically feasible alternatives to open burning of various agricultural materials and to meet its legal obligation under the California Health & Safety Code (CH&SC). The Report is intended to satisfy the requirements from CH&SC Section 41855.6, by presenting the District's recommended determinations for specified crops and materials, particularly those that don't have an economically feasible alternative to open burning. The proposed recommendations apply to open burning conducted in the San Joaquin Valley Air Basin with the exception of prescribed burning and hazard reduction burning as defined in Rule 4106 (Prescribed Burning and Hazard Reduction Burning).

Adoption of the proposed *Recommendations on Agricultural Burning Report* by the District's Governing Board is a discretionary approval and as such is subject to the provisions of the California Environmental Quality Act (CEQA).

9. Other Agencies Whose Approvals Are Required and Permits Needed:

Adoption of the proposed *Recommendations on Agricultural Burning Report* by the District's Governing Board does not require permits from any agency, however the Air Resources Board must concur with the District's determinations regarding alternatives to open-burning.

10. Name of Person Who Prepared Initial Study:

Mark Montelongo
Air Quality Specialist

B. <u>FINDINGS</u>

District staff has prepared a *Recommendations on Agricultural Burning Report* which considers potential impacts that adoption of the proposed recommendations could have on air quality. Pursuant to CEQA Guidelines §15063(a), District staff prepared an Initial Study for the proposed project, which considers additional environmental impacts. The District finds that there is no substantial evidence, in light of the whole record before the District, that the project may have a significant effect on the environment. District staff has prepared a Draft Negative Declaration for the project. Upon approval of the proposed recommendations by the District's Governing Board, District staff will file a Notice of Determination with each County Clerk within the boundaries of the District, CEQA Guidelines §15075(d).

C. ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED

The environmental factors checked below would be potentially affected by the proposed project, involving at least one impact that is a "Potentially Significant Impact" or "Potentially Significant Unless Mitigated", as indicated by the checklist on the following pages.

☐ Aesthetics	☐ Agriculture Resources	☐ Air Quality
☐ Biological Resources	☐ Cultural Resources	☐ Geology/Soils
☐ Greenhouse Gas Emissions	☐ Hazards & Hazardous Materials	☐ Hydrology/Water Quality
☐ Land Use/Planning	☐ Mineral Resources	☐ Noise
☐ Population/Housing	☐ Public Services	☐ Recreation
☐ Transportation/Traffic	☐ Utilities/Service Systems	☐ Mandatory Findings of Significance

D. DETERMINATION

I certify that this project was independently reviewed and analyzed and that this document reflects the independent judgment of the District.

☐ I find that the proposed project is exempt from CEQA requirements under Public Resource Code 15061 (b)(3), and a Notice of Exemption has been prepared.

☒ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION has been prepared.

☐ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because the mitigation measures described on an attached sheet have been added to the project. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a significant effect(s) on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets, if the effect is a "potentially significant impact" or "potentially significant unless mitigated." An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

Signature: [signature] Date: 5/20/10

Printed name: Tony Barba
Title: Chair

E. ENVIRONMENTAL IMPACT CHECKLIST

I. AESTHETICS Would the proposal:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Affect a scenic vista or scenic highway?				X
b) Have a demonstrable negative aesthetic effect?				X
c) Create light or glare?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect aesthetics, as identified above (a-c).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				
II. AGRICULTURE RESOURCES In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?				X
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?				X
c) Involve other changes in the existing environment, which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect agricultural resources, as identified above (a-c).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				
III. AIR QUALITY Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Conflict with or obstruct implementation of the applicable air quality plan?				X

III. AIR QUALITY (Continued)	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?				**X**
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?				**X**
d) Expose sensitive receptors to substantial pollutant concentrations?				**X**
e) Create objectionable odors affecting a substantial number of people?				**X**

Discussion: The San Joaquin Valley Air Basin is classified as serious for 8-hour ozone nonattainment area and is classified as nonattainment for particulate matter 2.5 microns in size (PM2.5) for the health-based air quality standards established by the federal Clean Air Act. The serious ozone classification and nonattainment PM classification are the worst possible categories.

District staff has proposed Recommendations on Agricultural Burning Report (Report) for consideration by the District's Governing Board. The purpose of the report is to identify economically feasible alternatives to open burning of various agricultural materials and to meet its legal obligation under the California Health & Safety Code (CH&SC). The report is intended to satisfy the requirements from CH&SC Section 41855.6, by presenting the District's recommended determinations for specified crops and materials, particularly those that don't have an economically feasible alternative to open burning. The proposed recommendations apply to open burning conducted in the San Joaquin Valley Air Basin with the exception of prescribed burning and hazard reduction burning as defined in Rule 4106 (Prescribed Burning and Hazard Reduction Burning).

Proposed recommendations identify biomass facilities and soil incorporation as feasible alternatives to open burning. The identified alternatives have the potential to result in changes in criteria pollutant emissions. District staff has conducted a preliminary assessment on the potential air emissions associated with proposed alternatives. The analysis demonstrates that implementation of the proposed alternatives to open burning will result in annual net emission reductions of 39.2 tons of NOx; 123.1 tons PM2.5; and 105.2 tons VOC. The analysis demonstrates approval of the proposed recommendations would result in a benefit to air quality.

Thus, the District concludes that the proposed amendments would have a positive impact on air quality as identified above (a-e).

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

IV. BIOLOGICAL RESOURCES Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?				**X**
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, and regulations or by the California Department of Fish and Game or US Fish and Wildlife Service?				**X**
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?				**X**
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?				**X**
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?				**X**
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?				**X**
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect biological resources, as identified above (a-f).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

V. CULTURAL RESOURCES Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Cause a substantial adverse change in the significance of a historical resource as defined in '15064.5?				X
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to '15064.5?				X
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?				X
d) Disturb any human remains, including those interred outside of formal cemeteries?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect cultural resources, as identified above (a-d).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

VI. GEOLOGY/SOILS Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				X
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.				X
ii) Strong seismic ground shaking?				X
iii) Seismic-related ground failure, including liquefaction?				X
iv) Landslides?				X
b) Result in substantial soil erosion or the loss of topsoil?				X
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?				X

VI. GEOLOGY/SOILS (Continued)	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?				X
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?				X

Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect geology/soils, as identified above (a-e).

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

VII. GREENHOUSE GAS EMISSIONS Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?			X	
b) Conflict with any applicable plan, policy or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases?			X	

Discussion: Global Climate Change (GCC), which is now generally accepted by the scientific community to be caused by Greenhouse Gases (GHGs), is a widely discussed scientific, economic, and political issue in the United States. Briefly stated, GCC is the cumulative change in the average weather of the earth that may be measured by changes in temperature, precipitation, storms, and wind. GHGs are gases that trap heat in the atmosphere. Some greenhouse gases such as water vapor occur naturally and are emitted to the atmosphere through natural processes as well as through human activities, such as electricity production, vehicle use, etc. The most common GHG that results from human activity is carbon dioxide, followed by methane and nitrous oxide.

District staff has prepared proposed *Recommendations on Agricultural Burning Report* (Report) for consideration by the District's Governing Board. The purpose of the report is to identify economically feasible alternatives to open burning of various agricultural materials and to meet its legal obligation under the California Health & Safety Code (CH&SC). The report is intended to satisfy the requirements from CH&SC Section 41855.6, by presenting the District's recommended determinations for specified crops and materials, particularly those that don't have an economically feasible alternative to open burning. The proposed recommendations apply to open burning conducted in the San Joaquin Valley Air Basin with the exception of prescribed burning and hazard reduction burning as defined in Rule 4106 (Prescribed Burning and Hazard Reduction Burning).

Proposed recommendations identify biomass facilities and soil incorporation as feasible alternatives to open burning. The identified alternatives have the potential to result in changes in GHG emissions because of possible increased fuel consumption associated with equipment used to grind/chip and transport agricultural biomass. District staff examined the proposed recommendations to determine their potential to have a cumulatively significant impact on global climate change, results of which are presented below. The analysis demonstrates that implementation of the proposed recommended alternatives to open burning will not have a cumulative significant impact on global climate change.

Potential Greenhouse Gas Impacts

The primary existing practice for disposing of orchard removal material is to burn it in place (open burning). The proposed alternative to open burning of orchard removal materials is chipping the organic matter and using the chipped material as fuel in a biomass plant to produce electricity. Sources of GHG emissions from this alternative include fuel consumed in chipping the plant material; fuel consumed in transporting the chipped material to a biomass plant; fuel consumed in processing the chipped material at the biomass plant; and combustion of the chipped material to produce electricity at the biomass facility.

Because the current practice is open burning, the alternative practice of burning chipped material in a biomass power plant would not result in an increase in GHG emissions compared to the status quo. In fact, burning the material in a biomass plant would produce a net GHG benefit by producing electric power from a renewable source of energy rather than a fossil fuel. This concept is one of the strategies adopted by the State of California to reduce GHG emissions to 1990 levels by the year 2020 by requiring the state's load serving entities to meet a 33 percent renewable energy target by 2020 (Executive Order S-21-09). Biomass fuels burned in existing facilities are currently transported from various locations outside and within the San Joaquin Valley Air Basin. Use of locally produced fuel could reduce VMT associated with transporting materials, and thus result in a net GHG benefit. GHG emissions associated with chipping orchard removal material are expected to be offset by the benefits associated with displacing fossil fuels and reducing VMT.

The alternative to the open burning of orchard prunings is shredding the material in place and allowing it to remain in the orchard as a land application or mulch. Sources of GHG emissions for this alternative include the fuel consumed to shred the plant material. It is reasonable to conclude, land application of shredded orchard pruning materials will reduce GHG emissions by sequestering some amount of carbon, offsetting any GHG emissions associated with the chipping operation and potentially resulting in a net GHG benefit.

The District concludes, GHG emissions resulting from alternatives to open burning of orchard removal materials and prunings are expected to have a net positive benefit on global climatic change compared to the status quo of open burning. Therefore, the District concludes that implementation of the proposed recommendations would have a less than cumulatively significant impact on global climatic change.

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

VIII. HAZARDS & HAZARDOUS MATERIALS Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?				**X**
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?				**X**
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?				**X**
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?				**X**
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?				**X**
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?				**X**
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?				**X**
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?				**X**

Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect hazards and hazardous materials, as identified above (a-h).

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

IX. HYDROLOGY/WATER QUALITY Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Violate any water quality standards or waste discharge requirements?				**X**
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?				**X**
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner, which would result in substantial erosion or siltation on- or off-site?				**X**
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?				**X**
e) Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff?				**X**
f) Otherwise substantially degrade water quality?				**X**
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?				**X**
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?				**X**
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?				**X**

Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect hydrology/water quality, as identified above (a-i).

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

X. LAND USE/PLANNING Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Physically divide an established community?				**X**
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?				**X**
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?				**X**
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect land use/planning as identified above (a-c).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

XI. MINERAL RESOURCES Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?				**X**
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?				**X**
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect mineral resources, as identified above (a-b).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

XII. NOISE Would the project result in:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?				**X**

XII. NOISE (Continued)	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?				X
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?				X
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?				X
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?				X
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?				X

Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect noise, as identified above (a-f).

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

XIII. POPULATION/HOUSING Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?				X
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?				X
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?				X

Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect population/housing, as identified above (a-c).

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

XIV. PUBLIC SERVICES Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				X
Fire protection?				X
Police protection?				X
Schools?				X
Parks?				X
Other public facilities?				X
b) Cumulatively exceed official regional or local population projections?				X
c) Induce substantial growth in an area either directly or indirectly (e.g., through projects in an undeveloped area or extension of major infrastructure)?				X
d) Displace existing housing, especially affordable housing?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect public services, as identified above (a-d).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

XV. RECREATION	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?				X
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?				X

Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect recreation, as identified above (a-b).

Mitigation: None

Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*

XVI. TRANSPORTATION/TRAFFIC Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?				X
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?				X
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?				X
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?				X
e) Result in inadequate emergency access?				X
f) Result in inadequate parking capacity?				X

XVI. TRANSPORTATION/TRAFFIC (Continued)	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect transportation/traffic, as identified above (a-g).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

XVII. UTILITIES/SERVICE SYSTEMS Would the project:	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?				X
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?				X
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?				X
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?				X
e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?				X
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?				X

XVII. UTILITIES/SERVICE SYSTEMS (Continued)	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
g) Comply with federal, state, and local statutes and regulations related to solid waste?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would affect utilities/service systems, as identified above (a-g).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

XVIII. MANDATORY FINDINGS OF SIGNIFICANCE	**Potentially Significant Impact**	**Potentially Significant Impact Unless Mitigated**	**Less Than Significant Impact**	**No Impact**
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?				X
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively Considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?				X
c) Does the project have environmental effects, which will cause substantial adverse effects on human beings, either directly or indirectly?				X
Discussion: Adoption of the proposed *Recommendations on Agricultural Burning Report* does not impose regulatory requirements that would have adverse environmental impacts as identified above (a-c).				
Mitigation: None				
Reference: Supporting Proposed *Recommendations on Agricultural Burning Report.*				

Appendix D

Summary of Significant Comments & District Responses

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Appendix D: SUMMARY OF SIGNIFICANT COMMENTS & DISTRICT RESPONSES FOR THE APRIL 14, 2010 VERSION OF THE REPORT

US EPA REGION IX STAFF COMMENTS

No comments were received.

ARB STAFF COMMENTS

ARB staff has reviewed the Draft Staff Report and Recommendations on Agricultural Burning and has no comments at this time.

STAKEHOLDER COMMENTS

Stakeholders who submitted comments:

Albert Segal (AS)
B&B Farms, LLC (BBF)
Bernie Mettler (BM)
Bertie Sousa (BS)
Bogle Vineyards (BV)
California Biomass Energy Alliance (CBEA)
California Citrus Mutual (CCM)
California Cotton Ginners and Growers Association and Western Agricultural Processors Association (CCGGA/WAPA)
California Grape and Tree Fruit League (CGTF)
Chaffese Farming Company (CFC)
Char Don Farms, Inc (CDF)
Dave Baker (DB)
David Presk (DP)
Don Gallagher (DG)
Earth Justice (EJ)
Fresno Metro Ministry (FMM)
Global Greensteam, LLC (GGS)
Jack Davis (JD)
James Irrigation District (JID)
Jeff Tienken (JT)
John Paoluccio Consulting Engineers, Inc. (JPC)
John Price (JP)
Kautz Farms (KF)
Kern Wild Land Management & Kern Asthma Coalition (KLM, KAC)
Kings River Conservation District (KRCD)
Larry P. Mettler (LM)
Lance Canty (LC)
Lodi District Grape Growers Association, Inc. (LDGGA)
Lodi Farms (LF)
Fresno-Madera Medical Society (FMMS)
Michael Harris (MH)
Nisei Farmers League (NFL)
Pete Sunny (PS)
Phil Shield (PhS)
Richard Bonotto (RB)
Rio Bravo Biomass Plant (RBB)
Robert Pampaian (RP)
Roy Nagata (RN)
San Joaquin Farm Bureau (SJF)
Sandline Farms (SF)
Sanger Hill Ranch (SHR)
Tom Frantz (TF)
Turlock Irrigation District (TID)
Unknown Gentleman (UK)
UCCE Merced County - David Doll, Farm Advisor (UCCEMC)

UCCE San Joaquin County - Paul S. Verdegaal, Farm Advisor (UCCESJC)
Vance Kennedy (VK)
Vineyard Management (VM)

34 agencies signed a single comment letter – the list of agencies is located at the end of this appendix (MULTI)

1. **COMMENT:** Over the past seven years, some nut and tree fruit growers have begun to use the new brush and limb shredding machines rather than burn their orchard material. These shredders move through the field and grind the material into smaller chips. These machines have helped reduce the amount of material being burned. The Flory brand shredding machine grinds the material into smaller chips which decompose faster. There are also an increasing number of growers that are moving to no-till farming, and these growers need shredded material to decompose before harvest. Other brands of shredding machines on the market, but none that chip the material as small as Flory's.

   Almonds, walnuts, pecans, and tree fruit constitute 1.3 million acres in the Valley. To date only 40 of Flory's machines have been purchased, at a cost of more than $12 million. We estimate every machine would have to chip over 20,000 acres per year if burning is eliminated. A typical shredder may be able to accomplish ¼ of that amount in a given year, given the very narrow window in which to chip. This means that growers need to spend another $60 million to reach the point in the number of machines necessary to attempt to eliminate burning.

   A delay in the burn prohibition of surface-harvested pruning is necessary in order for more of these machines to be put into use. Such a delay would enable more of these machines to be purchased, as well as the existing machines to be updated. At a cost of $315,000, the average grower is not able to purchase a machine of his own and must rely on contractors to come in and shred his field, which may or may not be on the grower's timeline. (NFL, CCGGA/WAPA)

   RESPONSE: District staff appreciates the information provided above and concurs with stakeholders' concerns regarding the ability of an average grower to purchase a shredder. District staff acknowledges that purchasing a shredder is an expensive option for the average grower and believes that many growers would likely hire a custom shredder. District staff will continue to assess the availability of custom shredders and the ability to shred the material within the timeline.

   Based on the analysis in Chapter Three, staff believes that a grower that farms almonds, walnuts, and/or pecans over 3,500 acres would find it more cost effective to purchase a shredder rather than hire a custom shredder. However, more time is needed to assess the economics and availability of custom shredders for the average growers. Please refer to Chapter 3, Section 3.7.3, for additional information.

2. **COMMENT:** The ARB attributed the reduction of PM since 2002 to the reduction of open burning. The changeover to non-till operations played a more significant role in reducing PM than reducing open burning. Many farmers have changed to non-till or reduced tilling operations and the results have proven to be very beneficial to reducing dust generation. Dust mites and other pest problems have been reduced. The small particle dust generated by disking orchards is considerably greater then that of non-till. ARB wants farmers to chip prunings and disc them into the soil instead of burning them. Chipping and allowing the wood pruning's to decay causes more air pollution than open burning of dry prunings. (JPC)

   Has it been considered that grinding my orchard waste [almond prunings], disking them into the soil, spring-toothing the soil and then planning the orchard to re-establish the orchard floor would use a great deal more energy [pollution] and cause more airborne particulate matter than simply burning? In the Air Pollution Control District's approved process, I will have compacted my soil so I'll have to rip my orchard to improve water penetration. This must be done when the soil is dry to be effective, making lots of dust; then it is necessary to disc and spring tooth and plane the orchard once again, making more dust, burning more fossil fuels, causing more pollution. (AS)

   RESPONSE: In addition to reduced open burning through the use of sustainable agricultural practices, growers have also continued to conduct research and other practices to help further reduce emissions (especially PM) through best management practices from other operations, such as no-till. Based on our findings, many growers are shredding the almond (and walnut) prunings and leaving the materials in place. Some growers may prefer to till or disc the materials, but this alternative would not be required by the District. Other options that are available include taking the material to the biomass power plants, which one grower is doing.

   The District conducted an analysis comparing the emissions from open burning and the recommended alternatives, shredding the pruning materials on site and taking the orchard materials to biomass power plants. Based on District's analysis, the emissions from the recommended alternatives are lower than open burning. Please see Chapter 5, Section 5.3, for additional information.

3. **COMMENT:** The percentage of "no-till" acreage has grown to near 90% of the total walnut orchard acreage. Second, the chips in walnut and pecan orchards are problematic. For example, the pruning of walnuts occurs during the wet season, making it impossible for chippers to enter the orchards until the rains

have subsided. However, when the rains have subsided, growers need to apply blight sprays, which is impossible if prunings are scattered on the orchard floor. Another point is the potential for mold. Since prunings are organic, they are subject to the development of mold, which can be carried into the huller/dehydrator. This is a major concern in terms of food safety. Finally, the chips themselves become a problem at the processing plants, where they can plug up equipment. (CCGGA/WAPA)

RESPONSE: Given the fact that the majority of growers are currently practicing no-burn alternatives and the increasing availability of small chip shredders, it would appear that many of these technical concerns are being addressed. Staff is recommending an extension of the burn prohibition deadline in selected cases to allow the supporting infrastructure to fully develop and for technical issues to be resolved.

4. **COMMENT:** Consideration might be given to restricting open burning on “No Burn” days like they do with fireplaces. Growers should not be allowed to burn when fireplace burning is prohibited. (JPC, BS)

RESPONSE: The residential wood burning declarations are in effect from November 1 to February 28. During that time, the District also prohibits allocation of open burning from agricultural material in any zones in a county that had declared a residential wood burning curtailment.

5. **COMMENT:** When forest fires occur, very wet wood is burned and millions of tons of GHG’s are formed. The forest departments are on the right track to divert that biomass to offset fossil fuel use, but they still have to slash and burn most of the forest thinning and residue because not enough biomass power plants are available. When wet wood is burned, incomplete combustion occurs with the release of substantial amounts of polluting greenhouse gases (GHGs). The burning of wet wood should be discouraged.

Burning dry wood is natural and good for our environment and is an important part of the cycle of life on earth. Burning dry wood releases the stored solar energy and water vapor and carbon dioxide. When dry wood is burned, instant smoke and water vapor is visible along with CO2, CO, methane and other GHGs, plus ash being emitted. Dryer wood results in more complete combustion with more energy and water generated. (JPC)

RESPONSE: Forest fires are addressed in the District’s Rule 4106 (Prescribed Burning and Hazard Reduction Burning). For open burning of agricultural material, Rule 4103 (Open Burning) requires that agricultural materials are allowed to dry for minimum time periods before being burned. Specifically, the rule requires three weeks of drying time for prunings and small branches, and at least six weeks for large branches and orchards.

6. **COMMENT:** If wood is allowed to decay by natural means, including decomposition by ants, termites, fungus, microbes, etc., then considerable amounts of methane gas are generated and released along with other GHG's. Methane is one of the major primary airborne contaminants generated on earth. (JPC)

RESPONSE: There are at least two types of decomposition processes which help convert the material into soil amendment – anaerobic and aerobic decomposition. The aerobic process uses oxygen to help decompose the material, which also helps reduce the amount of emissions generated and emitted into the environment. District staff is currently reviewing the emissions impact from composting as part of a different project, Draft New Rule 4566 (Organic Waste Composting), and will work with stakeholders to address these concerns. For the purpose of this project on open burning, District staff has found that shredding the pruning materials and leaving the material on the orchard floor is a viable practice for many growers. The amount of material shredded is typically less than three inches above the orchard floor and is not considered the same as a compost operation. District staff would appreciate receiving information on any studies which may show the amount of greenhouse gas emitted into the air from wood decomposition.

7. **COMMENT:** Biomass holds the promise of reducing fossil fuel use and can substantially help our energy production and dependency on foreign oil. If this wood resource were burned in a biomass plant under ideal conditions, only a very small amount of pollutants would be emitted. Biomass is considered a Renewable Energy with a zero net addition of carbon to our environment. The practical use of this resource should be encouraged. Biomass offers the only practical near term solution to meeting our carbon dioxide reduction goals. Encourage renewable energy in lieu of fossil fuel use. Many of the recently published reports by the Energy Commission and ARB are recognizing that tapping into biomass can help California reach its mandated 1/3 reduction in CO2 by 2020. (JPC)

RESPONSE: The District recognizes that biomass operators are integral to the success of implementing the CH&SC requirements. On January 21, 2010, the District Governing Board adopted the Districts 2010 Legislative Platform. On that Legislative Platform are two 2010 Legislative Priorities that will affect biomass facilities. These legislative priorities will provide policy guidance for legislative action and recognize the unique needs of the District during the upcoming legislative session. One of the principles of the legislative platform that will guide District policy is to support legislation that would provide for the continued operation of strategically located biomass facilities to provide disposal options for agricultural, urban, and forest wood waste. District has recommended the use of biomass power plants as one of the viable alternatives in the SJVAB for agricultural material. While shredding the prunings on site is a viable alternative, taking the pruning material to the biomass power plants is also a possible option for growers. As part of the recommendations, District staff would increase the amount of material going to biomass power plants by reducing the amount of fig orchard removals and other orchard removal materials that could be burned to 15 acres or less per location per year.

8. **COMMENT:** New technologies, inventions, and processes that utilize renewable biomass offer many opportunities that can lead to a substantial reduction in fossil fuel use. These include bio-diesel, ethanol, wood pellets, torrefied wood pellets, and many others. Technology and economics do not currently allow for many other practical options for the farmer other than to burn the prunings. Wood chipping and transporting the chips to a pellet mill or biomass plant would be ideal and may soon be practical as soon as efficient biomass conversion to fuel becomes more acceptable. In the meantime, while it is not practical or economic to justify this method of energy conversion, it still is best to burn the wood prunings. (JPC)

Based on the realities of a small operation, there are few if any financial options for alternate technology or methods for pruning disposal. If a small grower can not deal with the pruning materials in a low or no cost method using personal labor (that is, burning), then he may be forced to take the land out of production. There is not enough residual profit from a small farming operation to accommodate an alternate that has a monetary cost. Pruning materials are limited because of the small size of the operation. Burning of pruning material only needs to occur for a very short period once a year and can be easily managed and controlled. The impact to air quality can be negligible from this small of an operation with good management practices. (SHR)

RESPONSE: As previously mentioned, many growers are already shredding the pruning material as a viable option. District staff has considered the impact of the burn alternative on small operations. Please see Chapter 3.7.3 for the District's proposed recommendations.

9. **COMMENT:** The switch to chipping of almond prunings has caused significant economic loss to the almond hulling industry in the form of lost revenue from the sales of "prime hulls". The chips are not eliminated by the normal pre-cleaning process. Consequently, the chips end up mixed in with the hulls, which increases the fiber content to a point where it can no longer be sold as "prime hull." Our members indicate that they have experienced a 5% to 11% loss in prime hull sales. If the industry is forced to eliminate burning altogether, almond

hullers will have to install additional pre-cleaning equipment at a substantial cost, or be forced to live with substantially reduced revenue streams from the sales of prime hulls. (CCGGA/WAPA)

RESPONSE: There is a vendor that has a shredder which would be able to shred the pruning materials to finer pieces to help speed the break down of the shredded material. This process does not require a grower to till the material into the ground. There are also other shredders available in the market which may require more passes to reduce the material into smaller pieces. Because the infrastructure is not sufficiently large enough to meet all shredding requirements, specific burn allowances are recommended for surface-harvested prunings.

10. **COMMENT:** Restricting open burning results in considerable economic loss to the state, hurts farmers and taxpayers, and the resulting air pollution problems will become worse not better. It is in the best interest of the state that restricting open burning be curtailed until practical methods of transferring ag waste and pruning's to biomass facilities for efficient burning. (JPC)

    RESPONSE: Since 2003, the District has worked with the affected stakeholders to address the state law requirements. Growers have reduced significant amount of agricultural materials being burned since then through sustainable agricultural practices. The District will continue to work with affected stakeholders to address these concerns.

11. **COMMENT:** Long range storage of ag materials increases rat, mice, rodent and flea infestations that migrate to populated areas. (JPC)

    RESPONSE: Any storage of agricultural materials on farms is to allow the materials to dry before the material is shredded, removed, or burned. Growers typically do not store these materials for long periods of time because it could delay other operations.

12. **COMMENT:** The allocation system should be re-worked. When I have ten acres to burn the system will only approve eight acres and I have to come back the next day to burn the remaining two acres. I should be allowed to burn the whole ten acres at once to save time and money. (JT)

    RESPONSE: The District is required to utilize a Smoke Management System where burning is allocated daily based on the forecasted meteorological conditions and the total tonnage of emissions allotted for each individual zone within the District, to ensure that the allowance of agricultural burning does not cause or contribute to a violation of a Federal National Ambient Air Quality Standard.

13. **COMMENT:** When prunings are chipped, stored, and then disked into the soil, much more air pollution and other problems occur. Considerable PM 10 & PM 2.5 are generated due to chipping and disking chips into the soil. Decomposition leads to the release of many greenhouse gases. Plus 100% of the pollution from the use of fossil fuels by the chipper/grinder and other equipment is added to our environment. (JPC, JPC, JT, MH)

RESPONSE: Please refer to Section 5.3 for further discussion on the comparison of the PM2.5 emissions from open burning with shredding the pruning materials and taking the orchard materials to biomass power plants. Many growers are shredding the pruning material and leaving the material on the orchard floor without tilling. District staff has clarified in the report that the likely alternative for almond, walnut, and pecan crops is to shred the material in place.

14. **COMMENT:** Alternatives offered are cover for dust or erosion control and/or wood mulch. What is the market in the San Joaquin Valley for these products and where are the outlets? What is the current price structure for these products? (CCM)

RESPONSE: District staff has found that the alternatives above are technologically feasible; however, these alternatives are currently not a viable source on a commercial scale to address the agricultural materials that are subject to the state law requirements. District staff has clarified in the report that the likely alternative for almond, walnut, and pecan crops is to shred the material in place.

15. **COMMENT:** Why allow an exemption for 20 acres of prunings from almonds, pecans, and walnuts? (EJ)

RESPONSE: According to the custom shredders, the average charge to shred the prunings is a minimum of two hours. The recommended shredder, which can shred the materials to finer pieces to address issues with the chips not being decomposed by harvest season or being picked up during harvest, can process eight to ten acres per hour. Due to the two hours minimum that custom shredder charges the grower, District staff believes that the cost on a per acre basis would increase as the acreage becomes smaller. Therefore, the 20 acres limit within the two hour timeframe is reasonable.

16. **COMMENT:** In table 5-6, is prunings from the 3,500 acre farms included in the 12,670 acres annual reduction in acreage burned from almond pruning? (EJ)

RESPONSE: Yes, District staff included all burn acres from growers whose total nut acreage at all agricultural operation sites is 3,500 acres or more. The burn acres also include small acreages since the shredder would be available to shred any amount of nut acres owned by the grower.

17. **COMMENT:** Is the information in Table 5-1 what is under consideration for this report? (EJ)

    RESPONSE: Yes. For this report, District staff is evaluating the crop categories that are subject to the June 1, 2010 burn prohibition deadline, as well as the crop types that had been postponed in earlier phases. District staff has removed the category for “Untreated Grapestakes” since this category is not specified in the CH&SC. Therefore, we do not plan to evaluate it at this time. Our "vineyard removal" category, which is in the CH&SC, is defined to include untreated grapestakes that is removed along with the vineyard orchard. However, in the "untreated grapestakes" category, only the untreated grapestakes are removed (typically to replace broken ones or to change the stakes with steel versions).

18. **COMMENT:** Clarification should be added to the report that attrition is not covered in the report and it will still be allowed to be burned because it’s not part of the CH&SC. (PS)

    RESPONSE: Please refer to Section 1.1.2 for further information on attrition.

19. **COMMENT:** How can the District staff do a case by case evaluation for almond pruning in a timely manner? (SJF)

    RESPONSE: As part of the recommendations, District staff has taken the timing and availability of the custom shredding operator into account and will work with stakeholders to develop a streamline process to address the information needed to conduct the evaluations in a timely manner.

20. **COMMENT:** Why is the District considering reducing burning for orchard removals from 20 acres to 15 acres? We request the District reconsider and keep the orchard removals at 20 acres. Farmers tend to farm in 20 acre plots, it makes more sense to keep the exemption at 20 acres. (SJF, DB, CCM)

    RESPONSE: District staff has found that limiting the acreage amount to 15 acres would be feasible based on the District’s cost analysis to chip and haul the orchard removal materials to the biomass power plants, where the cost per acre appears to level out at about 15 acres or more. In addition, the District’s Compliance Department has indicated that several requests above 15 acres have been denied because the costs to chip and remove the orchards were determined to be economically feasible. Further information on cost analysis can be found in Chapter Six of this report.

According to the burn applications, burn permits that were approved for less than 15 acres make up for most of the burns, over 84%. According to some growers and chipping operators, the cost per acre could level out to as low as 10 acres for some growers; however, District staff believes that 15 acres is a reasonable limit based on the cost analysis and considering fluctuations in cost caused by location, fuel costs, and materials, and other factors. One grower of a small farm indicated that a few acres of orchards are removed every few years to keep the farm productive. This amount is less than the 15 acre limit.

21. **COMMENT:** For orchard removal, is there a significant reduction in emissions between burning 15 and burning 20 acres? Will this difference of five acres be produce a significant enough reduction in pollution to justify reducing allowed burning from 20 acres to 15 acres? (SJF)

    RESPONSE: The District will continue to review the remaining crop categories and crop types to assess the economic feasibility of further reducing the amount of specific materials being burned, as required by the California Health and Safety Code. Per Table 5-5, the total annual emission reductions for this category contributes to at least half of the total emissions that the District is expected to reduce from the recommendations in this report. As mentioned in comment #20, the District's Compliance Department has indicated that several requests above 15 acres have been denied because the costs to chip and remove the orchards were determined to be economically feasible. Therefore, some emissions from this category have already been reduced.

22. **COMMENT:** Can small farms get together and have the chippings hauled away together to reduce costs to them? (KLM, KAC)

    RESPONSE: Based on discussion with some of the chipping operators and custom shredders, the overall costs could be lower if another job is nearby, however, the District could not require such pooling as their chippings may pose timing, logistical and legal issues for small farmers.

23. **COMMENT:** There are over six hundred farmers with small farms in Stanislaus County. Will small citrus farmers be allowed to burn citrus prunings? What about citrus orchard removals? (LC)

    RESPONSE: Prunings (of all acres) from citrus crops were no longer allowed to be open burned since 2005, as part of the Prunings category. The burn prohibition for orchard removals from citrus crop was postponed in 2007; therefore, District staff has reviewed this category as part of this report and recommends that the burning or orchard removals from citrus crops be allowed due to economic infeasibility and capacity concerns of burn alternatives. Please see Chapter 3 for further information regarding orchard removals from citrus crop.

24. **COMMENT:** We recommend that citrus be allowed to continue to burn as currently allowed in Rule 4103, but with at least an 8-10 week drying time so that the wood burns as cleanly as possible. California Citrus Mutual is supportive of the proposal as presented and would be supportive of an 8-10 week drying time prior to receiving authorization to burn. (CCM)

RESPONSE: Based on the findings in Chapter 3, District staff has recommended that growers allow a drying time before burning of between eight to ten weeks for citrus materials as a best management practice to minimize emissions from these burns.

25. **COMMENT:** Section 3.6.1 citrus crops – need for correction. The Valley biomass power plants do accept citrus and, further, the amount that is accepted in each plant's wood yard during the peak removal season can actually be higher than 20 or 30% of the plants' daily wood fuel needs. The plants are capable of accepting and storing up to 40 or 50% for later mixing into other fuel varieties. (CBEA)

RESPONSE: As discussed in Chapters 3 and 7, uncertainty for the long term capacity of processing citrus crops at the biomass facilities remains. District staff will work with the biomass industry to obtain further information on the amount and type of fuel that has been accepted at the biomass power plants in the SJVAB over the next few years. Information that would help further the District's analysis on biomass capacity includes, but is not limited to:

1) Actual amount of agricultural materials and actual amount of urban or other materials accepted per year.
2) Additional information on storage capacity, such as the actual amount of materials that can be stored onsite at a given time and the actual amount and type of material that is stored per year.

26. **COMMENT:** Hilly areas or rocky soil are prevalent in some citrus growing areas. What will be the procedure when a chipper refuses a job because the grove is located in these areas? (CCM)

RESPONSE: District staff has found that the costs to chip citrus orchard removals are typically higher than other orchard removals. Based on staff's analysis, it is not economically feasible for citrus growers to chip and remove the orchards at the current cost. For growers that are in hilly areas or have rocky soil, the cost would be even higher or not feasible.

27. **COMMENT:** Section 6.3.2 Apple, Pear, and Quince Orchard Removal Matter. needs to be updated. This orchard wood has been accepted and since the wood is combusted for power production no chance of spreading blight would exist. (CBEA)

RESPONSE: The process of chipping and transporting diseased pome fruit material is currently considered a method of transferring blight to other orchards, which is an unacceptable risk to the industry. The District could not find any technologically feasible alternatives of disposing of the diseased pome fruit material.

28. **COMMENT:** What about allowing to burn when it's raining? We should be allowed to burn when it's raining. (UK)

RESPONSE: Often times, the PM levels can actually increase just before a rain event and after the material is wet, then it does not burn cleanly. District staff consider each rain event separately and adjust the burn allowances to account for any positive or negative impacts it may have on air quality.

29. **COMMENT:** The health and economic benefits plus the GHG benefits of returning most of this agricultural biomass to the soil rather than burned openly or burned in biomass incinerators needs a lot more thorough analysis There needs to be more of a full cycle analysis following the green house gas emissions associated with biomass incineration. Also, there seems to be a negligible analysis of the trucking of biomass fuel to the biomass incinerators which includes both the agricultural material and the fuel imported from urban areas both within and outside the valley.

RESPONSE: The proposed report does include an extensive health and economic analysis including the emissions from diesel trucks used to haul materials to the biomass power plants. While the District does not currently have authority over greenhouse gases, the associated initial study and negative declaration analysis does discuss the impacts of the proposed recommendations on such emissions.

30. **COMMENT:** Vineyards cannot be shredded due to the wire, and metal stakes that after years becomes entangled in the wood throughout the vineyards. Biomass power plants will not accept vineyard material that is contaminated with steel. Therefore, vineyards should be allowed to continue to be burned. Costs would be outrageous to try to remove these materials from the vineyards, if even possible. Burning of Vineyards is the only true sanitary means of eliminating diseased vineyards. Chipping or grinding has the potential to spread disease pathogens, and canker diseases such as Eutypa. (CFC, RB, VM, CDF, BBF, RN, KF, LM, LF, BM, LDGGA)

RESPONSE: The cost of removing the wire prior to shredding and the ten-year profit from vineyards was used to determine that chipping and grinding the vineyard removals was not economically feasible so an extension of the burn prohibition is recommended for this category.

31. **COMMENT:** Does the crop category "vineyard pruning" include stumps? (DP)

RESPONSE: No, any part of the vine that is pruned occasionally would be considered part of "vineyard pruning". If the stump is removed because it is dead or broken, it is in a category called "attrition".

32. **COMMENT:** We caution that your analysis must incorporate further discussion to what is economically reasonable. Additionally, I respectfully ask the District to include clarifying information on how it intends to determine and define profit and once determined how the District will use this factor when considering whether an alternative measure is appropriate (or inappropriate) for use by the affected community. (CGTF)

Is the profit calculation based on gross or net sales? There is a significant difference between the two calculations, especially for permanent crops. (CCM)

RESPONSE: District staff appreciates the profitability information provided by the industry to further refine the economic analysis. Further discussion on the District's consideration and recommendations of the alternatives are found in Chapter 3. The economic analysis report is presented as part of this report.

33. **COMMENT:** Citrus growers are reporting charges in the range of $500 to $700 per acre to chip and haul material to the biomass facilities. It is reasonable to project that costs will increase as chippers upgrade their equipment to be compliant with ARB's off-road rule. (CCM)

RESPONSE: District staff appreciates the contribution of costs provided by the industry to further enhance the cost analysis.

34. **COMMENT:** A complete ban of agricultural burning will greatly impact our small farming operation. Please consider keeping a plan of restrictive controlled burning for agricultural material for small farms or small acreage pullouts. (JP, RP, RB, LC, SF)

RESPONSE: The proposed recommendations do include allowances for small burns based on the technical and economic issues faced by small farms.

35. **COMMENT:** How long will this next version of the rule last? The ag industry needs predictability and stability, therefore we request the District not revisit this issue for five years. (JT, SJF)

The District should revisit and re-evaluate open burning and alternatives in the next two years (FMM)

RESPONSE: Rule 4103 requires the APCO to review the recommendations at least once every five years. Many of the changes in the economy and infrastructure will not occur for at least two years with an additional year or two needed to evaluate impacts of those changes, revise the report, as needed, and allow for public review and discussion. Therefore, barring an overwhelming development in this area, a four to five year review cycle seems most likely. The California Health and Safety Code Section 41855.5 also provided the District with at least five years to review all of the crops as specified in the state law.

36. **COMMENT:** The open burning of ag material does not create a single job, it does not generate any additional economic activity, and it does not produce one additional dollar of state and local tax revenue. Open burning does not result in the generation of a single megawatt of alternative energy at a time when the state is seeking to maximize the generation of renewable energy and reduce our reliance on fossil fuels. (CBEA)

RESPONSE: Although there are beneficial aspects of reducing open burning, the economics of the process does not allow all available materials to be processed and delivered to biomass plants. Vineyard materials would require significant labor to remove embedded wire, placing it well outside the cost a biomass operator would pay for it as a fuel. Similarly, soil incorporation or mulching of the shredded pruning material can reduce water usage, control weeds and pests, and return nutrients to the soil, creating a sustainable farming operation.

37. **COMMENT:** The burning of weeds along canals, ditchbanks, and waterways is necessary, as there are no known alternatives that can be used in all situations. Federal EPA and the State and Regional Water Boards continue to push to eliminate the use of chemicals near any waterway. Hand labor to remove the weeds individually is impossible and impractical given the thousands of miles of canals, and ditchbanks. The use of flame desiccation, direct burning of residual weed foliage and over growth of weeds assures the destruction of weed seeds. In many remote locations, fire is the only option for effective weed control. Some areas have accessibility issues for mechanical control, and time limitations can also be a problem. We would urge the District to continue the burn postponement indefinitely. (CCGGA/WAPA, JID, MULTI, TID)

In April 2007 the Corps released a draft white paper that called for the removal of wild growth, trees, and other encroachment which might impair levee integrity or flood-fighting access in order to reduce the risk of flood damage. The Corps has proposed that levees that fail to meet these existing standards will be rated as unacceptable, with the consequence that KRCD could lose eligibility for Federal Assistance in post-flood levee rehabilitation. With the Corps new vegetation standard, KRCD will have to do some heavy tree brushing and some of the brush will be to big for our chipper. We also have some tree that have fallen along the levees and into the river that have to be cut and stacked into burn piles. KRCD does not believe there is any economically feasible alternative to open burning. (KRCD)

RESPONSE: The report recommends postponement of the ban on burning weeds along ditches and waterways. Because of the way the State law is written, the burn prohibition can be postponed by the Board, but not indefinitely. Like the other recommendations, it will be reviewed periodically to determine if further postponement is warranted.

38. **COMMENT:** Section 5.5 Health Benefits of Reduced Open Burning. The District claims here and elsewhere in the report they support legislation that will encourage, promote, and facilitate alternative uses for ag material. We would encourage the Air District to continue to vigorously support legislative initiatives to support continued viability of Biomass power. The District should incentivize biomass power plants to reduce the open burning in the Valley. (CBEA, FMM)

RESPONSE: The District's 2010 Legislative Platform contains support for policies and initiative that encourage renewable energy such as biomass plants.

39. **COMMENT:** Citrus is still not accepted by all biomass facilities and, for those that do accept it, the fuel blend is no more than 20% citrus wood (with some exceptions). It is doubtful whether these facilities will have the capacity to purchase all citrus wood given the limited amount of citrus in their fuel mixture. Additionally, biomass facilities have always preferred urban wood due to its lower cost. Although there is limited availability of urban wood because of the current economic conditions, when conditions improve, nothing indicates that the biomass facilities will not return to their previous purchasing patterns. (CCM)

We believe that additional capacity is required to accommodate the processing of biomass which can no longer be openly burned. Most of the biomass facilities were built many years ago and have experienced serious problems causing shut-downs or operations at reduced capacity. We believe they will continue to have serious problems in the future due to age and inherent design limitations. If this wood resource were burned in a biomass plant under ideal conditions, only a very small amount of pollutants would be emitted. We would derive substantial energy and reduce our dependence of fossil fuels through new technologies like bio-diesel, ethanol, wood pellets, torrefied wood pellets and many others. However, these new technologies is not yet available to the Valley's farmers. In the meantime, it is still best to burn the wood prunings. (JPC)

RESPONSE: The District's proposed recommendations are based on the current market analysis of specific crop types, as well as the historical information and documented data of the amount of agricultural material that was accepted at biomass power plants. District staff will continue to work with the biomass operators and ag industry to assess the actual capacity and amount of agricultural materials that will be accepted over the next few years.

40. **COMMENT:** Two coal plants in Stockton are making changes to their facilities to be able to accept and burn biomass materials. One facility will be able to burn 50% biomass fuel, the second facility would burn 40% biomass fuel by 2012, and the facility at the port is also making changes. (CBEA)

RESPONSE: Staff researched the permit database and was able to locate information regarding the two named facilities. Staff was able to verify that one of those facilities appears to be attempting to make changes in order to accept biomass fuel. Staff requests the CBEA submit more information to the District regarding these facilities. However, staff have added language presented by CBEA to the report. Please refer to Chapter 7 for further details.

41. **COMMENT:** Biomass Power Plants can't get enough ag materials at this time. They need more of it and can't seem to get enough to meet their needs. (CBEA)

RESPONSE: Staff agrees that the biomass power plants have increased consumption of agricultural materials at this time and believes that the economic down turn and reduction of available urban waste for fuel may have contributed to the increased consumption of agricultural materials. However, the statement that biomass plants need more ag fuel has been added to the report, please refer to Chapter 7 for further details.

42. **COMMENT:** The biomass plants have made great investments in improving their infrastructure and accepting larger quantities of materials including vineyard and citrus removal materials. Future plants are also planned that will further increase the capacity of the industry to accept agricultural materials. (CBEA)

RESPONSE: District staff thanks CBEA for the updated information and has incorporated it into the report as appropriate. Please refer to Chapter 7 for further details. As stated by CBEA, these plants will take four to five years to develop. The change in burn prohibitions will go into effect this summer. Staff must evaluate alternatives that are currently available. In the future, when staff re-examines open burning and alternatives to open burning, the future biomass power plants, if operational, will be included in those evaluations.

43. **COMMENT:** The staff report does to seem to fully recognize the criteria pollutant reduction that our facilities are already providing through our current operations and acceptance of agricultural waste. (CBEA)

The staff report is severely underestimating the criteria air emissions from biomass incinerators. (TF)

RESPONSE: Data presented in the report is taken directly from the District database of emissions from the facilities and from the open burning activities. These are not estimations. The staff report presents the emissions inventory for both the open burning of the crops and from the biomass power plants activities.

44. **COMMENT:** There seems to be no assessment of GHG reduction benefits that our industry provides when compared to open field burning. This important contribution, as demonstrated by the District's emission estimate, is an ongoing, annual contribution to improving the Valley's overall air quality when compared to open burning. (CBEA)

There needs to be an analysis of GHG emissions associated with biomass power plants and trucking biomass to the plants. (TF)

RESPONSE: Language regarding GHGs has been added to the report as appropriate. Please refer to chapter 7 for further details. For a thorough and complete discussion of GHGs staff refers you to the Initial Study and Negative Declaration.

45. **COMMENT:** Section 7.7.1 Locations and 7.7.3 Historical Fuel Usage. Only the nine existing biomass plants within the District are evaluated. We would encourage staff to evaluate the data that we submitted in August of last year. This data includes submissions for plants outside the District boundaries that use Valley agricultural material. (Chinese Station and SPI for example) (CBEA)

RESPONSE: Staff has added language to the report regarding the Chinese Station and SPI as appropriate. Please refer to chapter 7 for further details. However, as the District does not receive quarterly reports regarding fuel received, used, burned, and associated emissions, therefore, staff will not include information from these plans in the Historical Fuel Usage section of the report.

46. **COMMENT:** Table 7-4 shows annual fluctuations in agricultural use by Valley plants. The conclusion that this is solely due to availability of cheap alternative

urban fuel is not a correct conclusion. In 2008, there were multiple plants down for refurbishment. In 2006, there was a regional shortage of Ag fuel. (CBEA)

RESPONSE: The fluctuations in agricultural fuel used at Valley plants were calculated using operational data submitted to the District that consisted of total BDT used and agricultural BDT used. These calculations compared total fuel used versus ag fuel used and would not account for time when plants were nonoperational, as during those times no fuel would be used. Staff added the comment regarding the ag fuel shortage in 2006 to the report as appropriate and request the CBEA submit data to the District validating this statement.

47. **COMMENT:** As a trained plant pathologist, it has also been my advice to remove diseased branches from the orchard by burning if they provide the opportunity (albeit unknown in some cases) to infect healthy trees. I would think, and this may be listed within the report, that growers should have the opportunity to burn diseased wood regardless of orchard/operation size.

In my estimation chipping would slightly slow down the spread of spores, but would at the same time cause a slow accumulation of latent spores in soils. Transportation for co-generation would further spread spores and act as a source of spores. The ban on burning would also increase costs of growers. These increased costs would be the result of alternative disposal methods; as growers would be required to purchase chipping equipment or pay custom operators for chipping and/or haul removed wood to other sites. After all the increased cost there would still be accumulation and facilitated spread of disease spores present. (UCCESJC)

RESPONSE: In 2004, the District incorporated the state law requirements for diseased crops into Section 5.9 of Rule 4103. District staff has added a discussion for diseased crops. Please refer to Chapter 1, on page 1-2, for further information.

48. **COMMENT:** Increased costs would especially affect small operations less than 100 acres (approximately 700 of 750 growers in Lodi/San Joaquin County). Currently it costs about $400 to $450 per ton to produce grapes in Lodi (UC Cost Study for Crush District 11, P. Verdegaal et al, 2008). Average grower returns across varieties was about $487 per ton in 2009. I estimate it would cost about $150 to $250 on a per acre basis for whole vineyard removal. For annual rouging of diseased and dead vines the cost might be closer to $75 to $100 per acre pro-rated. A small acreage grower could expect to pay more. This would compare to about 2-3 hours of labor per acre to collect and burn. That is based on a vineyard replacement rate of about 1 to 2% annually. Cost of labor is currently around $10.50 per hour, which includes benefits and taxes or contractor fees.

A ban on any burning of vines removed, especially to mitigate vine loss on an annual basis for small operations, would significantly increase costs; further exacerbate consolidations of operations (force small farm operators out of business). (UCCESJC)

RESPONSE: Please refer to Chapter 3, on page 3-8 for further discussion on grape attrition and on page 3-13 for vineyard removals.

Signatory agencies:
Allied Grape Growers
California Citrus Mutual
California Cotton Growers Association
California Dairy Campaign
California Grape and Tree Fruit League
California Women for Agriculture
Central California Irrigation District
Columbia Canal Company
Consolidated Irrigation District
Cross Creek Flood Control District
Excelsior/Kings River Resource Conservation District
Firebaugh Canal Water District
Fresno County Farm Bureau
Fresno Irrigation District
Henry Miller Water District
Kern County Farm Bureau
Kern Delta Water District
Kings County Farm Bureau
Kings County Water District
Kings River Conservation District
Lakeside Irrigation Water District
Last Chance Ditch Company
Lower San Joaquin Levee District
Madera County Farm Bureau
Merced County Farm Bureau
Nisei Farmers League
Peoples Ditch Company
San Joaquin Farm Bureau Federation
Settlers Ditch Company
Stanislaus County Farm Bureau
Tulare County Farm Bureau
Tulare Lake Drainage District
Tulare Lake Resource Conservation District
Western Pistachio Association

Appendix D: SUMMARY OF SIGNIFICANT COMMENTS & DISTRICT RESPONSES FOR THE MAY 20, 2010 VERSION OF THE REPORT

US EPA REGION IX STAFF COMMENTS

No comments were received.

ARB STAFF COMMENTS

ARB staff has reviewed the Draft Staff Report and Recommendations on Agricultural Burning and has no comments at this time.

STAKEHOLDER COMMENTS
Stakeholders who submitted comments:
Black Crowe Vineyards (BCV)
California Biomass Energy Alliance (CBEA)
Carol Keltner (CK)
City of Fresno Department of Public Utilities (DPU)
Clarke Marek (CM)
Vicki Cunniffe (VC)
Daniel Cobb (DaC)
Greg & Laurie Schwaller (G&LS)
Lindsay Black (LB)
Robert Van Nieuwenhuyzen (RVN)

Group 1 (Individuals that are a part of group 1 are listed at the end of this Appendix).

1. **COMMENT:** Thank you for your commitment to improving air quality in the Valley. As an advocate for our national parks, air quality is very important to the park experience and our health. I support your efforts to reduce air pollution in the Valley by restricting open burning. (Group 1)

   RESPONSE: Comment noted.

2. **COMMENT:** The draft report on Recommendations for Agricultural Burning does not contain a thorough enough analysis of the alternatives to open burning. You need to further explore the alternatives to open burning, including more analysis of the cost of chipping or shredding the waste as well as the availability of those who are capable of doing this. (Group 1)

RESPONSE: District staff has conducted extensive research and analysis on the alternatives to open burning and the cost of chipping and shredding the agricultural material.

For the alternatives to open burning, District staff has conducted research on feasible alternatives to open burning since 2007 and has continued to review available alternatives in 2009 and for this Report. While growers are not limited to the alternatives selected for further analysis in this report, District staff has found that chipping the orchard removals for fuel use at biomass power plants and shredding the pruning materials appear to be the most viable and cost effective alternatives and therefore, conducted further economic feasibility analysis for the affected crops. Please refer to Chapter Four of this report for more information on the alternatives to open burning.

For the analysis on the cost of chipping or shredding the agricultural material, District staff also conducted extensive research and outreach to obtain costs and availability of operators, which included reviewing the District's burn applications, conducting searches on the web/directories, surveys, phone calls, and meetings with the chipping and shredding operators/vendors.

3. **COMMENT:** The draft report on Recommendations for Agricultural Burning provides too many exemptions to the ban. (Group 1)

   RESPONSE: Open burning of agricultural crops and materials is managed by the District's Smoke Management System (SMS), which is intended to limit emissions to levels below the federal ambient air quality standards and to better distribute emissions temporally and spatially for flexibility of burn days for growers while minimizing the impact on the public. Since 2005, District staff prohibited open burning for most of the crops and materials that were identified in the CH&SC and will continue to monitor open burning through SMS, as well as review the alternatives to open burning periodically.

4. **COMMENT:** More time should be provided between the time the report is released and the time allowed for commenting. (Group 1)

   RESPONSE: The District will continue to work with stakeholders to ensure that comments and concerns are addressed during the project, with consideration to more time for document review during the commenting periods.

5. **COMMENT:** I am an asthmatic that was told to move up out of the valley because of the bad air. So I did and am now suffering from controlled burning. Please clean up the air, water and food contamination asap! It's too late for me but our children and future generations health and lives depend on it. Big ag and business do not have the right to pollute our environment. (CK)

We have friends from all over the world visiting this summer to attend our daughter's wedding in Bear Valley. Many are staying on to visit Yosemite and our many lovely parks in the area. We are proud of our parks and want to be able to enjoy them and share with our friends the beauty that can only be found here. (VC)

My grandson and I both have respiratory issues and I want him to have cleaner air to breath. I have stood atop Morro Rock in Sequoia National Park and have been unable to see the valley due to pollution. That really opened my eyes to the severity of the problem. (DaC)

These services [chipping and shredding] need to be made affordable and widely available to the public in order to discourage burning and the terrible air quality. I've been living here for six years now, and last year was the first year I've ever had seasonal allergies. I'm sure that the reason why is because of the bad air quality and the amount of pollen in the park. However, if this problem continues, I will be moving away from the area in order to improve my quality of life. (LB)

Tulare County often has the worst air quality in the nation, and we are in the national press for that reason. The economic costs of bad air in the Valley are close to $200 million per year, not to mention the premature deaths, the asthma, and other debilitating cardiopulmonary diseases. Don't sell our health and the quality of our national parks for bigger profits for a few agriculturalists. (G&LS)

RESPONSE: The District will continue to strive to protect the health of Valley residents through efforts to meet health-based state and federal ambient air-quality standards. According to the National Parks Conservation Association's webpage, most of the air pollution affecting national parks results from the burning of fossil fuels, especially coal-fired power plants (http://www.npca.org/cleanair/). Public exposure to smoke has been significantly reduced with the implementation of the smoke management program. Open burning of agricultural crops and materials is managed by the District's Smoke Management System (SMS). The Valley has not experienced episodes where communities are inundated with smoke due to the District's ability to better manage and minimize smoke production based on local meteorological conditions for each of the SMS zones. Greater control over the timing of burns also improved the general air quality in all areas of the District. As mentioned in Comment #3, the District will also continue to monitor open burning through SMS, as well as review the alternatives to open burning periodically.

6. **COMMENT:** We have a chipper shredder at home and never burn any of our prunings and trimmings. (G&LS)

RESPONSE: The state law has required that open burning be prohibited for prunings from specific orchards in 2005. As a result, the District has prohibited open burning for those crop types, except in instances where the agricultural commissioner has indicated the need for continued burning due to diseases. For 2010, state law required that burning be prohibited from surface harvested prunings. Unlike other orchards such as tree fruits, surface harvested crops (almonds, walnuts, and pecans), are harvested from the ground and require a shredding machine that would chip the pruning material to smaller pieces in order to not be picked up along with the nuts during harvest season.

7. **COMMENT:** There doesn't appear to be an established alternative to destroying used raisin trays after harvest. Commenter is a very small independent organic raisin grower who relies on the ability to destroy used raisin trays by burning them in an established cage. As the reports on the website indicate, the Biomass and compost operators refuse to accept these trays due to having certain residue components. Commenter requests that the SJVAPCD postpone the ban until a viable alternative for destruction/removal of these used trays is established.

Commenter feels it is very important to address this issue and would like to express their positions of support for this postponement as a small independent organic grape and raisin grower in Fresno County, California. (BCV)

RESPONSE: Based on the findings for raisin trays in the Report, there are currently no feasible alternatives to open burning of raisin trays. However, District staff is recommending that growers implement the practices, as described in Section 3.7.2 of the Report, during open burning and will work with the agricultural industry to develop any additional measures.

8. **COMMENT:** Regarding Section 6.2.2 – Contraband. We recommend the District amend this section to include the following language: "such as but not limited to, disposal of dangerous explosives which pose an immediate threat to health and safety" as a special consideration in which the APCO will waive the 15 day notice requirement. (DPU)

RESPONSE: Based on Rule 4103 (Open Burning), explosives are included as part of the definition for contraband (see Section 3.13: http://www.valleyair.org/rules/currntrules/r4103.pdf). Pursuant to Section 6.2.2 for Contraband, the APCO may waive the 15-day notice requirement in special circumstances upon notification. District staff recommends that commenter contact the District's Compliance Department prior to hosting such events during the year that dispose of contrabands through open burning.

9. **COMMENT:** As a farmer of 15 acres of almonds, I need to be able to burn brush and not accumulate it. It is not economically feasible for me to hire a shredder or chipper to deal with brush and stumps whenever one of my trees falls down. This proposal would be one more hardship for the small farmer who is attempting to make a profit, however small. (RVN)

   Your recommendations do not address the issue of pruning's or brush generated thru attrition of almond trees year round. It is impractical to hire a shredder for small quantities of organic waste. Also, having prunings with limited space to store them, after removing from the orchard, is another issue shredding does not address. (CM)

   RESPONSE: According to the District's findings and analysis, the cost per acre for shredding of nut prunings starts to increase for chipping operations below 20 acres. Therefore, District staff has recommended that open burning continue to be allowed for prunings up to 20 acres per year for growers that farm less than 3500 acres of total nut acreages.

   The California Health and Safety Code do not address attrition as part of the crop categories that are subject to the burn prohibition. Therefore, the District will not address attrition at this time. Please refer to the Executive Summary and Chapter One for more information.

10. **COMMENT:** Since air quality does not seem to be as big an issue in the winter months due to windy and wet conditions, I was hoping your recommendations would allow a more liberal burning policy in colder weather. (CM)

   RESPONSE: According to the *PM2.5 Plan*, winter brings rainfall, but also creates an atmospheric environment that forms more ammonium nitrate particulates. During winter, some types of cold winter fog events are linked to atmospheric chemistry that forms additional secondary particulates. The cold weather also induces the public to increase residential wood combustion use that adds further emissions to the atmosphere (though Rule 4901, Wood Burning Fireplaces and Wood Burning Heaters, prohibits fireplace use when the PM2.5 air quality is forecast to be unhealthy).

11. **COMMENT:** All nine plants in the Valley and the three outside the Valley total over 240 MW of renewable capacity, and all are under contract to California's investor owned utilities.

The draft report incorrectly states that only 3 biomass plants accept citrus, this is outdated information. Our facilities continue to fall short of their goals for more citrus orchard waste.

Information was provided on the wood fuel storage capacity, new powerplants in development, biomass crop assistance program, and the State's RPS program. (CBEA)

RESPONSE: District staff appreciates the updated information and clarifications on several items and has incorporated the information above as part of Chapter 7 of this report.

12. **COMMENT:** The 12 Valley biomass plants have very broad acceptance policies for wood fuel. This includes citrus orchard and vineyard removal waste along with many other commonly accepted wood types. (CBEA)

RESPONSE: The District appreciates the updated information and clarifications on the current availability of biomass plant capacity for the disposal of citrus orchard removal and vineyard removal materials. Consistent with State Health and Safety Code Section 41855.5 and 41855.6, the decision to recommend that burn prohibitions be postponed for these crop types was based on economic feasibility and the lack of future commitments to biomass plant operation. However, we do agree that it is important to accurately characterize both current and future biomass capacity concerns in the report. Therefore, the information provided regarding future capacity has been incorporated in Chapter 7 of the Report. Future capacity is of great concern, especially when the construction industry ultimately rebounds and urban wood waste from Southern California and the Bay Area becomes more available, as it was until the recent economic downturn. In the past, biomass power plants have resisted incorporation of increased agricultural biomass fuel as a condition on their permit. Without such certainty, the farmers cannot rely on biomass power plants as a reliable and dependable alternative. Additionally, chipping/orchard removals are seasonal activities and there is concern that storage space and equipment failure may create short-term situations when the biomass power plant operators must turn away agricultural materials. This inability to guarantee that a facility can accept agricultural biomass at all times, particularly given the seasonal nature of agricultural biomass, creates uncertainty in the ability of the biomass plants to accept increased amounts of agricultural fuel. The District looks forward to working with the biomass power plants to achieve long-term commitments toward the extensive use of agricultural biomass as fuel.

13. **COMMENT:** District staff has done a thorough evaluation of open-burn emissions vs. disposal of the same agriculture waste in a biomass plant in the Draft Report. CBEA is surprised the District did not also include the conclusions from a 1997 report published by Dr. Carl Moyer of Accurex Environmental Corp. titled "Emission Benefit From Firing Orchard Residue at Delano Energy Company". This Accurex report evaluated all emissions from open burning vs. use at the Delano Energy facility, including the emissions from the chipping & hauling equipment and all the equipment used at the plant site. The emissions reductions at Delano Energy were much more dramatic than the Draft Report concludes. You may remember that the District and others often quoted the conclusions of this report when it supported the very successful Agricultural Biomass-to-Energy Grant Program back in 2000-2003. (CBEA)

RESPONSE: District staff thanks commenter for the information and will review the report.

14. **COMMENT:** The discussion on greenhouse-gas emissions (page 7-11) properly identify biomass facilities as a feasible alternative to open burning of agricultural residues. However, the analysis of the greenhouse-gas emissions tacitly assumes that open-field burning and combustion in a biomass facility are equivalent, from a greenhouse-gas perspective. In fact, studies have shown that net greenhouse-gas emissions are reduced when biomass is diverted from conventional disposal alternatives like open burning to use as an energy resource, by amounts that are on the same order of magnitude as the amount of displacement of fossil fuel emissions (Morris, G., *Bioenergy and Greenhouse Gases*, Report of the Pacific Institute, May 15, 2008.) (CBEA).

RESPONSE: District staff appreciates the information provided above. In the report, District staff concluded that GHG emissions resulting from alternatives to open burning of orchard removal materials and prunings are expected to have a net positive benefit on global climatic change compared to the status quo of open burning. District staff recognizes that biomass power plants burn cleaner than open burning. However, for the purposes of the District's analysis, transportation emissions still needs to be considered in the analysis which would otherwise not be produced if orchard and vineyard removals were burned on the field.

Group #1 Comment Submitters:

Aletha Fulton-Vengco (AFV)
Alex MacCollom (AC)
Alicia Lippman (AL)
Andrea Tong-Dickson (ATD)
Ann Lopez (AL)
Anthony Arcure (AA)
Audra Lofstedt (ALL)
Barry Swars (BS)
Bernard Hochendoner (BH)
Berniece Hollingsworth (BH)
Beth Olson (BO)
Brad Martin (BM)
Bradford Lee Steele PhD (BLS)
Bradley Hallihan (BHH)
Brian Malone (BM)
Brian Vannatter (BV)
Brigitte Dinaberg (BD)
Bruce Odelberg (BO)
Callie Riley (CR)
Candy Bowman (CB)
Cari Chenkin (CC)
Carol Keltner (CK)
Cathy Herrera (CH)
Chad Hall (CH)
Christina Roe (CR)
Chuck Weiland (CW)
Coke Hallowell (CH)
Colleen Carr (CC)
Craig Swenson (CS)
Crista Vantassel (CV)
Daniel Cobb (DaC)
Danny DeTora (DT)
David Black (DB)
David Driver (DD)
David Murray (DM)
Dean Cobb (DC)
Deborah Hirsch (DH)
Dennis Battrick (DBB)
Dennis Ledden (DL)
Deoyani Sarkhot (DS)
Diana Cho (DC)
Diane Murphy (DM)
Diane Schultheis (DSS)
Don Woolf (DW)
Donna D'Amico (DDA)
Donna Tobaie (DT)
Donna Watson (DW)
Edh Stanley (ES)
Edward Seakamp (ESE)
Elizabeth Jackson (EJ)
Ellen Jamra (EJ)
Emili Obara (EO)
Emily Schrepf (ES)
Emily Webb (EW)
Etta Robin (ER)
Francis Palmer (FP)
Greg & Laurie Schwaller (G&LS)
Harley Sebastian-Lewis (HSL)
Heather Levin (HL)
Heike Beauchaine (HB)
Howard Whitaker (HW)
Gabriel Sheets (GS)
Georgia Lynn (GL)
Geraldine May (GM)
Glenda Lipman (GLL)
Graeme Kinsey (GK)
Ismael Macias (IM)
James Baker (JBA)
James Columbia (JC)
Janet Moffett (JM)
Janet Westbrook (JW)
Jason Bowman (JB)
Jeff Ball (JBB)
Jeff Colvin (JC)
Jennifer Will (JW)
Jim Nakata (JN)
Tim Taylor (JTY)
Jan Maltzan (JMZ)
Joceline Tobacco (JT)
Jody Wright (JWW)
John Honnette (JH)
John Murphy (JM)
John Satchell (JS)
Joseph Buhowsky (JB)
Judy Commons (JCC)
Julie Ostoich (JO)
Justin Delemus (JD)
Karen E. Steele (KES)
Karen Linarez (KL)
Karen Peck (KP)
Karyn Gil (KG)
Kate Harper (KH)
Kathey Norton (KN)
Keith Forrest (KF)
Kenneth Avance (KA)
Kenneth Wemmer (KW)
Kevin Mcnamara (KM)
Kevin Wang (KW)
Kristin Smith (KS)
Kristina Kahl (KK)
Laura Herrera (LH)
Leilani Echols (LE)
Les Roberts (LR)
Lisa Ross (LR)
Loraine Baldwin (LB)
Lars Johansson (LJ)
Laura Curran (LC)
Linda Jones (LiJ)
Louise Johnson (LJJ)
Lynda Austin (LA)
Lyndsay Black (LBB)
Margo Tarver (MTA)
Maria Skercevic (MS)
Mark Maloney (MM)
Marjorie Northern (MN)
Mary Ann McDonald (MAM)
Maureen Russell (MR)
Maxine Jacobsen (MJ)

Melanie Graf (MG)
Melissa Didomenico (MD)
Melvin Taylor (MT)
Mena Yang (MY)
Michael Hobbs (MH)
Michael Todd (MTD)
Mike Clipka (MC)
Mila Christ (MCC)
Nancy Kelly (NK)
Nancy Reynolds (NR)
Oscar Vazquez (OV)
Pamela Roe (PR)
Pamela Skillings (PS)
Paul Gullam (PG)
Paula Hartgraves (PHA)
Phil Helman (PH)
Phillip King (PK)
Ray Ann Sullivan (RAS)
Ray Morris (RM)
Rhonda Lynn (RL)
Richard Blakemore (RB)
Richard Harvey (RH)
Richard Robinson (RR)
Rob Grace (RG)
Robert Cassinelli (RC)
Robert Dayton (RD)
Robert Sennett (RS)
Robert Sullivan (RSS)
Robert Williams (RW)
RoseMarie Kuhn (RMK)
Roy Mcknight (RMM)
S. Hodges (SH)
Saeed Eghbali (SE)
Sandra Mitchell (SM)
Sandy Commons (SC)
Sarah Hafer (SH)
Scott Herman (SCH)
Shawn Hampton (SHH)
Socorro Scow (SS)
Sophie E. Miranda (SEM)
Steve Holzberg (SHO)
Steven Anderson (SA)
Susan Goldstein (SG)
Tarvin Clark (TC)
Teddi Gonzalez (TGG)
Terry Manning (TM)
Thomas Danfield (TD)
Tricia Philipson (TP)
Vicki Cunniffe (VC)
Wendell Hovey (WH)
Wendy Scott (WS)
Will Cole (WC)
William Brashear (WB)
William Mittig (WM)
William Sanford (WS)
William Wollner (WW)
Yvonne Peck (YP)

Appendix D: SUMMARY OF SIGNIFICANT COMMENTS & DISTRICT RESPONSES FROM THE MAY 20, 2010 PUBLIC HEARING

US EPA REGION IX STAFF COMMENTS

1. **COMMENT:** As noted in Table 9-1 of the Staff Report, the District is removing the requirement to limit burning of rice stubble by 50% in 2010. This appears to relax the requirement found in Section 5.5.2.3 of the current federally enforceable version of Rule 4103. The District should demonstrate that this relaxation is consistent with Clean Air Act Section 110(l).

   RESPONSE: District staff does not expect that the recommendation to maintain the burn limit of rice stubble at 70% would have any adverse impact on the Reasonable Further Progress (RFP) and attainment goals of the District's *2007 Ozone Plan* and *2008 PM2.5 Plan*. There are currently no viable non-burn alternatives for the remaining rice stubble due to the fluctuation in market demand and issues with water allocation. In 2009, rice growers were granted a variance because the 70% reduction was difficult to achieve with no available alternatives. The emissions reduction estimates for the 2007 amendments to Rule 4103 (Phase III) were 912.5 tons of NOx/year, 1204.5 tons of VOC/year, and 949 tons of PM10/year. For this Report, District staff estimated additional emissions reduction of 39.2 tons of NOx/year, 105.2 tons of VOC/year, and 123.1 tons of PM2.5/year. The estimated emissions reduction achieved from Phase III amendments to the rule and the final phase from this report were not included in the *2007 Ozone Plan* and *2008 PM2.5 Plan*. The total emissions reduction achieved from both phases exceeds the projected reductions expected for the Open Burn control measure from both plans.

   RFP and Attainment Demonstration from the *2007 Ozone Plan*
   The Federal Clean Air Act Section 182(c)(2)(B) requires nonattainment areas to show that the plan will result in VOC and NOx emission reductions. RFP requirements for 8-hour ozone (*2007 Ozone Plan*) are outlined in EPA's Phase 2 rule to implement the 8-hour ozone standard (70 *FR* 71631-71652). Nonattainment areas for 8-hour ozone that have already met the 15% VOC emission reduction requirement for the 1-hour ozone standard are subject to the RFP requirement to obtain an average of 3% annual reductions of VOC and/or NOx emissions reductions for the first six (6) years after the baseline year and every subsequent three (3) years out to the attainment date. EPA approved the SJVAB's 1994 Ozone Attainment Demonstration Plan and its 15% rate of progress (ROP) demonstration in the Federal Register on January 8, 1997, effective February 7, 1997 (62 *FR* 1172). The District has submitted periodic Milestone Compliance Demonstrations to show retrospectively that the emissions

reductions required through ROP have occurred in the SJVAB. Therefore, the SJVAB has met the initial 15% VOC reduction requirement.

The SJVAB must now obtain an average of 3% annual reductions of VOC or NOx emissions for the first six (6) years after the baseline year and every subsequent 3-year period until the attainment year. The baseline year is 2002 (70 FR 71631), so the six-year milestone is 2008. The 3-year milestone years are 2011, 2014, 2017, 2020, and 2023. The year 2023 is also the expected actual attainment year for extreme areas. According to the analysis in the *2007 Ozone Plan*, the SJVAB meets RFP since the combined percent reduction surpasses the RFP requirements.

2. **COMMENT:** The schedule for providing comments on both the final draft of Rule 4103 and the District Staff Report and Recommendations on Agricultural Burning was very short, particularly given the size of the staff report. While we understand the District has time and resource limitations, this schedule has limited our ability to perform a timely thorough review.

   RESPONSE: The District thanks EPA for their cooperation and understanding as staff developed such a comprehensive report. For future re-evaluations of the District's determinations for agricultural burning, District staff will continue to work closely with interested parties and to ensure that the schedule provides adequate time for review and comments.

ARB STAFF COMMENTS

ARB staff has reviewed the Draft Staff Report and Recommendations on Agricultural Burning and has no comments at this time.

STAKEHOLDER COMMENTS

Stakeholders who submitted comments:

Allied Grape Growers (AGG)
California Biomass Energy Alliance (CBEA)
California Citrus Mutual (CCM)
California Grape and Tree Fruit League (CGTF)
Covanta Delano (CD)
Fresno Metro Ministry (FMM)
Fresno County Farm Bureau (FCFB)
Gerald Nola (GN)
John – Unidentified Gentleman provided comments via FAX (UG1)

Marvin Dean (MD)
Nisei Farmers League (NFL)
San Joaquin Farm Bureau (SJF)
Representatives for Senator Dean Florez (SDF)
Raisin Bargaining Association (RBA)
Rio Bravo (RB)

Earth Justice, The California Food Project, Pesticide Watch Education Fund, Coalition for Clean Air, Fresno Metro Ministry, Tri-Valley CAREs, Medical Advocates for Healthy Air, and the Central Valley Air Quality Coalition's Watchdog Committee (Group A)

3. **COMMENT:** Burning should be allowed to begin at daybreak and not at 10 am. I know there has to be a good reason for the midmorning start, but what does a few hours mean? Burn days are only allowed when there is air movement and that means wind. At daybreak before the winds start from SE to NW, it is cool, calm and the convective column goes straight up, with no damage. For people like myself, it would be nice to wave the 10 am rule. (UG1)

   RESPONSE: The 10 AM start time was established to allow the morning inversion to weaken. An inversion is defined as the temperature increases (warms) with height. During the early morning hours (prior to 10 AM), the temperature inversion is normally the strongest. This inversion would cause smoke emissions from a source to remain trapped near the surface leading to a potential for localized impacts. With solar heating, the inversion tends to disappear or break-up around 10 AM leading to better mixing conditions.

4. **COMMENT:** We were very supportive of the SB 700 series that Senator Florez passed in the California legislature to end the long-standing exemptions for agriculture from complying with the Clean Air Act including SB 705 which specifically addressed agricultural burning. We understand that there are multiple sources that need to be addressed in order to achieve clean air standards in the valley, but we still believe that any potential emission reductions need to be gained if there are public health benefits. (FMM)

   RESPONSE: As a public health agency, we agree with the comment and are committed to achieving as many emissions reductions as possible, which are economically and technologically feasible. The District's recommendations do include additional burning prohibitions which will achieve additional emission reductions. However, as allowed under SB705, the District has recommended the postponement of a few crop types since there were no economically or technologically feasible alternatives at this time.

   Additionally, to assure that open burning of agricultural materials did not cause any violations of health-based ambient air quality standards, agricultural burning has only been permitted under the District's comprehensive Smoke Management System, which uses real-time meteorological information to analyze the impact of burning on air quality and appropriately limit burn allocations.

5. **COMMENT:** Metro staff was present at the workshop and the previous board hearing where there was much testimony about the availability of biomass facilities to handle the ag waste that should no longer be allowed to be burned. We are pleased to see that the new Staff report reflects these comments, but concerned that this information was still not taken into account when determining feasibility. While we are not proponents of biomass facilities, especially if processing waste from other parts of the state, we do believe that the newest and cleanest biomass facilities should be considered as an alternative to burning, along with composting, chipping and shredding, and reintroducing to the land. (FMM)

   RESPONSE: As detailed in Chapters 3 and 7 of the report, staff did consider information provided by stakeholders when determining economic and technological feasibility of alternatives to open burning. In fact, the District will continue to work with the biomass industry on the ability to accept and store ag materials, especially during the peak seasons when the amount of ag materials become significant. Other alternatives, as specified, have been considered in the staff report, especially reintroducing the shredded pruning materials to the land. While shredding and land applying pruning material works on permanent crops, chipping orchard removal materials for soil incorporation was determined to not be a technologically feasible alternative.

6. **COMMENT:** Postponements and exemptions should be much more limited if necessary at all. Most special situations such as proven cases of disease should be handled on a case-by-case basis through conditional burn permits. We believe it is important to follow the letter of the law on this issue, because it was created to protect the health of all residents in the San Joaquin Valley, especially the most sensitive. (FMM)

   The result of these postponements is that over 90 percent of the emissions intended to be reduced by 2010 will be allowed to continue. This means at least 1,030 tons per year of oxides of nitrogen ("NOx") emissions, 1,262 tons per year of fine particulate matter ("PM-2.5") emissions, and 1,138 tons per year of volatile organic compound ("VOC") emissions will continue to be emitted. At a time when Valley residents are suffering from some of the highest asthma rates in the nation, the District needs all the reductions it can get in order to meet federal ozone and particulate matter standards and move toward cleaner air for the Valley. (Group A)

RESPONSE: The District has taken a number of actions to reduce open burning, including implementation of a comprehensive Smoke Management System (SMS), phasing out the majority of open burning, and only allowing burning where economically feasible alternatives were not available, as provided by SB 705, with ARB concurrence. The limited remaining burning is tightly regulated under the District's SMS, which uses advanced modeling and real time information to cap daily burning with little or no impact on air quality and public health, which SB 705 did not take into account. The District's actions have eliminated the majority of agricultural open burning since 2002, with 70% reduction in acreage burned. The additional reduction from open burning for 2010, along with the significant emissions reduction from 2007, have satisfied and exceeded the Plan commitment for the Open Burning control measure. The District will continue to address other control measures in the Plans and seek further emissions reduction.

7. **COMMENT:** The fundamental defect in the District's "10 percent of profits" test is that it has no rational connection to whether an alternative is "economically feasible." Although "economic feasibility" is not defined in the California Health and Safety Code, the common usage of "feasible" is understood as "capable of being done or carried out. "Feasible" is also defined in the California Environmental Quality Act Guidelines. Thus, the key question is whether an industry is *capable* of handling the costs of an alternative to burning. (Group A)

RESPONSE: In absence of mandated threshold to determine the industry's capability of handling the additional costs, District staff used the 10% of profits test as a reasonable method to identify any significant impacts. The report takes into account the economic and technological feasibility of the alternatives and whether growers and operators would be able to handle the ag materials in a reasonable period of time.

As mentioned in Chapter 1 of this report, the 10 percent threshold utilized in this analysis represents the economic significance level generally utilized by the District in the development of District rules, and represents the level that a regulatory action would pose a significant economic impact to affected sources. The ten percent threshold was based on the parameters of accepted methodologies discussed in a 1995 California Air Resource Board (ARB) report called "Development of a Methodology to Assess the Economic Impact Required by SB 513/AB 969" (by Peter Berck, PhD, UC Berkeley Department of Agricultural and Resources Economics, Contract No. 93-314, August, 1995).

8. **COMMENT:** The "10 percent of the industry's profits" test used by the District has no direct connection to whether each industry is "capable" of bearing the costs of control. It gives no indication of whether the industry will be threatened or whether sources will shut down. (Group A)

A lot of the net profit is reinvested toward farm loans, operating lines, improvements, and regulations. (SJF)

RESPONSE: As stated in the report, the 10% is the District's standard metric for determining economic impact. The CH&SC does not define the term "economically feasible alternative" so our standard metric is used for consistency with past actions. During the public hearing process, affected growers indicated burn prohibitions would cause substantial economic hardships. Although the District does not explicitly state whether the industry will be threatened or sources will shut down, the 10% threshold has been historically used as the percentage where significant impacts to an industry will occur with percentages ranging from just around 10% to well above 50% for certain crop types; along with the current economic situation, it can easily be assumed that significant impact would occur if the District did not postpone the burn prohibitions.

9. **COMMENT:** The Staff Report erroneously concludes that burn alternatives for citrus orchard removal are not economically feasible. This error is further exacerbated by the fact that the costs of citrus orchard removal seem to be inflated. The District assumes an additional $244 per acre for transporting roots to a composting facility. However, in conversations with biomass facility operators and two of the largest orchard removal contractors in the Valley, no such special treatment is needed for citrus roots. These can be chipped and transported to biomass facilities along with the rest of the chipped material. The District needs to remove this added fee for a more realistic cost estimate for this alternative. (Group A)

   RESPONSE: Based on staff's understanding, the root removal process is independent from the chipping and biomass operations. Citrus trees are notorious for having an extensive root system. When orchards are prepared for removal and the trees are pushed over, many of the tree roots remain in the soil. Therefore, after the orchard is chipped and the materials are removed from the site, the grower must hire a contractor to "rip" the ground and the remaining roots are collected and piled using hand labor.

10. **COMMENT:** The District cites concerns by unidentified agricultural representatives that not all biomass plants accept citrus chips and that the existing biomass plants may not have the capacity to handle the additional wood material that would be generated if burning citrus removal were prohibited. First, the biomass industry has testified repeatedly and submitted comments contradicting the District's claims that citrus is not readily accepted at the biomass facilities serving the Valley. The Staff Report states: "Biomass power plant operators have indicated that previous concerns regarding certain materials have been alleviated over the past few years as the operators have improved the

methods in processing the materials to better suit the needs of the plant." The Staff Report acknowledges the multi-million dollar investments many biomass operators have made to upgrade their facilities. (Group A)

RESPONSE: While the understanding is that biomass power plants typically blend the citrus materials, Table 3-4 shows that it is not economically feasible to prohibit open burning for this crop type.

11. **COMMENT:** The District is proposing to allow growers whose total nut acreage is less than 3,500 acres to burn 20 acres of prunings, plus an unrestricted additional amount if conditions are met. Not only does this provision constitute illegal director's discretion, it undermines the economic analysis by allowing the APCO to make affordability determinations on an individual basis, rather than assessing the ability of the industry as a whole to absorb the costs of a control. The District is suggesting that it is not feasible to require any farm under 3,500 acres to shred. In conversations with several contractors, all indicated that they are at nowhere near capacity for work and could easily take on the additional acres that would come with a burn ban. The District needs to identify all such contractors before it can adequately assess whether the industry is capable of handling the additional acres. There is no reason for the District to assume that a grower must purchase the expensive shredding machine himself in order to make shredding feasible. There is no reason to believe that the industry couldn't handle the remaining acres if the burn ban was implemented as intended by law. Regarding the problems hullers have with chips getting mixed in with hulls, in conversations with contractors and representatives of the Almond Board of California, we've learned that this problem has gotten significantly better as chipping shredding has gotten finer and most contractors have not had any complaints about the chips in recent years. Shredding prunings is technologically feasible (it's already being done), economically feasible ($38/acre), and has been found to be beneficial for soil (see attached articles). (Group A)

RESPONSE: District staff has conducted extensive search on the availability of shredding operators for tree nut prunings through directories, internet searches, and other resources. District staff also contacted available contractors to determine those that only work on orchard removals, those that only shred tree fruit prunings, those that shred tree nut prunings, and those that are no longer in business. District staff welcomes any additional lists or contact information for shredding operators that provide services for tree nut prunings. As mentioned in Section 6.2.2 and Section 3.7.3, and according to shredding operators, there is a minimum job charge of two hours (about 20 acres) for the $38/acre. As mentioned in the Report, District staff analyzed the cost of hiring a custom shredder as the likely alternative for the economic analysis rather than requiring growers to purchase the equipment. District staff discussed in the Report that the problems with the hulls have improved through the use of the shredders that can shred the materials into finer pieces. While the analysis shows that growers that farm less than 3,500 acres would likely hire a custom shredder, there is not enough information to determine whether the identified contractors would be available during the season to address the remaining acres. Any additional burns would be determined on a case-base-case basis and does not guarantee burn allowance.

12. **COMMENT:** The District erroneously uses a 10 year life for a vineyard that is expected to last at least 25 years. The highly profitable kiwi industry should easily be able to handle the additional cost necessary to avoid burning and should not receive a postponement. Wine grapes, on the other hand, may be more significantly impacted by the cost of burn alternatives, though we still dispute the "10% of profits" test and request more analysis. The District must separate raisin and table grape categories and analyze the ability of each to bear the cost of the burn alternatives. If this analysis finds that one category is able to bear the costs while the other is not, the District can propose a postponement for that category. (Group A, SDF)

    RESPONSE: Although the Report subcategorized the variety of grapes for further analysis, the state law did not differentiate the varieties in the "vineyard removal" category.

    As noted in the Report (page 1-5), the ten year approach is based on the harvested acreage when growers are making profits, which does not include the non-bearing years during the first few years. Growers have mentioned that crops may be pulled out before the full life-cycle to keep the farm productive. District staff would evaluate alternative approaches to the economic feasibility analysis in the future.

13. **COMMENT:** The Staff Report mentions treatment, with Streptomycin and burying diseased material in double plastic bags, but offers no analysis of the technical or economic feasibility of these options. The Staff Report also explains that pruning and orchard removal equipment is routinely sterilized when moving from tree to tree but doesn't explain why, with these routine precautions, it is still infeasible for the resulting waste materials to be removed off-site rather than pushed out and burned. More fundamentally, however, the risk of disease is not an allowable basis for postponing burning bans under state law. The District uses the possibility of disease to claim that there is no technically feasible alternative to burning whether or not the materials actually are diseased or pose any threat to adjacent plots. This proposal meets none of the specific legal requirements for allowing burning to address disease. (Group A)

RESPONSE: See Appendix H, Disease Crop, for a memo from the County of Fresno Ag Commissioner on the possible options for controlling Fireblight, which is becoming resistant to chemical means. District staff is not aware of any growers that would put several acres (equating to several tons) of these materials into double plastic bags for burial onsite for prunings every few years or for orchard removals (prior to replanting). Since there are no technologically feasible alternatives, it can be assumed that these alternatives will also be economically infeasible.

14. **COMMENT:** The District cites concerns that biomass facilities are not a reliable alternative for disposing of agricultural waste. This is largely because in the past, biomass facilities have shut down for upgrades, and fears that when the economy and the building industry recover, biomass facilities will no longer choose agricultural waste when "cheaper" urban waste is more readily available. The biomass industry has repeatedly stated that it has a great need for more wood fuel and that ag waste is its preferred fuel due to the higher quality (higher BTU content and lower ash content) and because of the equipment damage sustained from the use of lower-quality urban wood waste. (Group A)

RESPONSE: Section 7.1.3 and Table 7-4 explains the historical usage and the average annual percentage of agricultural material burned through just 2009 of last year. We will be re-evaluating the burn allowance based on future fuel usage and can make adjustments, if warranted.

15. **COMMENT:** The District is subtracting the emissions that come from the biomass facility from the total benefit of the avoided open burning emissions. However, the biomass facilities are permitted and the District must assume that they will continue to produce these emissions whether or not the District prohibits open burning. Therefore, the real benefit is the total emissions that are avoided by banning open burning. This conclusion is supported by the study by Dr. Carl Moyer, ***Emission Benefit From Firing Orchard Residue at Delano Energy Company*** (attached), which found that burning orchard residues in a biomass facility lead to a 96% reduction in criteria pollutants compared to open burning, taking into account equipment used to chip and haul the material. Also, in this study, the average distance to collect agricultural fuel was found to be 29 miles. This is in contrast to the District's assumed 100 mile distance. (Group A)

Study by Dr. Carl Moyer shows that it is cleaner to take the materials to biomass facilities than open burn. (CBEA)

RESPONSE: The District's emissions analysis compares the complete operation of open burning versus the alternative of taking the material to the biomass power plants. Therefore, the emissions from the amount of agricultural materials being open burned need to be compared with the emissions from the same amount of agricultural materials being burned at the biomass power plants. The District's analysis takes into account the emissions from transporting the equipment to the site, the tubgrinder, grinding process, and that not all operators process the materials directly into the truck, rather grinding the materials onsite and then loading the materials to the truck. District staff used the 50-mile radius for the analysis based on discussion with biomass operators, which equates to the 100-mile roundtrip.

16. **COMMENT:** The Governor of California has made biomass a priority and there is further evidence of the State's commitment to ensure the success of biomass energy through several programs. CBEA points out in its letter that nearly every biomass facility serving the Valley has a long-term contract with one of California's investor owned utilities, and there is a Biomass Crop Assistance Program authorized under the 2008 Farm Bill that incentivizes growers to send their agricultural waste to a qualified bioenergy facility. (Group A)

    RESPONSE: Section 7.3 of the Report further explains the current federal and state funding commitments for biomass facilities in the SJVAB. Staff has included CBEA's comment on Biomass Crop Assistance Program, which stated that this is a short-term incentive program. One of the criteria that the District must make a determination on is whether there is any <u>long-term</u> federal or state <u>funding</u> commitment for the continued operation of biomass facilities in the SJVAB.

17. **COMMENT:** District's Feasibility Study on Biomass Incentives was not mentioned in the report nor analyzed. (CBEA)

    RESPONSE: District staff incorporated the draft feasibility study on biomass incentives into the Report early in the process, which can be found in Chapter 7. The Report also indicated that there were no long term funding programs available at this time.

18. **COMMENT:** Consultant that provided actual numbers to the District of what it cost to chip materials for vineyards. The numbers provided to the District are accurate from the growers that use alternatives to open burning. Vineyards are pulled out because they are no longer productive. (RBA, AGG)

    RESPONSE: Comment noted.

19. **COMMENT:** Data came from UDSA and UCCE, not from the industry. (NFL, CCM, FCFB)

    RESPONSE: Comment noted.

20. **COMMENT:** Supports staff's recommendations. Project is a balanced approached. (SJF, CGTF, NFL, CCM, FCFB, MD)

RESPONSE: Comment noted.

21. **COMMENT:** Open field burning should be banned. (SDF)

RESPONSE: Comment noted.

22. **COMMENT:** Covanta Delano can accept 100,000 tons of citrus material. Covanta will work with the Ag industry. (CD)

RESPONSE: The District is supportive of any collaboration with biomass power plant facilities and the agricultural industry. Although progress has been made in the biomass industry for accepting agricultural material, the recommendation for citrus orchard removals is based on economic infeasibility and lack of long-term commitment for accepting citrus removals.

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Appendix E

Economic Feasibility Analysis Methodology

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E-1
Vineyard Removal

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E-1: Vineyard Removal

1	Average Farm Size By Farm Size Category			
		Vineyards		
		Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
	15 to 24.9 acres	22.0	22.0	22.0
	25 to 99.9 acres	42.4	42.4	42.4
	100 to 249.9 acres	165.8	165.8	165.8
	250 to 499.9 acres	359.0	359.0	359.0
	500 to 749.9 acres	716.0	716.0	716.0
	750 to 999 acres	874.5	874.5	874.5
	over 1,000 acres	2,469.8	2,469.8	2,469.8

Source: USDA Agricultural Census 2007

2	Tons of Crop Per Acre				
		Vineyards			
		Grapes (wine grapes only	Grapes (raisin & table)	Kiwi	
	Not Adjusted (tons of crop) *All acreage*	*8.99*	*6.52*	*8.15*	Productivity Adjustment Factors[(1)]
	Adjusted (tons of crop)				
	15 to 24.9 acres	*8.02*	*5.82*	*7.27*	*0.892*
	25 to 99.9 acres	*8.35*	*6.06*	*7.57*	*0.929*
	100 to 249.9 acres	*8.67*	*6.30*	*7.87*	*0.965*
	250 to 499.9 acres	*9.00*	*6.53*	*8.17*	*1.002*
	500 to 749.9 acres	*9.33*	*6.77*	*8.46*	*1.038*
	750 to 999 acres	*9.66*	*7.01*	*8.76*	*1.075*
	over 1,000 acres	*9.99*	*7.25*	*9.06*	*1.111*

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report

3	Tons of Crop Per Average Farm By Size Category			
		Vineyards		
		Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
	15 to 24.9 acres	176.4	128.1	160.0
	25 to 99.9 acres	353.5	256.6	320.7
	100 to 249.9 acres	1,438.3	1,044.0	1,304.8
	250 to 499.9 acres	3,231.6	2,345.7	2,931.6
	500 to 749.9 acres	6,680.5	4,849.2	6,060.5
	750 to 999 acres	8,446.0	6,130.7	7,662.1
	over 1,000 acres	24,663.6	17,902.7	22,374.5

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report

4	Price Per Ton of Crop (2003-2008 avg)			
		Vineyards		
		Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
	Not Adjusted	*$284.2*	*$954.2*	*$1,551.1*

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report and US BLS

5	Annual Revenue Per Average Farm			
		Vineyards		
		Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
	15 to 24.9 acres	$50,133	$122,193	$248,241
	25 to 99.9 acres	$100,468	$244,880	$497,486
	100 to 249.9 acres	$408,716	$996,206	$2,023,840
	250 to 499.9 acres	$918,317	$2,238,307	$4,547,228
	500 to 749.9 acres	$1,898,397	$4,627,157	$9,400,290
	750 to 999 acres	$2,400,101	$5,850,009	$11,884,572
	over 1,000 acres	$7,008,682	$17,082,973	$34,704,875

Source: ADE, Inc.

6	Ten-Year Revenue Per Average Farm			
		Vineyards		
		Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
	15 to 24.9 acres	$501,325	$1,221,931	$2,482,412
	25 to 99.9 acres	$1,004,678	$2,448,804	$4,974,862
	100 to 249.9 acres	$4,087,164	$9,962,059	$20,238,399
	250 to 499.9 acres	$9,183,169	$22,383,072	$45,472,278
	500 to 749.9 acres	$18,983,973	$46,271,567	$94,002,897
	750 to 999 acres	$24,001,005	$58,500,089	$118,845,722
	over 1,000 acres	$70,086,821	$170,829,730	$347,048,746

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report and USDA Ag Census 2007

7	Ten-Year Net Profit Per Average Farm @ 5.9% Avg		
	Vineyards		
	Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
15 to 24.9 acres	$29,578	$72,094	$146,462
25 to 99.9 acres	$59,276	$144,479	$293,517
100 to 249.9 acres	$241,143	$587,762	$1,194,066
250 to 499.9 acres	$541,807	$1,320,601	$2,682,864
500 to 749.9 acres	$1,120,054	$2,730,022	$5,546,171
750 to 999 acres	$1,416,059	$3,451,505	$7,011,898
over 1,000 acres	$4,135,122	$10,078,954	$20,475,876
Ten-Year Net Profit Per Farm (< 100 and ≥ 100 acres)			
	Vineyards		
	Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
<100 acres	$44,427	$108,287	$219,990
≥ 100 acres	$1,490,837	$3,633,769	$7,382,175

Source: ADE, Inc, based on Dun & Bradstreet, Risk Management Association, and USDA Ag Census 2007

8	Cost Per Acre for Burning Alternative		
	Vineyards		
	Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
District Estimate	*$762*	*$762*	*$762*
Stakeholder Estimate	*$1,132*	*$1,132*	*$1,132*

Source: SJVUAPCD staff and stakeholders

9a	Cost for Burn Alternative Per Average Farm Using District Cost Estimate		
	Vineyards		
	Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
15 to 24.9 acres	$16,764	$16,764	$16,764
25 to 99.9 acres	$32,276	$32,276	$32,276
100 to 249.9 acres	$126,342	$126,342	$126,342
250 to 499.9 acres	$273,532	$273,532	$273,532
500 to 749.9 acres	$545,594	$545,594	$545,594
750 to 999 acres	$666,369	$666,369	$666,369
over 1,000 acres	$1,882,024	$1,882,024	$1,882,024
Cost for Burn Alternative Per Farm (< 100 and ≥ 100 acres) Using District Cost Estimate			
	Vineyards		
	Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
<100 acres	$24,520	$24,520	$24,520
≥ 100 acres	$698,772	$698,772	$698,772

Source: ADE, Inc.

9b	Cost for Burn Alternative Per Average Farm Using Stakeholder Estimate		
	Vineyards		
	Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
15 to 24.9 acres	$24,904	$24,904	$24,904
25 to 99.9 acres	$47,949	$47,949	$47,949
100 to 249.9 acres	$187,689	$187,689	$187,689
250 to 499.9 acres	$406,350	$406,350	$406,350
500 to 749.9 acres	$810,515	$810,515	$810,515
750 to 999 acres	$989,934	$989,934	$989,934
over 1,000 acres	$2,795,868	$2,795,868	$2,795,868
Cost for Burn Alternative Per Farm (< 100 and ≥ 100 acres) Using Stakeholder Cost Estimate			
	Vineyards		
	Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
<100 acres	$36,426	$36,426	$36,426
≥ 100 acres	$1,038,071	$1,038,071	$1,038,071

Source: ADE, Inc.

10a	Cost Per Ten-Year Net Profit Per Average Farm - District Cost Estimate		
	Vineyards		
	Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
15 to 24.9 acres	56.7%	23.3%	11.4%
25 to 99.9 acres	54.5%	22.3%	11.0%
100 to 249.9 acres	52.4%	21.5%	10.6%
250 to 499.9 acres	50.5%	20.7%	10.2%
500 to 749.9 acres	48.7%	20.0%	9.8%
750 to 999 acres	47.1%	19.3%	9.5%
over 1,000 acres	45.5%	18.7%	9.2%
Cost Per Ten-Year Net Profit Per Avg Farm (< 100 and ≥ 100 acres) Using District Cost Estimate			
	Vineyards		
	Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
<100 acres	**55.2%**	**22.6%**	**11.1%**
≥ 100 acres	**46.9%**	**19.2%**	**9.5%**

Source: ADE, Inc.

10b	Cost Per Ten-Year Net Profit Per Average Farm - Stakeholder Estimate			
		Vineyards		
		Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
	15 to 24.9 acres	84.2%	34.5%	17.0%
	25 to 99.9 acres	80.9%	33.2%	16.3%
	100 to 249.9 acres	77.8%	31.9%	15.7%
	250 to 499.9 acres	75.0%	30.8%	15.1%
	500 to 749.9 acres	72.4%	29.7%	14.6%
	750 to 999 acres	69.9%	28.7%	14.1%
	over 1,000 acres	67.6%	27.7%	13.7%
	Cost Per Ten-Year Net Profit Per Avg Farm (< 100 and ≥ 100 acres) Using Stakeholder Cost Estimate			
		Vineyards		
		Grapes (wine grapes only	Grapes (raisin & table)	Kiwi
	<100 acres	**82.0%**	**33.6%**	**16.6%**
	≥ 100 acres	**69.6%**	**28.6%**	**14.1%**

Source: ADE, Inc.

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E-2
Other Orchard Removal

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E-2: Other Orchard Removal

1	Average Farm Size By Farm Size Category									
	Other Fruits - Orchards									
	Apricot	Avocado	Cherries	Nectarine	Olive	Peach	Persimmon	Plum	Pomegranate	Figs
15 to 24.9 acres	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
25 to 99.9 acres	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4
100 to 249.9 acres	165.8	165.8	165.8	165.8	165.8	165.8	165.8	165.8	165.8	165.8
250 to 499.9 acres	359.0	359.0	359.0	359.0	359.0	359.0	359.0	359.0	359.0	359.0
500 to 749.9 acres	716.0	716.0	716.0	716.0	716.0	716.0	716.0	716.0	716.0	716.0
750 to 999 acres	874.5		874.5	874.5	874.5	874.5		874.5		874.5
over 1,000 acres	2,469.8		2,469.8	2,469.8	2,469.8	2,469.8		2,469.8		2,469.8

Source: USDA Agricultural Census 2007

2	Tons of Crop Per Acre										
	Other Fruits - Orchards										
	Apricot	Avocado	Cherries	Nectarine	Olive	Peach	Persimmon	Plum	Pomegranate	Figs	Productivity Adjustment Factors
Not Adjusted (tons)	*7.82*	*2.73*	*2.76*	*8.21*	*2.99*	*13.22*	*6.70*	*6.02*	*4.02*	*1.51*	
Adjusted (tons)											
15 to 24.9 acres	*6.97*	*2.43*	*2.47*	*7.32*	*2.66*	*11.79*	*5.98*	*5.37*	*3.59*	*1.35*	*0.892*
25 to 99.9 acres	*7.26*	*2.53*	*2.57*	*7.62*	*2.77*	*12.28*	*6.22*	*5.59*	*3.73*	*1.40*	*0.929*
100 to 249.9 acres	*7.54*	*2.63*	*2.67*	*7.92*	*2.88*	*12.76*	*6.47*	*5.81*	*3.88*	*1.46*	*0.965*
250 to 499.9 acres	*7.83*	*2.73*	*2.77*	*8.22*	*2.99*	*13.24*	*6.71*	*6.03*	*4.03*	*1.51*	*1.002*
500 to 749.9 acres	*8.11*	*2.83*	*2.87*	*8.52*	*3.10*	*13.72*	*6.96*	*6.25*	*4.17*	*1.57*	*1.038*
750 to 999 acres	*8.40*	*2.93*	*2.97*	*8.82*	*3.21*	*14.20*	*7.20*	*6.47*	*4.32*	*1.62*	*1.075*
over 1,000 acres	*8.68*	*3.03*	*3.07*	*9.12*	*3.32*	*14.69*	*7.45*	*6.69*	*4.47*	*1.68*	*1.111*

3	Tons of Crop Per Average Farm By Size Category									
	Other Fruits - Orchards									
	Apricot	Avocado	Cherries	Nectarine	Olive	Peach	Persimmon	Plum	Pomegranate	Figs
15 to 24.9 acres	153.4	53.5	54.2	161.1	58.6	259.5	131.5	118.1	78.9	29.6
25 to 99.9 acres	307.5	107.3	108.7	322.9	117.5	520.0	263.6	236.7	158.1	59.3
100 to 249.9 acres	1,250.9	436.6	442.2	1,313.4	477.9	2,115.3	1,072.4	963.0	643.1	241.3
250 to 499.9 acres	2,810.5	980.9	993.6	2,951.0	1,073.8	4,752.6	2,409.5	2,163.7	1,445.0	542.1
500 to 749.9 acres	5,810.0	2,027.7	2,054.1	6,100.6	2,219.9	9,824.9	4,981.1	4,473.0	2,987.2	1,120.7
750 to 999 acres	7,345.4	0.0	2,597.0	7,712.8	2,806.5	12,421.4	0.0	5,655.1	0.0	1,416.9
over 1,000 acres	21,449.7	0.0	7,583.5	22,522.6	8,195.5	36,272.4	0.0	16,513.7	0.0	4,137.5

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report

4	Price Per Ton of Crop (2003-2008 avg)									
	Other Fruits - Orchards									
	Apricot	Avocado	Cherries	Nectarine	Olive	Peach	Persimmon	Plum	Pomegranate	Figs
Not Adjusted	609	1,612	4,208	906	784	572	1,602	1,048	1,368	1,327

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report and US BLS

5	Actual Crop Acreage									
	Other Fruits - Orchards									
	Apricot	Avocado	Cherries	Nectarine	Olive	Peach	Persimmon	Plum	Pomegranate	Figs
Not Adjusted	9,508.4	520.6	25,877.8	38,823.0	16,661.2	57,514.2	1,243.2	46,255.2	4,238.6	8,914.4

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report

6	Annual Revenue Per Average Farm		
			Other Fruits - Orchards
			Weighted Average
	15 to 24.9 acres		$136,478
	25 to 99.9 acres		$273,508
	100 to 249.9 acres		$1,112,665
	250 to 499.9 acres		$2,499,971
	500 to 749.9 acres		$5,168,084
	750 to 999 acres		$6,546,841
	over 1,000 acres		$19,117,835
	Revenue Per Average Farm (< 100 and ≥ 100 acres)		
		<100 acres	$204,993
		≥ 100 acres	$6,889,079

Source: ADE, Inc.

7	Ten-Year Revenue Per Average Farm		
			Other Fruits - Orchards
			Weighted Average
	15 to 24.9 acres		$1,364,779
	25 to 99.9 acres		$2,735,076
	100 to 249.9 acres		$11,126,652
	250 to 499.9 acres		$24,999,714
	500 to 749.9 acres		$51,680,841
	750 to 999 acres		$65,468,409
	over 1,000 acres		$191,178,353
	Ten-Year Revenue Per Average Farm (< 100 and ≥ 100 acres)		
		<100 acres	$2,049,927
		≥ 100 acres	$68,890,794

Source: ADE, Inc.

8	Ten-Year Net Profit Per Average Farm @ 3.6% (Fruit/Tree Nut Avg)		
			Other Fruits - Orchards
			Weighted Average
	15 to 24.9 acres		$49,132
	25 to 99.9 acres		$98,463
	100 to 249.9 acres		$400,559
	250 to 499.9 acres		$899,990
	500 to 749.9 acres		$1,860,510
	750 to 999 acres		$2,356,863
	over 1,000 acres		$6,882,421
	Ten-Year Profit Per Average Farm (< 100 and ≥ 100 acres)		
		<100 acres	$73,797
		≥ 100 acres	$2,480,069

Source: ADE, Inc.

9	Cost Per Acre for Burning Alternative										
		Other Fruits - Orchards									
		Apricot	Avocado	Cherries	Nectarine	Olive	Peach	Persimmon	Plum	Pomegranate	Figs
	District/industry	*$161*	*$161*	*$161*	*$161*	*$161*	*$161*	*$161*	*$161*	*$161*	*$161*

Source: SJVUAPCD staff and stakeholders

10	Cost for Burn Alternative Per Average Farm	
		Other Fruits - Orchards
		Weighted Average
	15 to 24.9 acres	$3,542
	25 to 99.9 acres	$6,820
	100 to 249.9 acres	$26,694
	250 to 499.9 acres	$57,794
	500 to 749.9 acres	$115,276
	750 to 999 acres	$140,795
	over 1,000 acres	$397,645
	Cost Per Average Farm (< 100 and ≥ 100 acres)	
	<100 acres	$5,181
	≥ 100 acres	$147,641

Source: ADE, Inc.

11	Cost Per Ten-Year Net Profit Per Average Farm	
		Other Fruits - Orchards
		Weighted Average
	15 to 24.9 acres	7.2%
	25 to 99.9 acres	6.9%
	100 to 249.9 acres	6.7%
	250 to 499.9 acres	6.4%
	500 to 749.9 acres	6.2%
	750 to 999 acres	6.0%
	over 1,000 acres	5.8%
	Cost Per Ten-Year Profit Per Average Farm (< 100 and ≥ 100 acres)	
	<100 acres	**7.0%**
	≥ 100 acres	**5.95%**

Source: ADE, Inc.

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E-3
Citrus Orchard Removal

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E-3: Citrus Orchard Removal

1	Average Farm Size By Farm Size Category			
	Citrus Fruits - Orchards			
	Grapefruit	Lemons	Oranges (all)	Tangerines
15 to 24.9 acres	22.0	22.0	22.0	22.0
25 to 99.9 acres	42.4	42.4	42.4	42.4
100 to 249.9 acres	165.8	165.8	165.8	165.8
250 to 499.9 acres	359.0	359.0	359.0	359.0
500 to 749.9 acres	716.0	716.0	716.0	716.0
750 to 999 acres			874.5	
over 1,000 acres			2,469.8	

Source: USDA Agricultural Census 2007

2	Tons of Crop Per Acre				
	Citrus Fruits - Orchards				
	Grapefruit	Lemons	Oranges (all)	Tangerines	Productivity Adjustment Factors(1)
Not Adjusted (tons)	*12.36*	*13.12*	*12.99*	*9.22*	
Adjusted (tons)					
15 to 24.9 acres	*11.03*	*11.71*	*11.59*	*8.23*	*0.892*
25 to 99.9 acres	*11.48*	*12.19*	*12.06*	*8.57*	*0.929*
100 to 249.9 acres	*11.93*	*12.66*	*12.54*	*8.90*	*0.965*
250 to 499.9 acres	*12.38*	*13.14*	*13.01*	*9.24*	*1.002*
500 to 749.9 acres	*12.83*	*13.62*	*13.48*	*9.58*	*1.038*
750 to 999 acres	*13.28*	*14.10*	*13.96*	*9.91*	*1.075*
over 1,000 acres	*13.73*	*14.58*	*14.43*	*10.25*	*1.111*

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report

3	Tons of Crop Per Average Farm By Size Category			
	Citrus Fruits - Orchards			
	Grapefruit	Lemons	Oranges (all)	Tangerines
15 to 24.9 acres	242.6	257.6	255.0	181.1
25 to 99.9 acres	486.1	516.1	511.0	362.9
100 to 249.9 acres	1,977.5	2,099.7	2,078.7	1,476.4
250 to 499.9 acres	4,443.1	4,717.8	4,670.5	3,317.3
500 to 749.9 acres	9,185.1	9,752.9	9,655.2	6,857.6
750 to 999 acres	0.0	0.0	12,206.8	0.0
over 1,000 acres	0.0	0.0	35,645.9	0.0

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report

4	Price Per Ton of Crop (2003-2008 avg)			
		Citrus Fruits - Orchards		
	Grapefruit	Lemons	Oranges (all)	Tangerines
Not Adjusted	*$675.4*	*$860.9*	*$483.4*	*$1,192.8*

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report and US BLS

5	Actual Crop Acreage			
		Citrus Fruits - Orchards		
	Grapefruit	Lemons	Oranges (all)	Tangerines
Acreage	*1,997.8*	*7,959.4*	*171,367.4*	*10,326.6*

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report

6	Annual Revenue Per Average Farm
	Citrus Fruits - Orchards
	Combined Citrus - Weighted Average
15 to 24.9 acres	$132,768
25 to 99.9 acres	$266,073
100 to 249.9 acres	$1,082,421
250 to 499.9 acres	$2,432,018
500 to 749.9 acres	$5,027,607
750 to 999 acres	$5,900,991
over 1,000 acres	$17,231,848

Source: ADE, Inc.

7	Ten-Year Revenue Per Average Farm
	Citrus Fruits - Orchards
	Combined Citrus - Weighted Average
15 to 24.9 acres	$1,327,682
25 to 99.9 acres	$2,660,732
100 to 249.9 acres	$10,824,211
250 to 499.9 acres	$24,320,180
500 to 749.9 acres	$50,276,069
750 to 999 acres	$59,009,908
over 1,000 acres	$172,318,484
	Ten-Year Revenue Per Average Farm (< 100 and ≥ 100 acres)
	Citrus Fruits - Orchards
	Combined Citrus - Weighted Average
< 100 acres	$1,994,207
≥ 100 acres	$63,349,771

Source: ADE, Inc.

8	Ten-Year Net Profit Per Average Farm @ 5% Average
	Citrus Fruits - Orchards
	Combined Citrus - Weighted Average
15 to 24.9 acres	$66,384
25 to 99.9 acres	$133,037
100 to 249.9 acres	$541,211
250 to 499.9 acres	$1,216,009
500 to 749.9 acres	$2,513,803
750 to 999 acres	$2,950,495
over 1,000 acres	$8,615,924
	Ten-Year Net Profit Per Average Farm (< 100 and ≥ 100 acres)
	Citrus Fruits - Orchards
	Combined Citrus - Weighted Average
< 100 acres	$99,710
≥ 100 acres	$3,167,489

Source: ADE, Inc.

9	Cost Per Acre for Burning Alternative
	Citrus Fruits - Orchards
District Estimate	*$369*
Stakeholder Estimate	*$338*

Source: SJVUAPCD staff and stakeholders

10a	Cost for Burn Alternative Per Average Farm Using District Cost Estimate			
	Citrus Fruits - Orchards			
	Grapefruit	Lemons	Oranges (all)	Tangerines
15 to 24.9 acres	$8,118	$8,118	$8,118	$8,118
25 to 99.9 acres	$15,630	$15,630	$15,630	$15,630
100 to 249.9 acres	$61,181	$61,181	$61,181	$61,181
250 to 499.9 acres	$132,459	$132,459	$132,459	$132,459
500 to 749.9 acres	$264,205	$264,205	$264,205	$264,205
750 to 999 acres	$0	$0	$322,691	$0
over 1,000 acres	$0	$0	$911,374	$0
	Combined Citrus - Weighted Average			
15 to 24.9 acres	$8,118			
25 to 99.9 acres	$15,630			
100 to 249.9 acres	$61,181			
250 to 499.9 acres	$132,459			
500 to 749.9 acres	$264,205			
750 to 999 acres	$322,691			
over 1,000 acres	$911,374			
	Cost for Burn Alternative Per Average Farm (< 100 and ≥ 100 acres)			
	Citrus Fruits - Orchards			
	Combined Citrus - Weighted Average			
< 100 acres	$11,874			
≥ 100 acres	$326,064			

Source: ADE, Inc.

10b	Cost for Burn Alternative Per Average Farm Using Stakeholder Cost Estimate			
	Citrus Fruits - Orchards			
	Grapefruit	Lemons	Oranges (all)	Tangerines
15 to 24.9 acres	$7,436.0	$7,436.0	$7,436.0	$7,436.0
25 to 99.9 acres	$14,316.8	$14,316.8	$14,316.8	$14,316.8
100 to 249.9 acres	$56,041.5	$56,041.5	$56,041.5	$56,041.5
250 to 499.9 acres	$121,330.7	$121,330.7	$121,330.7	$121,330.7
500 to 749.9 acres	$242,008.9	$242,008.9	$242,008.9	$242,008.9
750 to 999 acres	$0.0	$0.0	$295,581.0	$0.0
over 1,000 acres	$0.0	$0.0	$834,808.5	$0.0
	Combined Citrus - Weighted Average			
15 to 24.9 acres	$7,436			
25 to 99.9 acres	$14,317			
100 to 249.9 acres	$56,042			
250 to 499.9 acres	$121,331			
500 to 749.9 acres	$242,009			
750 to 999 acres	$295,581			
over 1,000 acres	$834,809			
Cost for Burn Alternative Per Average Farm (< 100 and ≥ 100 acres)				
	Citrus Fruits - Orchards			
	Combined Citrus - Weighted Average			
< 100 acres	$10,876			
≥ 100 acres	$298,671			

Source: ADE, Inc.

11a	Cost Per Ten-Year Net Profit Per Average Farm Using District Cost Estimate
	Citrus Fruits - Orchards Combined Citrus - Weighted Average
15 to 24.9 acres	12.2%
25 to 99.9 acres	11.7%
100 to 249.9 acres	11.3%
250 to 499.9 acres	10.9%
500 to 749.9 acres	10.5%
750 to 999 acres	10.9%
over 1,000 acres	10.6%
Cost per Ten-Year Net Profit per Average Farm (< 100 and ≥ 100 acres)	
	Citrus Fruits - Orchards
	Combined Citrus - Weighted Average
< 100 acres	**11.9%**
≥ 100 acres	**10.3%**

Source: ADE, Inc.

11b	Cost Per Ten-Year Net Profit Per Average Farm Using Stakeholder Cost Estimate	
		Citrus Fruits - Orchards Combined Citrus - Weighted Average
	15 to 24.9 acres	11.2%
	25 to 99.9 acres	10.8%
	100 to 249.9 acres	10.4%
	250 to 499.9 acres	10.0%
	500 to 749.9 acres	9.6%
	750 to 999 acres	10.0%
	over 1,000 acres	9.7%
	Cost per Ten-Year Net Profit per Average Farm (< 100 and ≥ 100 acres)	
		Citrus Fruits - Orchards
		Combined Citrus - Weighted Average
	< 100 acres	**10.9%**
	≥ 100 acres	**9.4%**

Source: ADE, Inc.

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E-4
Nut Prunings

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E-4: Nut Prunings

1	Average Farm Size By Farm Size Category		
	Nuts		
	Almonds	Walnut	Pecans
15 to 24.9 acres	22.0	22.0	22.0
25 to 99.9 acres	42.4	42.4	42.4
100 to 249.9 acres	165.8	165.8	165.8
250 to 499.9 acres	359.0	359.0	359.0
500 to 749.9 acres	716.0	716.0	716.0
750 to 999 acres	874.5	874.5	874.5
over 1,000 acres	2,469.8	2,469.8	2,469.8

Source: USDA Agricultural Census 2007

2	Tons of Crop Per Acre			
	Nuts			
	Almonds	Walnut	Pecans	
Not Adjusted	*1.004*	*1.843*	*1.122*	Productivity Adjustment Factors[1]
Adjusted (tons of crop)				
15 to 24.9 acres	*0.895*	*1.645*	*1.001*	0.892
25 to 99.9 acres	*0.932*	*1.712*	*1.042*	0.929
100 to 249.9 acres	*0.969*	*1.779*	*1.083*	0.965
250 to 499.9 acres	*1.005*	*1.847*	*1.124*	1.002
500 to 749.9 acres	*1.042*	*1.914*	*1.165*	1.038
750 to 999 acres	*1.079*	*1.981*	*1.206*	1.075
over 1,000 acres	*1.115*	*2.048*	*1.247*	1.111

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report

3	Tons of Crop Per Average Farm by Size Category		
	Nuts		
	Almonds	Walnut	Pecans
15 to 24.9 acres	19.7	36.2	22.0
25 to 99.9 acres	39.5	72.5	44.1
100 to 249.9 acres	160.6	295.0	179.6
250 to 499.9 acres	360.9	662.8	403.5
500 to 749.9 acres	746.0	1,370.3	834.1
750 to 999 acres	943.2	1,732.4	1,054.5
over 1,000 acres	2,754.2	5,058.9	3,079.3

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report

4	Price Per Ton of Crop (2003-2008 avg)		
	Nuts		
	Almonds	Walnut	Pecans
Not Adjusted	*$4,240.8*	*$1,747.8*	*$3,429.2*

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report and US BLS

5	Actual Crop Acreage		
	Nuts		
	Almonds	Walnut	Pecans
Acerage	*541,729.4*	*123,465.6*	*724.8*

Source: ADE, Inc., based on Calif Ag Commissioners Annual Report

6	Annual Revenue Per Average Farm
	Nuts
	Combined Nut Crops (Weighted Average)
15 to 24.9 acres	$79,773
25 to 99.9 acres	$159,869
100 to 249.9 acres	$650,368
250 to 499.9 acres	$1,461,267
500 to 749.9 acres	$3,020,814
750 to 999 acres	$3,819,147
over 1,000 acres	$11,152,526
Annual Revenue Per Average Farm (< 100 and ≥ 100 acres)	
	Nuts
	Combined Nut Crops (Weighted Average)
< 100 acres	$119,821
≥ 100 acres	$4,020,824

Source: ADE, Inc.

7	Two-Year Revenue Per Average Farm
	Nuts
	Combined Nut Crops (Weighted Average)
15 to 24.9 acres	$159,546
25 to 99.9 acres	$319,738
100 to 249.9 acres	$1,300,735
250 to 499.9 acres	$2,922,533
500 to 749.9 acres	$6,041,628
750 to 999 acres	$7,638,293
over 1,000 acres	$22,305,052
Two-Year Revenue Per Average Farm (< 100 and ≥ 100 acres)	
	Nuts
	Combined Nut Crops (Weighted Average)
< 100 acres	$239,642
≥ 100 acres	$8,041,648

Source: ADE, Inc.

8	Two-Year Net Profit Per Average Farm @5.1% Avg	
		Nuts
		Combined Nut Crops (Weighted Average)
	15 to 24.9 acres	$8,137
	25 to 99.9 acres	$16,307
	100 to 249.9 acres	$66,337
	250 to 499.9 acres	$149,049
	500 to 749.9 acres	$308,123
	750 to 999 acres	$389,553
	over 1,000 acres	$1,137,558
	Two-Year Net Profit Per Average Farm (< 100 and ≥ 100 acres)	
		Nuts
		Combined Nut Crops (Weighted Average)
	< 100 acres	$12,222
	≥ 100 acres	$410,124

Source: ADE, Inc.

9	Cost Per Acre for Burning Alternative	
		Nuts
		Combined Nut Crops (Weighted Average)
	District Estimate	*$38*

Source: SJVUAPCD staff and stakeholders

10	Cost for Burn Alternative Per Average Farm Using District Cost Estimate	
		Nuts
		Combined Nut Crops (Weighted Average)
	15 to 24.9 acres	$836
	25 to 99.9 acres	$1,610
	100 to 249.9 acres	$6,301
	250 to 499.9 acres	$13,641
	500 to 749.9 acres	$27,208
	750 to 999 acres	$33,231
	over 1,000 acres	$93,854
	Cost for Burn Alternative Per Average Farm (< 100 and ≥ 100 acres) Using District Cost Estimate	
		Nuts
		Combined Nut Crops (Weighted Average)
	< 100 acres	$1,223
	≥ 100 acres	$34,847

Source: ADE, Inc.

11	Cost Per Two-Year Net Profit Per Average Farm Using District Cost Estimate	
		Nuts
		Combined Nut Crops (Weighted Average)
	15 to 24.9 acres	10.3%
	25 to 99.9 acres	9.9%
	100 to 249.9 acres	9.5%
	250 to 499.9 acres	9.2%
	500 to 749.9 acres	8.8%
	750 to 999 acres	8.5%
	over 1,000 acres	8.3%

Cost Per Two-Year Net Profit Per Average Farm (< 100 and ≥ 100 acres) Using District Cost Estimate	
	Nuts
	Combined Nut Crops (Weighted Average)
< 100 acres	**10.0%**
≥ 100 acres	**8.5%**

Source: ADE, Inc.

Appendix F

Summarized Information From CH&SC Section 41855.5

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Appendix F: SUMMARIZED INFORMATION FROM CH&SC SECTION 41855.5

Category Definitions List

CHSC Section 41855.5 defines Agricultural Material Categories as follows:

"Field crops" means any of the following crops:

(A) Alfalfa	(B) Asparagus	(C) Barley stubble
(D) Beans	(E) Corn	(F) Cotton
(G) Flower straw	(H) Hay	(I) Lemon grass
(J) Oat stubble	(K) Other field crops, as determined by the state board	
(L) Pea vines	(M) Peanuts	(N) Rice stubble
(O) Safflower	(P) Sugar cane	(Q) Vegetable crops
(R) Wheat stubble		

"Orchard removals" includes, but is not limited to, any of the following:

(A) Orchard removal matter	(B) Stumps	(C) Untreated sticks

"Other materials" includes, but is not limited to, any of the following:

(A) Brooder paper	(B) Deceased goats	(C) Diseased bee hives

"Other weeds and maintenance" includes, but is not limited to, any of the following:

(A) Ditch bank work	(B) Canal bank work	(C) Dodder weed
(D) Star thistle	(E) Tumbleweed	(F) Noxious weeds
(G) Pesticide sacks	(H) Fertilizer sacks	

"Prunings" means prunings from any of the following:

(A) Apple crops	(B) Apricot crops	(C) Avocado crops
(D) Bushberry crops	(E) Cherry crops	(F) Christmas trees
(G) Citrus crops	(H) Date crops	(I) Eucalyptus crops
(J) Fig crops	(K) Kiwi crops	(L) Nectarine crops
(M) Nursery prunings	(N) Olive crops	(O) Other prunings, as determined by the state board
(P) Pasture or corral trees	(Q) Peach crops	(R) Pear crops
(S) Persimmon crops	(T) Pistachio crops	(U) Plum crops
(V) Pluot crops	(W) Pomegranate crops	(X) Prune crops
(Y) Quince crops	(Z) Rose prunings	

"Surface harvested prunings" includes, but is not limited to, any of the following:

(A) Almond prunings	(B) Walnut prunings	(C) Pecan prunings
(D) Grape vines	(E) Vineyard removal materials	

"Vineyard materials" includes, but is not limited to, any of the following:

(A) Grape canes (B) Raisin trays

"Weed abatement" includes, but is not limited to, any of the following:

(A) Berms (B) Bermuda grass (C) Fence rows
(D) Grass (E) Pasture (F) Ponding or levee banks

OPEN BURN PROHIBITION SCHEDULE

State law requires burning to be prohibited for the following crops on the dates listed unless demonstrated to be economically unfeasible:

6/1/05	**Field Crops**			
	Alfalfa	Asparagus	Barley Stubble	Beans
	Corn	Cotton	Flower Straw	Hay
	Lemon Grass	Oat Stubble	Other Field Crops as determined by state board.	Pea Vines
	Peanuts	Rice Stubble	Safflower	Sugar Cane
	Vegetable Crops	Wheat Stubble		
	Prunings			
	Apple Crops	Apricot Crops	Avocado Crops	Bushberry Crops
	Cherry Crops	Christmas Trees	Citrus Crops	Date Crops
	Eucalyptus Crops	Fig Crops	Kiwi Crops	Nectarine Crops
	Nursery Prunings	Olive Crops	Other Prunings as determined by state board.	Pasture or Corral Trees
	Peach Crops	Pear Crops	Persimmon Crops	Pistachio Crops
	Plum Crops	Pluot Crops	Pomegranate Crops	Prune Crops
	Quince Crops	Rose Prunings		
	Weed Abatement			
	Berms	Bermuda Grass	Fence Rows	Grass
	Pasture	Ponding or Levee Banks		

Establish best management practices for control of weeds/maintenance effective 6/1/06:

Other Weeds and Maintenance			
Ditch Bank Work	Canal Bank Work	Dodder Weed	Star Thistle
Tumbleweed	Noxious Weeds	Pesticide Sacks	Fertilizer Sacks

6/1/07	**Orchard Removals**		
	Stumps	Orchard Removal Matter	Untreated Sticks

6/1/10	**Other Materials**			
	Brooder Paper	Deceased Goats	Diseased Bee Hives	
	Surface Harvested Prunings			
	Almond Prunings	Walnut Prunings	Pecan Prunings	Grape Vines
	Vineyard Removal Materials			
	Vineyard Removals			
	Vineyard Materials			
	Grape Canes	Raisin Trays		

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Appendix G

Cost Effectiveness Analysis

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Appendix G: COST EFFECTIVENESS ANALYSIS

G.1 APPROACH FOR COST EFFECTIVENESS ANALYSIS

In general, the reduction of agricultural waste from the pruning or the removal of orchards and vineyards by grinding or chipping followed by conversion to either biomass fuel or land incorporation results in fewer emissions when compared to open burning; however, these operations may incur extra costs over those associated with open burning. To examine the cost feasibility of these alternatives, cost effectiveness (CE) in dollars per ton of emission reduction is defined as the cost differential between chipping or grinding and open burning in dollars per acre divided by the difference between burning and chipping in per acre total emissions ($PM_{2.5}$ + NO_x + VOC), or:

$$CE = \left(\frac{(\$/\text{acre})_{chip} - (\$/\text{acre})_{burn}}{(\text{tons-emissions/acre})_{burn} - (\text{tons-emissions/acre})_{chip}} \right)$$

The cost effectiveness calculated by the above expression will primarily be a function of the type of tree or plant (which determines the difficulty of removal and the amount and fuel quality of the waste, affecting both the denominator and numerator of the above expression) and of the total acreage which affects the numerator of the above expression since operations on smaller acreages cost more per acre due to the project minimums imposed by most orchard contractors.

G.2 PER ACRE COSTS AND EMISSIONS

G.2.1 Orchard Removals

Costs and emissions associated with orchard removals, both by open burning and by grinding for biomass, have been developed in Chapter 5 and are presented in Tables 5-4, 5-5 and 5-6 of this report. As stated there, per acre cost for orchard removal increases for smaller acreage due to minimum project charges for both burning and for grinding to biomass. When larger acreages are removed, the per acre cost reaches a flat minimum rate. Likewise, per acre emissions are somewhat greater for small acreages due to the emissions associated with delivery and mobilization of equipment at the project site which is independent of acreage removed.

G.2.2 Disposal of Orchard Prunings for Surface Harvested Nut Orchards

Costs and emissions associated with the disposal of pruning by open burning, grinding for biomass and by chipping for land incorporation have also been developed in Chapter 5. The emissions are presented in Tables 5-7 and 5-8 of this report. As shown there, per acre emission reductions are greater when considering land incorporation chipping in lieu of open burning (versus grinding to biomass fuel in lieu of open burning). Also, analysis of the per acre costs presented in Chapter 5 indicates that the costs for land incorporation chipping are better defined and are less variable since issues associated with price, quality and demand for biomass fuel are not present.

G.3 COST EFFECTIVENESS ANALYSIS

G.3.1 Orchard Removals

Table G-1 presents the results of the District's evaluation of cost effectiveness of converting orchard removal waste to biomass fuel by grinding versus open burning for orchards other than citrus. Likewise, Table G-2 presents the results of the District's evaluation of cost effectiveness of converting orchard removal waste to biomass fuel by grinding versus open burning for citrus orchards. The tables present results for plot sizes between 1 and 20 acres, and include the cost and emission information presented in Tables 5-4 and 5-5 (expected emissions and cost for burning per acre, expected emissions and cost for grinding per acre, differential emissions and cost per acre) and the cost effectiveness calculations. The cost structure shown in the tables reflects a $5,000 minimum charge required for orchard removals by grinding to biomass and a minimum charge of $1,150 for orchard removal by open burning. The flat per acre charge only becomes effective after the minimum project cost is exceeded. As a result, per-acre costs and cost effectiveness value is generally higher for smaller acreages, trending to a lower fixed value for larger acreages as would be expected.

Table G-3 presents a similar analysis for vineyard removals using the emissions and cost data of Table 5-6 (Chapter 5). As with orchards, per-acre costs and cost effectiveness value is generally higher for smaller acreages, trending to a lower fixed value for larger acreages.

Table G-1
Cost Effectiveness Analysis Using District Data
Open Burning versus Grind and Haul for Orchards other than Citrus

Cost Basis: Chipper Contractor Quotations Jan 2010

Orchard Removal Size	Open Burning				Grind & Haul				Difference				Cost Effectiveness			
	Emissions Tons per Acre			Cost $/acre	Emissions Tons per Acre			Cost $/acre	Emissions Reduction Tons per Acre			Cost $/acre	$ Per Ton			
	NO_x	$PM_{2.5}$	VOC		NO_x	$PM_{2.5}$	VOC		NO_x	$PM_{2.5}$	VOC		NO_x	$PM_{2.5}$	VOC	$NO_x + PM_{2.5} +$ VOC
1	0.0945	0.1240	0.1075	$1,150	0.0575	0.0145	0.0065	$5,244	0.0370	0.1095	0.1010	$4,094	$110,600	$37,400	$40,500	$16,500
2	0.0925	0.1243	0.1073	$575	0.0503	0.0143	0.0065	$2,744	0.0422	0.1100	0.1008	$2,169	$51,400	$19,700	$21,500	$8,600
3	0.0918	0.1242	0.1072	$383	0.0480	0.0142	0.0065	$1,911	0.0438	0.1100	0.1007	$1,527	$34,900	$13,900	$15,200	$6,000
4	0.0915	0.1241	0.1073	$288	0.0468	0.0141	0.0065	$1,494	0.0447	0.1100	0.1008	$1,207	$27,000	$11,000	$12,000	$4,700
5	0.0913	0.1242	0.1072	$267	0.0465	0.0141	0.0065	$1,244	0.0448	0.1101	0.1007	$977	$21,800	$8,900	$9,700	$3,800
6	0.0912	0.1242	0.1072	$267	0.0460	0.0141	0.0065	$1,077	0.0452	0.1101	0.1007	$810	$17,900	$7,400	$8,000	$3,200
7	0.0911	0.1241	0.1072	$267	0.0459	0.0141	0.0065	$958	0.0452	0.1100	0.1007	$691	$15,300	$6,300	$6,900	$2,700
8	0.0910	0.1242	0.1072	$267	0.0456	0.0141	0.0065	$869	0.0454	0.1101	0.1007	$602	$13,300	$5,500	$6,000	$2,300
9	0.0909	0.1242	0.1072	$267	0.0456	0.0141	0.0065	$800	0.0453	0.1101	0.1007	$533	$11,800	$4,800	$5,300	$2,100
10	0.0909	0.1242	0.1072	$267	0.0453	0.0141	0.0065	$744	0.0456	0.1101	0.1007	$477	$10,500	$4,300	$4,700	$1,860
12	0.0908	0.1242	0.1072	$267	0.0450	0.0140	0.0065	$661	0.0458	0.1102	0.1007	$394	$8,600	$3,600	$3,900	$1,530
14	0.0908	0.1242	0.1072	$267	0.0450	0.0141	0.0065	$632	0.0458	0.1101	0.1007	$365	$8,000	$3,300	$3,600	$1,420
15	0.0908	0.1242	0.1072	$267	0.0449	0.0141	0.0065	$632	0.0459	0.1101	0.1007	$365	$8,000	$3,300	$3,600	$1,420
16	0.0908	0.1242	0.1072	$267	0.0448	0.0141	0.0065	$632	0.0460	0.1101	0.1007	$365	$7,900	$3,320	$3,620	$1,420
18	0.0907	0.1242	0.1072	$267	0.0448	0.0141	0.0065	$632	0.0459	0.1101	0.1007	$365	$8,000	$3,320	$3,620	$1,420
20	0.0907	0.1242	0.1072	$267	0.0447	0.0141	0.0065	$632	0.0460	0.1101	0.1007	$365	$7,900	$3,320	$3,620	$1,420

Basis:
- 30 BDT/acre for other orchard
- 4 BDT/acre for roots
- Roots are burned in burning case
- Roots are transported to composting operation for grinding case
- Grind & haul cost includes $244 for root composting

Table G-2
Cost Effectiveness Analysis Using District Data
Open Burning versus Grind and Haul for Citrus

Cost Basis: Chipper Contractor Quotations Jan 2010

Orchard Removal Size	Open Burning				Grind & Haul				Difference				Cost Effectiveness			
	Emissions Tons per Acre			Cost $/acre	Emissions Tons per Acre			Cost $/acre	Emissions Reduction Tons per Acre			Cost $/acre	$ Per Ton			
	NO_x	$PM_{2.5}$	VOC		NO_x	$PM_{2.5}$	VOC		NO_x	$PM_{2.5}$	VOC		NO_x	$PM_{2.5}$	VOC	NO_x + $PM_{2.5}$ + VOC
1	0.0945	0.1240	0.1075	$1,150	0.0575	0.0145	0.0065	$5,244	0.0370	0.1095	0.1010	$4,094	$110,600	$37,400	$40,500	$16,500
2	0.0925	0.1243	0.1073	$575	0.0503	0.0143	0.0065	$2,744	0.0422	0.1100	0.1008	$2,169	$51,400	$19,700	$21,500	$8,600
3	0.0918	0.1242	0.1072	$400	0.0480	0.0142	0.0065	$1,911	0.0438	0.1100	0.1007	$1,511	$34,500	$13,700	$15,000	$5,900
4	0.0915	0.1241	0.1073	$400	0.0468	0.0141	0.0065	$1,494	0.0447	0.1100	0.1008	$1,094	$24,500	$9,900	$10,900	$4,300
5	0.0913	0.1242	0.1072	$400	0.0465	0.0141	0.0065	$1,244	0.0448	0.1101	0.1007	$844	$18,800	$7,700	$8,400	$3,300
6	0.0912	0.1242	0.1072	$400	0.0460	0.0141	0.0065	$1,077	0.0452	0.1101	0.1007	$677	$15,000	$6,200	$6,700	$2,600
7	0.0911	0.1241	0.1072	$400	0.0459	0.0141	0.0065	$958	0.0452	0.1100	0.1007	$558	$12,400	$5,100	$5,500	$2,200
8	0.0910	0.1242	0.1072	$400	0.0456	0.0141	0.0065	$869	0.0454	0.1101	0.1007	$469	$10,300	$4,300	$4,700	$1,800
9	0.0909	0.1242	0.1072	$400	0.0456	0.0141	0.0065	$800	0.0453	0.1101	0.1007	$400	$8,800	$3,600	$4,000	$1,600
10	0.0909	0.1242	0.1072	$400	0.0453	0.0141	0.0065	$769	0.0456	0.1101	0.1007	$369	$8,100	$3,400	$3,700	$1,440
12	0.0908	0.1242	0.1072	$400	0.0450	0.0140	0.0065	$769	0.0458	0.1102	0.1007	$369	$8,100	$3,300	$3,700	$1,440
14	0.0908	0.1242	0.1072	$400	0.0450	0.0141	0.0065	$769	0.0458	0.1101	0.1007	$369	$8,100	$3,400	$3,700	$1,440
15	0.0908	0.1242	0.1072	$400	0.0449	0.0141	0.0065	$769	0.0459	0.1101	0.1007	$369	$8,000	$3,400	$3,700	$1,440
16	0.0908	0.1242	0.1072	$400	0.0448	0.0141	0.0065	$769	0.0460	0.1101	0.1007	$369	$8,000	$3,350	$3,660	$1,440
18	0.0907	0.1242	0.1072	$400	0.0448	0.0141	0.0065	$769	0.0459	0.1101	0.1007	$369	$8,000	$3,350	$3,660	$1,440
20	0.0907	0.1242	0.1072	$400	0.0447	0.0141	0.0065	$769	0.0460	0.1101	0.1007	$369	$8,000	$3,350	$3,660	$1,440

Basis:

30 BDT/acre for citrus
4 BDT/acre for roots
Roots are burned in burning case
Roots are transported to composting operation for grinding case
Grind & haul cost includes $244 for root composting

Table G-3
Cost Effectiveness Analysis Using District Data
Open Burning versus Grind and Haul for Vineyards/Kiwis

Cost Basis: Chipper Contractor Quotations Jan 2010

Orchard Removal Size	Open Burning				Grind & Haul				Difference				Cost Effectiveness			
	Emissions Tons per Acre			Cost $/acre	Emissions Tons per Acre			Cost* $/acre	Emissions Reduction Tons per Acre			Cost $/acre	$ Per Ton			
	NO_x	$PM_{2.5}$	VOC		NO_x	$PM_{2.5}$	VOC		NO_x	$PM_{2.5}$	VOC		NO_x	PM_{10}	VOC	$NO_x + PM_{2.5}$ + VOC
1	0.0210	0.0220	0.0190	$1,150	0.0305	0.0030	0.0020	$5,725	0.0000	0.0190	0.0170	$4,575	N/A	$240,800	$269,100	$172,600
2	0.0193	0.0220	0.0190	$575	0.0233	0.0028	0.0018	$3,225	0.0000	0.0192	0.0172	$2,650	N/A	$138,000	$154,100	$81,800
3	0.0185	0.0220	0.0190	$383	0.0210	0.0027	0.0017	$2,392	0.0000	0.0193	0.0173	$2,008	N/A	$104,100	$116,100	$58,900
4	0.0183	0.0220	0.0190	$288	0.0199	0.0026	0.0016	$1,975	0.0000	0.0194	0.0174	$1,688	N/A	$87,000	$97,000	$47,900
5	0.0180	0.0220	0.0190	$230	0.0195	0.0026	0.0016	$1,725	0.0000	0.0194	0.0174	$1,495	N/A	$77,100	$85,900	$42,400
6	0.0179	0.0220	0.0190	$213	0.0190	0.0026	0.0016	$1,558	0.0000	0.0194	0.0174	$1,345	N/A	$69,300	$77,300	$37,700
7	0.0176	0.0219	0.0190	$213	0.0186	0.0026	0.0016	$1,439	0.0000	0.0193	0.0174	$1,226	N/A	$63,500	$70,500	$34,300
8	0.0178	0.0219	0.0189	$213	0.0183	0.0026	0.0016	$1,350	0.0000	0.0193	0.0173	$1,137	N/A	$58,900	$65,700	$31,500
9	0.0177	0.0219	0.0189	$213	0.0181	0.0026	0.0016	$1,281	0.0000	0.0193	0.0173	$1,068	N/A	$55,300	$61,700	$29,500
10	0.0177	0.0220	0.0190	$213	0.0182	0.0026	0.0016	$1,225	0.0000	0.0194	0.0174	$1,012	N/A	$52,200	$58,200	$27,900
12	0.0176	0.0220	0.0190	$213	0.0178	0.0026	0.0016	$1,142	0.0000	0.0194	0.0174	$929	N/A	$47,900	$53,400	$25,400
14	0.0175	0.0220	0.0190	$213	0.0176	0.0026	0.0016	$1,082	0.0000	0.0194	0.0174	$869	N/A	$44,800	$50,000	$23,700
15	0.0175	0.0220	0.0190	$213	0.0176	0.0026	0.0016	$1,058	0.0000	0.0194	0.0174	$845	N/A	$43,600	$48,600	$23,000
16	0.0175	0.0219	0.0190	$213	0.0176	0.0026	0.0016	$1,038	0.0000	0.0193	0.0174	$825	N/A	$42,700	$47,400	$22,500
18	0.0175	0.0219	0.0189	$213	0.0175	0.0026	0.0016	$1,003	0.0000	0.0193	0.0173	$790	N/A	$40,900	$45,700	$21,600
20	0.0175	0.0220	0.0190	$213	0.0175	0.0026	0.0016	$975	0.0000	0.0194	0.0174	$762	N/A	$39,300	$43,800	$20,700

* Grind and haul cost includes $650 per acre for removal of wire and stakes
$75 per acre for composting roots

Basis
5 BDT/acre for Vineyard
1 BDT/acre for roots
Roots are burned in burning case
Roots are transported to composting operation for grinding case

G.3.2 Prunings

Based on the above emissions, the District has examined cost effectiveness only for land incorporation chipping operations (which provides the greatest emission reduction). The results are presented in Table G-4. The analysis is based on an orchard of twenty acres with chipping costs varying between $30 and $60 per acre. This price range is inclusive of both the District's information and the estimate provided by the ag industry.

Based on the information developed by the District, the most likely scenario is a chipping price between $30 to $45 per acre which yields a cost effectiveness varying between approximately $1,052 and $3,026 per ton of emission reduction.

Table G-4
Cost Effectiveness of Land Incorporation Chipping in Lieu of Open Burning for Disposal of Orchard Pruning
(20 Acre Orchard)

Chip Cost ($/acre)	Burning Cost ($/acre)	Delta Cost ($/acre)	NOx		PM2.5		VOC	
			Emission Reduction (lb/acre)	Cost Effectiveness ($/ton)	Emission Reduction (lb/acre)	Cost Effectiveness ($/ton)	Emission Reduction (lb/acre)	Cost Effectiveness ($/ton)
30	22	8	1.5	10,667	7.7	2,078	6	2,667
45	22	23	1.5	30,667	7.7	5,974	6	7,667
60	22	38	1.5	50,667	7.7	9,870	6	12,667

Appendix H

Ag Burn Information Provided By the Agricultural Industry

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Wine Grapes

Wine Grape

Winter	Associated Cost/acre
Pruning	$180.00
Fertilizer Application	$17.00
Fix Stakes and wires	$32.00
Plant layers	$11.00
Shred Prunings	$8.00
Spring	
Action	
Irrigation	$170.00
Weed Control	$151.00
Cultivation	$25.00
Shoot Removal	$20.00
Fungicide Application	$115.00
Pest Control	$102.00
Summer	
Mow Weeds/Cut Canes	$15.00
Fall	
Harvest & Haul	$345.00
Plant Cover Crop	
Overhead Expenses	
Cash: Taxes, Insurance, Office, etc.	$415.00
Non-Cash Overhead Expenses	$1,153.00
Total Cost	**$2,834.00**
Total Income	**$2,616.00**
Average Tons/acre 11.1	
Average Price $236	
Net Return/acre	**($218.00)**

*Vineyard prunings are not burned, they are shredded in the vineyard.

Source:

Cost & Return Data, Agricultural Economics UC Davis http://coststudies.ucdavis.edu/files/grapewinesjv2005.pdf

Historical Yield & Pricing

Yield (Dist. 12-14)	All Raisin Yield	Chardonnay	French Colombard	Muscat	Barbera	Cabernet Sauvignon	Grenache	Merlot	Rubired	Syrah	Zinfandel
2009											
2008	11.3	10.9	12.6	18.3	8.8	9.8	11.9	9.8	16.4	11.3	16.2
2007	9.4	10.8	12.2	18.8	10.6	11.4	10.7	11.0	14.3	13.1	13.8
2006	7.8	8.4	11.4	13.8	10.0	10.3	13.6	10.0	15.1	11.6	10.4
2005	9.5	9.8	11.4	16.8	10.3	13.1	12.3	11.2	15.8	13.5	12.7
2004	8.4	7.6	9.0	10.1	6.6	8.4	11.4	7.3	14.2	9.6	9.2
2003	8.7	8.8	10.0	10.9	8.5	9.5	7.9	7.9	11.4	12.4	10.4
2002	11.4	11.4	9.1	10.7	9.5	10.2	11.5	8.7	14.9	12.6	11.7
2001	9.4	9.6	9.0	10.0	9.1	11.8	9.9	7.9	12.5	13.8	9.9
2000	10.4	10.3	10.4	11.8	11.4	12.5	10.8	8.8	12.5	15.7	11.6

Revenue Per Acre (Dist. 12-14)	All Raisins	Chardonnay	French Colombard	Muscat	Barbera	Cabernet Sauvignon	Grenache	Merlot	Rubired	Syrah	Zinfandel
2009											
2008	$2,550.34	$4,316.53	$2,911.27	$5,316.91	$2,114.76	$3,516.81	$2,808.58	$3,345.18	$4,161.52	$4,107.09	$4,309.59
2007	$1,456.45	$3,228.79	$2,239.00	$4,372.93	$2,242.47	$2,637.78	$2,033.98	$2,674.78	$3,113.36	$3,032.36	$3,772.20
2006	$1,206.33	$2,587.54	$2,143.86	$3,590.57	$2,203.27	$2,546.31	$2,610.65	$2,678.72	$3,088.96	$2,801.66	$2,862.24
2005	$1,561.42	$3,223.69	$2,497.03	$4,571.88	$2,394.15	$3,568.15	$2,728.74	$3,403.85	$3,488.46	$3,950.73	$4,154.48
2004	$1,670.49	$2,268.87	$1,788.32	$3,159.30	$1,529.44	$2,251.74	$2,373.27	$2,556.51	$3,001.05	$2,444.45	$2,868.31
2003	$827.06	$2,101.58	$1,267.33	$1,974.35	$1,563.07	$2,092.69	$1,367.05	$2,154.50	$1,805.71	$2,556.29	$2,220.24
2002	$854.88	$2,889.21	$1,014.72	$1,540.80	$1,707.47	$2,807.62	$1,558.65	$2,317.21	$2,505.86	$2,925.65	$2,377.87
2001	$810.60	$2,821.68	$1,137.64	$1,718.32	$1,727.04	$3,574.41	$1,384.21	$2,742.20	$2,349.63	$3,710.74	$2,576.23
2000	$1,304.02	$3,531.78	$1,519.67	$2,458.22	$2,393.23	$4,244.34	$1,698.66	$3,278.80	$3,201.12	$5,442.01	$2,983.75
Average from 2000 -2008	$1,360.18	$2,996.63	$1,835.43	$3,189.25	$1,986.10	$3,026.65	$2,062.64	$2,794.64	$2,968.41	$3,441.22	$3,124.99

Source: Allied Grape Growers

Pullout Costs

Chipping (1)	
	Cost/Acre
Remove Trellis & Post (Labor & Equipment)	$509
Cut Wire & Remove from Field (Cordon Wire)	$266
(Labor and Equipment)	
Could be multiple wires @ $180/wire	
Push and Pile Cost	$160
Chip Stacked Piles	$200
20 acres/day (varies)	
Dust Control ~$400/day	$20
Remove and Dump Roots and Stumps after Chipping	
~4 tons/acre	
Deliver and dump container at Composter ($225/load)	$90
$25.00/ton Composting	$100
Tractor /labor to load roots into Container	$54
Loader to compress roots into container	
Total Cost of Chipping	***$1,398.64***

(1) - Commercial grinders state that if they remove non-vegetative material cost = 1,000/acre+, which does not include root and stump removal

Burning	
Cut Wire	$3.60
Move Roots and Stumps to Piles Before Burn	
~4 tons/acre	
Tractor/trailer/labor to load roots into piles	$54.00
Push and Pile Cost	$160.00
Burn Control (supervise burn)	$11.82
Burn Permit Fee	$26.00
Remove Steel after Burn	$11.82
20 acres/8 hour	
Total Cost of Burning	***$267.24***

If steel is removed before burn, cost would increase

Wine Grapes

Methodology: Cost Study data was collected based on the farming costs of an average wine vineyard in the South and North San Joaquin Valley, which runs from the Grapevine to Highway 12. The cost study data is from 2005, though growers estimate that the farming costs have increased 10 to 15% since then. The main areas of cost increases have been in fuel, labor, and water. Costs are generally consistent across varieties.

The non-cash overhead costs are based on the repayment of the establishment and other long-term costs of the vineyard. Costs associated with non-cash overhead include: land purchase, tools, fuel tanks, irrigation system, establishment costs, and equipment. Land and establishment costs are based over the 25 years of assumed production of the vineyard. 25 years is the standard production lifetime for a vineyard; after 25 years, the production deteriorates. Many vineyards continue to be in production past the 25 year mark, because growers cannot afford the up-front costs of establishing a new vineyard. The cost study information makes note of the fact that their costs do not take into account the cost of paying the owner a salary. The owner is assumed to be paid on any positive return at the end of the year.

Pullout Costs were calculated based on conversations with growers, chippers, and farm labor contractors. The vineyard trellis system would have a combination of metal stakes and cross arms, as well as multiple support wires which would have to be removed before the vineyard can be chipped. The labor rate used was $8.00 per hour (the state minimum wage), plus 35% to take into account all state and federal taxes, social security deductions, and worker's compensation insurance. The labor rate may be higher depending on the labor conditions. Another issue with chipping is that chippers are not always able to do their work on the farmer's schedule. It can take weeks or even months to have a field chipped, at which point it may be too late to plant for the next season.

The stakes would be removed by three workers operating a loader in the field. Two workers would use chains to remove the stakes and one employee would operate the loader. These workers would be able to complete approximately one acre in an 8 hour workday. When burning, the stakes are piled with the vines, and removed after the burn.

Wire must also be removed from the vineyard before it can be chipped. Depending on the chipper's equipment, wire must be removed completely from the vineyard or must be present only in very short lengths. This presents an issue for vineyards where a cordon is created by wrapping the vine around the wire in the second year. As the vine grows, the wire becomes more and more embedded in the vine, making it impossible to remove. In some trellis systems, there may be as many as four wires embedded in the cordon. Chippers reported this wire causing problems and getting wrapped around the moving parts of their machinery. It was also reported that the bio mass facilities prefer not to receive material with wire, because the wire causes havoc with their equipment.

Wire removal is based on the cutting and removal of the wire from the field. For the chipping calculation, the wire removal cost estimate is significantly higher than the wire removal from burning. When wire is removed from a chipped vineyard, the wire has to be cut at every point where it is exposed. An individual wire would be cut between 700 and 800 times (depending on the number of vines in a row) per quarter mile. When burning, the wire has to be cut only once every 4-6 vines. This is only 45-60 per wire per row. The other issue for chipping is the removal of the clips or dog ears that hold the wire in place. These have to be removed from every stake in order to pull out the wire. Additionally, loose wire must also be picked up before the equipment can come into the field. Growers and contractors relayed that the wire removal for a single wire (the main wire) would take approximately 20 man-hours, as well as the use of a tractor or ATV to drive around picking up buckets full of pieces of wire. Each additional wire in the trellis system would cost $180 per wire. A typical trellis system for wine grapes would have between 3-6 wires. Growers who are able to burn do not have this issue, as the wire stays with the vine until burned, and can then be picked up with a loader or forklift from the piles. This wire is then loaded onto a truck and taken to a recycling center.

Root removal also differs with regards to chipping or burning. Roots and stumps must be removed from the field before it can be replanted. In a typical vineyard, there will be approximately 4 tons of roots and stumps remaining in the field when the vines are laid over and piled. These roots will have to be excavated using a chisel to get them out of the ground, and hand and machine labor to remove them from the field. When burning, the roots and stumps can be placed into the burn piles along with the above-ground material. When chipping, the roots must be hauled from the field to either a composter or dump. Chippers stated that they do not like to chip roots because of the amount of dirt that is associated. This volume of dirt negatively affects the machinery and causes wear and tear. The rates listed on the attached sheets are for the most cost-effective removal and disposal of the roots. The roots and stumps would be hauled by truck to the composter that charges $25 per ton for the material. This compares favorably to the $60 per ton that was quoted at the waste disposal site.

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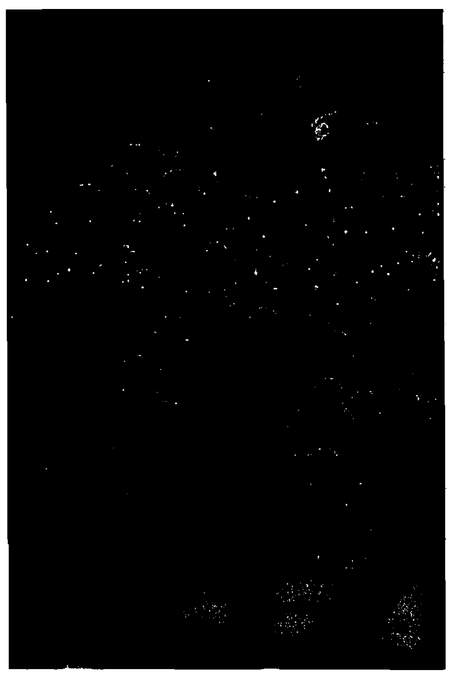
UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

2005

SAMPLE COSTS TO ESTABLISH AND PRODUCE WINE GRAPES



SAN JOAQUIN VALLEY

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UC COOPERATIVE EXTENSION

SAMPLE COSTS TO ESTABLISH AND PRODUCE WINE GRAPES
San Joaquin Valley - 2005

CONTENTS

INTRODUCTION

Sample costs to establish and produce wine grapes in the southern San Joaquin Valley are presented in this study. This study is intended as a guide only, and can be used to make production decisions, determine potential returns, prepare budgets and evaluate production loans. Practices described are considered typical for the crop and area, but these practices will not apply to every farming operation. The sample costs for labor, materials, equipment and custom services are based on current figures. A blank column, "*Your Costs*", in Tables 2 and 3 is provided for entering your farm costs.

The hypothetical farm operation, production practices, overhead, and calculations are described under the assumptions. For additional information or an explanation of the calculations used in the study call the Department of Agricultural and Resource Economics, University of California, Davis, (530) 752-3589 or your local UC Cooperative Extension office.

Sample Cost of Production Studies for many commodities can be downloaded at http://coststudies.ucdavis.edu, requested through the Department of Agricultural and Resource Economics, UC Davis, (530) 752-4424 or obtained from the local county UC Cooperative Extension offices. Some archived studies are also available on the website.

The University of California and the United States Department of Agriculture, Risk Management Agency, cooperating.

ASSUMPTIONS

The assumptions refer to Tables 1 to 8 and pertain to sample costs to establish the vineyard and produce wine grapes in the San Joaquin Valley. The cultural practices described represent production operations and materials considered typical on a well-managed vineyard in the region. Costs, materials, and practices in this study will not apply to all farms. Timing of and types of establishment and cultural practices will vary among growers within the region and from season to season due to variables such as weather, soil, and insect and disease pressure. The study does not represent a single farm and is intended as a guide only. **The use of trade names and cultural practices in this report does not constitute an endorsement or recommendation by the University of California nor is any criticism implied by omission of other similar products or cultural practices.**

Land. The hypothetical vineyard, owned and operated by the grower, is located on previously farmed land in the San Joaquin Valley. The farm is comprised of 120 acres, 40 acres of wine grapes being established and 75 acres of raisin grapes. Roads, irrigation systems, and farmstead occupy the remaining five acres.

Establishment Operating Costs (Table 1)

Site Preparation. This vineyard is established on ground previously planted to vineyards or orchards. Land coming from vines or trees should be fallowed for two years except for possible grain crops. The land is assumed to be fairly level. A custom operator chisels (subsoil) the ground twice to a depth of 4 to 5 feet. The grower floats the land to smooth and level the surface. Afterwards the ground is disced twice to apply and incorporate preplant herbicide. Nematode samples should be taken from land formerly in vines or trees and fumigated if necessary. Most operations that prepare the vineyard for planting are done in the year prior to planting, but costs are shown in the first year.

Trellis System. A commercial company installs the trellis system in December of the first year or January of the second year (January in this report). The trellis system is a vertical two-wire design. Trellis materials include 1.25 lb x 7-ft T-posts, 4 lb x 9.5-ft rail end posts, 1/4 x 40-inch rod, 12.5 gauge fruit and catch wires. Also a 14-guage wire is strung at 24-inches to hold the drip tubing.

Planting. Planting starts by laying out and marking vine sites in late winter. In the spring, holes are dug and the vines are planted and protected with an open carton placed over the vine. The vines are planted on a 7-ft x 11-ft (vine x row) spacing at 565 vines per acre. In the second year 2% or 11 vines per acre are replanted for those lost in the first year.

Vines. No specific variety is planted in this study, but the data refers to spur pruned varieties, such as white varieties - French Colombard, Chenin Blanc - and red varieties – Rubired, Ruby Cabernet, Barbera. The vines in this report are purchased as dormant vines that have been bench grafted or field budded onto nematode/phylloxera resistant rootstock. The life of the vineyard at planting is expected to be 25 years and the grapevines are expected to begin yielding fruit in three years.

Training/Pruning. Training and pruning to establish the vine framework will vary with variety and trellis system. Training includes tying, shoot thinning, shoot positioning and pruning. Bilateral cordon training and spur pruning is the selection of the main shoot and its upper laterals or branches that form the trunk and cordon. They are tied to the stake and cordon wire while unwanted shoots are removed, including any suckers arising from the rootstock. Quadrilateral cordon training requires the addition of crossarms. Dormant pruning begins in January of the second year. The young vines are pruned back to a 2-bud spur. Shoot thinning is done twice a month in April and May, shoot thinning and cordon training twice a month in June and July. In the third year, shoot thinning and shoot positioning are done in April and May, respectively. For more information on trellis and training systems please refer to *Wine Grape Varieties in California*, UC publication 3419.

Irrigation. In this study, the water is assumed to cost $5.67 per acre-inch or $68.00 per acre-foot. Water costs plus labor constitute the irrigation cost. Water costs vary considerably among districts and the water cost in this report represents a cost within that range. Irrigations occur during the growing season from March through September. No assumption is made about effective rainfall or runoff. The amount of water applied to the vines during the establishment years is shown in Table A. The drip irrigation system is described under Non-Cash Overhead.

Table A. Applied Irrigation Water

Year	AcIn/Year
1	8
2	18
3+	30

Pest Management. The pesticides and rates mentioned in this cost study as well as other materials available are listed in *UC Integrated Pest Management Guidelines, Grapes.* Pesticides mentioned in the study are commonly used, but other materials may be available.

Insects. Beginning in the third year, Kryocide insecticide is applied in early May at bloom (combined with Rubigan and zinc) to control worms (grape leaffolder, omnivorous leafroller, western grapeleaf skeletonizer). Provado insecticide is applied in July to control leafhoppers. Additionally, insects such as mealybugs should be monitored each year and may add additional costs if found. If mealybugs are found during vineyard establishment, the grower should consult with a PCA, farm advisor, and/or Ag commissioner to develop management strategies.

Diseases. The major disease treated in this study is powdery mildew. A dusting and spraying program for these diseases begins the third year with a wettable sulfur application soon after budbreak in late March or early April. Dusting sulfur is applied twice in April and once in June. A sterol inhibitor (SI) - Rubigan in this study - is applied in May during early bloom (combined with worm and zinc spray) and once in June, two weeks after bloom.

Weeds. Treflan herbicide is applied and incorporated during land preparation in the fall of the first year prior to planting. Vineyard floor management begins in late winter, February of the second year, with a strip spray in the vine row with Roundup, Surflan, and Goal. In the first year, the middles are mowed twice and disced twice. In the second and subsequent years, the row middles are disced in April and mowed in March, May, June, and August. The vine rows are spot treated with Roundup in late April and late July or early August.

Fertilization. Liquid nitrogen fertilizer - UN32, containing 32% nitrogen (N) - is applied in equal amounts through the drip system in May and June. Five pounds of N is applied in the first year, 10 in the second year, and 20 in the third year. Zinc as neutral zinc is applied with the bloom spray (Kryocide and Rubigan).

Harvest. Harvest begins the third year. The crop is mechanically harvested by a custom harvest operator and hauled to the processor by a custom hauler.

Yields. The average vineyard yields are six-tons per acre in the third year and 10-tons in the fourth.

Returns. In this study, the grapes are sold to a winery for which the grower receives $200 per ton, the current estimated market price

Production Years Operating Costs

Pruning. Pruning is done during the winter months – December and/or January. The vines are mechanically hedged or box pruned, followed with hand pruning to touch-up and clean the vines. The prunings are mechanically raked from the vine row, then shredded during the first mowing and incorporated into the soil with the April discing. Canopy skirting (mechanical) is done with the grower's equipment in June and in July.

Trellis/Vines. Trellis repairs are done annually (January in this study) and the cost is not taken from any specific data. Weak or missing vines are replaced by layering. One year-old canes from neighboring vines are buried (layered) in the soil next to the stake and allowed to root. After rooting, the canes are cut and the plant is trained on the trellis. Trellis repair and vine replacement increases with vineyard age.

Fertilization. Forty pounds per acre of nitrogen (N) as UN32 is divided and applied through the drip lines in equal amounts in May and June. Neutral zinc at five pounds of material per acre is applied in May with the disease and insect application.

Irrigation. Water costs plus labor, which includes checking the drip lines, constitute the irrigation cost. Irrigation labor includes servicing the clock and filters, set-up and injection of chemicals, checking, replacing, and repairing drip lines and laterals. In this study, water is calculated to cost $5.67 per acre-inch or $68.00 per acre-foot. Water costs vary considerably among districts and the water cost in this report represents a cost within that range. Thirty acre-inches are applied during the growing season from April through late September. No assumption is made about effective rainfall and runoff. Deficit irrigation may be used in mature vineyards in the San Joaquin Valley, but is not addressed in this study.

Pest Management. The pesticides and rates mentioned in this cost study are listed in *UC Integrated Pest Management Guidelines, Grapes.* For information on other pesticides available, pest identification, monitoring, and management visit the UC IPM website at www.ipm.ucdavis.edu. Information and pesticide use permits are available through the local county agricultural commissioner's office. Pesticides mentioned in this study are used to calculate rates and costs. Although growers commonly use the pesticides mentioned, many other pesticides are available. Adjuvants are recommended for use with many pesticides for effective control, but the adjuvants and their costs are not included. Pesticide costs may vary by location, brand, and grower volume. Pesticide costs in this study are from a single dealer and shown as full retail.

Pest Control Adviser (PCA). Written recommendations are required for many commercially applied pesticides and are made by licensed pest control advisers. In addition, the PCA can monitor the field for agronomic problems including pests and nutrition. Growers may hire private PCA's or receive the service as part of a service agreement with an agricultural chemical and fertilizer company. No costs for a PCA are included in this report.

Weeds. Surflan, Goal and Roundup herbicides are applied as a winter strip spray to the vine row in February. Vine row weeds that germinate during the growing season are controlled with two Roundup spot sprays – April, July. The row middles are mowed four times – March for frost control and to shred prunings, May, June, and August prior to harvest. The middles are also disced in April for weed control and to incorporate the vine prunings.

Insects. Vine Mealybug (*Pseudococcus sp.*) is treated with Lorsban insecticide in late February to early March (dormant vines). Western grapeleaf skeletonizer (*Harrisina brillians*) is treated at bloom with Kryocide in late April or early May (combined with powdery mildew and foliar fertilizer spray). Provado insecticide is applied in July to control grape leafhoppers (*Erythroneura elegantula*). The materials are applied with the grower's equipment. Growers with heavy mealybug infestations may apply split applications of Admire insecticide through the drip line around bloom to fruit set (mid-May) and then again 21-45 days later on light to medium textured soils. See the UC IPM guidelines for alternative management strategies if heavier soils are involved. A calculated cost for the split Admire applications is $130 per acre. It may be necessary to use multiple insecticides to control some mealybug species. Wineries may have restrictions on the use of some insecticides, so growers should consult with their winery prior to application.

Diseases. The major disease considered in this study is powdery mildew (*Uncinula necator*). Wettable sulfur is applied soon after budbreak in late March or early April. A second application is made in April. Dusting sulfur is applied once in April, in May, and in June. A sterol inhibitor, Rubigan, is applied in May at early bloom (with the worm and zinc spray) and a strobilurin fungicide, Flint, in June two weeks after bloom. Mildew is controlled during the season with various fungicide applications at 7 to 21 day intervals, depending on the fungicide used. Growers have the option of using sterol inhibitors (SI), quinolins, strobilurins, or sulfur (micronized, wettable, dust, flowable), as well as other fungicides to control powdery mildew. These materials are classes of fungicides with different modes of action. Check the IPM website under grapes for management options to control powdery mildew. It is recommended that applicators use fungicides with different modes of action in order to avoid fungicide resistance in powdery mildew populations. Growers should consult with wineries to determine cut-off dates for fungicide restrictions.

Harvest. A custom operator mechanically harvests the crop. Harvest costs in this report are $225 per acre, which is a mid-range of costs provided by the growers. A commercial trucker hauls the grapes to the processor for $10 per ton. Hauling costs will vary depending upon the hauling distance.

Yields. An average yield of 12-tons per acre is assumed over the remaining life of the vineyard.

Returns. The market price in this report, based on *2003 Final Grape Crush Report,* CDFA Agricultural Statistics Branch, depending on variety ranges from $124 to $270 per ton. An average of $200 per ton for both white and red varieties is used in this report to show a range of returns over various yields (Table 5).

Pickup/ATV. It is assumed that the grower uses the pickup for business and personal use. Estimated business mileage for the ranch is 3,300 miles. The all terrain vehicle (ATV) is used for spot spraying weeds and is included in that cost. It is assumed that the ATV will be used another two-hours per acre for checking the vineyards including the irrigation system.

Labor. Labor rates of $12.73 per hour for machine operators and $11.05 for general labor includes payroll overhead of 34%. The basic hourly wages are $9.50 for machine operators and $8.25 for general labor. The overhead includes the employers' share of federal and California state payroll taxes, workers' compensation insurance for vineyards (code 0040), and a percentage for other possible benefits. Workers' compensation insurance costs will vary among growers, but for this study the cost is based upon the average industry final rate as of January 1, 2004 (California Department of Insurance). Labor for operations involving machinery are 20% higher than the operation time given in Table 2 to account for the extra labor involved in equipment set up, moving, maintenance, work breaks, and field repair.

Equipment Operating Costs. Repair costs are based on purchase price, annual hours of use, total hours of life and repair coefficients formulated by the American Society of Agriculture Engineers (ASAE). Fuel and lubrication costs are also determined by ASAE equations based on maximum PTO horsepower, and fuel type. Prices for on-farm delivery of diesel and gasoline are $1.50 and $1.95 per gallon, respectively. The fuel prices are averaged based on two California delivery locations. The cost includes a 2% sales tax on diesel fuel and 7.25% sales tax on gasoline. Gasoline also includes federal and state excise tax, which can be refunded for on-farm use when filing your income tax. The fuel, lube, and repair cost per acre for each operation in Table 2 is determined by multiplying the total hourly operating cost in Table 7 for each piece of equipment used for the selected operation by the hours per acre. Tractor time is 10% higher than implement time for a given operation to account for setup, travel and down time.

Interest On Operating Capital. Interest on operating capital is based on cash operating costs and is calculated monthly until harvest at a nominal rate of 7.65% per year. A nominal interest rate is the typical market cost of borrowed funds. The interest cost of post harvest operations is discounted back to the last harvest month using a negative interest charge.

Risk. The risks associated with crop production should not be minimized. While this study makes every effort to model a production system based on typical, real world practices, it cannot fully represent financial, agronomic and market risks, which affect profitability and economic viability. Growers may purchase Federal crop insurance to reduce the production risk associated with specific natural hazards. Insurance policies vary and range from a basic catastrophic loss policy to one that insures losses for up to 75% of a crop. Crop insurance is not included in this report, but insurance costs will depend on the type and level of coverage.

Cash Overhead Costs

Cash overhead consists of various cash expenses paid out during the year that are assigned to the whole farm and not to a particular operation. These costs include property taxes, interest on operating capital, office expense, liability and property insurance, sanitation services, equipment repairs, and management.

Property Taxes. Counties charge a base property tax rate of 1% on the assessed value of the property. In some counties special assessment districts exist and charge additional taxes on property including equipment, buildings, and improvements. For this study, county taxes are calculated as 1% of the average value of the property. Average value equals new cost plus salvage value divided by 2 on a per acre basis.

Insurance. Insurance for farm investments varies depending on the assets included and the amount of coverage. Property insurance provides coverage for property loss and is charged at 0.690% of the average value of the assets over their useful life. Liability insurance covers accidents on the farm and costs $661 per year for the entire farm.

Office Expense. Office and business expenses for 120 acres are estimated at $75 per producing acre or $8,625 annually for the farm. These expenses include office supplies, telephones, bookkeeping, accounting, legal fees, road maintenance, etc. The cost is assumed and not taken from any specific data.

Sanitation Services. Sanitation services provide double portable toilets with washbasins for 10 months. The cost includes delivery and weekly cleaning service. The number of sanitation facilities and length of time the service is required will vary depending upon local regulations and size of labor force. In many cases labor contractors furnish the sanitation facilities for their crews and the cost is included in the contractor's labor overhead.

Management/Supervisor Wages. Salary is not included. Returns above costs are considered a return to management.

Investment Repairs. Annual maintenance is calculated as 2% of the purchase price.

Non-Cash Overhead Costs

Non-cash overhead is calculated as the annual capital recovery cost for ownership of equipment and other farm investments.

Capital Recovery Costs. Capital recovery cost is the annual depreciation and interest costs for a capital investment. It is the amount of money required each year to recover the difference between the purchase price and salvage value (unrecovered capital). It is equivalent to the annual payment on a loan for the investment with the down payment equal to the discounted salvage value. This is a more complex method of calculating ownership costs than straight-line depreciation and opportunity costs, but more accurately represents the annual costs of ownership because it takes the time value of money into account (Boehlje and Eidman). The formula for the calculation of the annual capital recovery costs is ((Purchase Price – Salvage Value) x Capital Recovery Factor) + (Salvage Value x Interest Rate).

Salvage Value. Salvage value is an estimate of the remaining value of an investment at the end of its useful life. For farm machinery (tractors and implements) the remaining value is a percentage of the new cost of the investment (Boehlje and Eidman). The percent remaining value is calculated from equations developed by the American Society of Agricultural Engineers (ASAE) based on equipment type and years of life. The life in years is estimated by dividing the wear out life, as given by ASAE by the annual hours of use in this operation. For other investments including irrigation systems, buildings, and miscellaneous equipment, the value at the end of its useful life is zero. The salvage value for land is the purchase price because land does not depreciate. The purchase price and salvage value for equipment and investments are shown in Table 6.

Capital Recovery Factor. Capital recovery factor is the amortization factor or annual payment whose present value at compound interest is 1. The amortization factor is a table value that corresponds to the interest rate used and the life of the machine.

Interest Rate. The interest rate of 6.01% used to calculate capital recovery cost is the USDA-ERS's ten-year average of California's agricultural sector long-run rate of return to production assets from current income. It is used to reflect the long-term realized rate of return to these specialized resources that can only be used effectively in the agricultural sector. In other words, the next best alternative use for these resources is in another agricultural enterprise.

Establishment Cost. Costs to establish the vineyard are used to determine capital recovery expenses on investment for the production years. Establishment cost is the sum of the costs for land preparation, trellis system, planting, vines, cash overhead and production expenses for growing the vines through the first year that grapes are harvested minus any returns from production. The Total Accumulated Net Cash Cost on Table 1, in the third year represents the establishment cost. For this study the cost is $7,104 per acre or $284,160 for the 40-acre vineyard. The establishment cost is spread over the remaining 22 years of the 25 years the vineyard is in production.

Irrigation System. The previous vineyard is assumed to have an irrigation system that has been refurbished. The drip line is laid on the ground prior to planting. After the trellis system is installed, the drip line is clipped to the bottom trellis wire. The system includes the installation labor, filters, fertilizer injector, time clock, and valves. Although the materials will have a useful life equivalent to the vineyard, the irrigation system can be included in the vineyard establishment costs or as in this case an improvement to the property with a 25-year life.

Land. The land was formerly a vineyard, but has been out of production for two years. The open land was planted to grain crops. Land in the San Joaquin Valley for grape production ranges from $4,500 to $6,500 per acre (CA Association of Farm Manager and Real Estate Appraisers). For this report, a land value of $5,800 per acre or $6,052 per producing acre is used (five of the 120 acres are not planted). It is assumed the grower originally purchased the land with an established vineyard. The annual cost of land is interest only since land does not depreciate.

Building. The metal buildings are on a cement slab and comprise 2,400 square feet.

Tools. This includes shop tools, hand tools, and miscellaneous field tools such as pruning tools.

Fuel Tanks. Two 250-gallon fuel tanks using gravity feed are on metal stands. The tanks are setup in a cement containment pad that meets federal, state, and county regulations.

Equipment. Farm equipment is purchased new or used, but the study shows the current purchase price for new equipment. The new purchase price is adjusted to 60% to indicate a mix of new and used equipment. Annual ownership costs for equipment and other investments are shown in Table 6. Equipment costs are composed of three parts: non-cash overhead, cash overhead, and operating costs. Both of the overhead factors have been discussed in a previous section. The operating costs consist of repairs, fuel, and lubrication and are discussed under operating costs.

Table Values. Due to rounding, the totals may be slightly different from the sum of the components.

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UC COOPERATIVE EXTENSION

Table 1. SAMPLE COSTS PER ACRE TO ESTABLISH A VINEYARD

SAN JOAQUIN VALLEY - 2005

	Cost Per Acre		
Year:	1st	2nd	3rd
Tons Per Acre:	0.0	0.0	6.0
Planting Costs:			
Land Prep: Chisel 2X (Custom)	300		
Land Prep: Level (Float)	7		
Land Prep: Disc/Apply Herbicide (Treflan) 1st pass	12		
Land Prep: Disc (Incorporate Herbicide) 2nd pass	7		
Plant: Survey & Layout Vineyard	76		
Plant: Dig, Plant, Place Vines Guards	170	2	
Vines: 565 Per Acre (2% Replant In 2nd Year)	1,497	29	
Install Trellis System		3,000	
TOTAL PLANTING COSTS	2,069	3,031	0
Cultural Costs:			
Prune: Dormant		55	133
Prune/Training: (Sucker, Tie & Train)		442	110
Fertilize: applied through drip line (UN32)	3	5	9
Irrigate: (water & labor)	79	132	204
Weed: Winter Strip-vine row- Spray (Goal, Surflan, Roundup)		79	79
Weed: Disc Middles Yr 1, 2X. Yr 2+, 1X.	14	7	7
Weed: Spot Spray (Roundup) 2X.		28	28
Weed: Mow Middles Yr 1 2X. Yr 2+ 4X.	16	25	25
Weed: Hand Hoe	33		
Insect: Leafhoppers (Provado)			54
Disease: Mildew (Wettable Sulfur) 2X			44
Disease: Mildew (Dusting Sulfur) 3X			26
Disease: Mildew (Flint)			46
Insect: Worms (Kryocide,). Disease: Mildew (Rubigan). Fertilize: (Zn)			54
Pickup: Business Use	41	41	41
ATV: General Use	33	33	33
TOTAL CULTURAL COSTS	219	847	893
Harvest Costs:			
Harvest: (Machine) & Haul			285
TOTAL HARVEST COSTS	0	0	285
Interest On Operating Capital	102	201	26
TOTAL OPERATING COSTS/ACRE	2,390	4,079	1,204
Cash Overhead Costs:			
Office Expense	75	75	75
Liability Insurance	6	6	6
Sanitation Services	20	20	20
Property Taxes	70	70	71
Property Insurance	6	7	8
Investment Repairs	32	32	32
TOTAL CASH OVERHEAD COSTS	209	210	212
TOTAL CASH COSTS/ACRE	2,599	4,289	1,416
INCOME/ACRE FROM PRODUCTION	0	0	1,200
NET CASH COSTS/ACRE FOR THE YEAR	2,599	4,289	216
PROFIT/ACRE ABOVE CASH COSTS	0	0	0
ACCUMULATED NET CASH COSTS/ACRE	2,599	6,888	**7,104**

UC COOPERATIVE EXTENSION
Table 1. continued

	Cost Per Acre		
Year:	1st	2nd	3rd
Tons Per Acre:	0	0	6.0
Capital Recovery Cost:			
Land	364	364	364
Drip Irrigation System	74	74	74
Shop Building	46	46	46
Shop Tools	10	10	10
Fuel Tank & Pump	2	2	2
Equipment	25	26	60
TOTAL CAPITAL RECOVERY COST	521	522	556
TOTAL COST/ACRE FOR THE YEAR	3,120	4,811	1,972
INCOME/ACRE FROM PRODUCTION	0	0	1,200
TOTAL NET COST/ACRE FOR THE YEAR	3,120	4,811	772
NET PROFIT/ACRE ABOVE TOTAL COST	0	0	0
TOTAL ACCUMULATED NET COST/ACRE	3,120	7,931	8,703

UC COOPERATIVE EXTENSION
Table 2. COSTS PER ACRE TO PRODUCE WINE GRAPES
SAN JOAQUIN VALLEY - 2005

Operation	Operation Time (Hrs/A)	Cash and Labor Cost per acre: Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost
Cultural:						
Vines: Layering Missing Vines	1.00	11	0	0	0	11
Trellis: Repair	2.00	22	0	10	0	32
Prune: (mechanical)	0.00	0	0	0	85	85
Prune: Clean Up Vines (hand prune)	4.00	44	0	0	0	44
Prune: Rake Prunings (mechanical)	0.23	4	2	0	0	5
Weed: Winter Strip Spray (Roundup, Goal, Surflan)	0.54	8	4	67	0	79
Irrigate: (water & labor)	3.05	34	0	170	0	204
Weed: Mow 4X	0.94	14	8	0	0	22
Insect: Mealybug (Lorsban)	0.83	13	8	27	0	49
Weed: Spot Spray 20% acres 2X (Roundup)	1.15	18	2	9	0	28
Weed: Disc	0.31	5	2	0	0	7
Disease: Mildew (Wettable Sulfur)	1.67	25	17	1	0	44
Disease: Mildew (Dusting Sulfur)	0.92	14	7	5	0	26
Fertilize: through drip (UN32)	0.10	1	0	16	0	17
Insect: Skeletonizer (Kryocide). Disease: Mildew (Rubigan). Fertilizer: (Zn)	0.83	13	8	33	0	54
Prune: Skirt Vines (mechanical)	0.50	8	4	0	0	11
Disease: Mildew (Flint)	0.83	13	8	25	0	46
Insect: Leaf Hopper (Provado)	0.83	13	8	33	0	54
Pickup: Business use for vineyard	1.50	23	18	0	0	41
ATV: Miscellaneous vineyard use	2.00	31	2	0	0	33
TOTAL CULTURAL COSTS	23.24	312	100	396	85	893
Harvest:						
Harvest: Machine Harvest & Haul	0.00	0	0	0	345	345
TOTAL HARVEST COSTS	0.00	0	0	0	345	345
Interest on operating capital						28
TOTAL OPERATING COSTS/ACRE		312	100	396	430	1,265
Cash Overhead:						
Office Expense						75
Liability Insurance						6
Sanitation						20
Property Taxes						107
Property Insurance						32
Investment Repairs						174
TOTAL CASH OVERHEAD COSTS						415
TOTAL CASH COSTS/ACRE						1,680

Non-Cash Overhead:	Per producing Acre	Annual Cost Capital Recovery	Total Cost
Land	6,052	364	364
Drip Irrigation System	950	74	74
Buildings	522	46	46
Tools-Shop/Field	104	10	10
Fuel Tanks	30	2	2
Vineyard Establishment	7,104	590	590
Equipment	496	67	67
TOTAL NON-CASH OVERHEAD COSTS	15,259	1,153	1,153
TOTAL COSTS/ACRE			2,834

UC COOPERATIVE EXTENSION

Table 3. COSTS AND RETURNS to PRODUCE WINE GRAPES

SAN JOAQUIN VALLEY - 2005

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
GROSS RETURNS					
Wine Grapes	12.00	Ton	200.00	2,400	
OPERATING COSTS					
Trellis System:					
Trellis Materials	1.00	acre	10.00	10	
Custom:					
Prune Mechanical	1.00	acre	85.00	85	
Machine Harvest	1.00	acre	225.00	225	
Haul to Crusher	12.00	ton	10.00	120	
Herbicide:					
Roundup Ultra Max	1.66	pint	8.56	14	
Goal 2XL	1.00	pint	16.21	16	
Surflan 4 AS	2.64	pint	16.96	45	
Irrigation:					
Water	30.00	acin	5.67	170	
Fungicide:					
Wettable Sulfur	6.00	lb	0.21	1	
Dusting Sulfur	30.00	lb	0.18	5	
Rubigan EC	4.00	floz	2.50	10	
Flint	1.50	oz	16.49	25	
Fertilizer:					
UN 32	40.00	lb N	0.41	16	
Neutral Zinc 50%	5.00	lb	0.92	5	
Insecticide:					
Lorsban 4E	4.00	pint	6.86	27	
Kryocide	6.00	lb	3.00	18	
Provado 1.6 Solupak	0.75	oz	43.96	33	
Labor (machine)	15.71	hrs	12.73	200	
Labor (non-machine)	10.15	hrs	11.05	112	
Fuel - Gas	7.93	gal	1.95	15	
Fuel - Diesel	27.34	gal	1.50	41	
Lube				8	
Machinery repair				35	
Interest on operating capital @ 7.65%				28	
TOTAL OPERATING COSTS/ACRE				1,265	
NET RETURNS ABOVE OPERATING COSTS				1,135	
Cash Overhead:					
Office Expense				75	
Liability Insurance				6	
Sanitation				20	
Property Taxes				107	
Property Insurance				32	
Investment Repairs				174	
TOTAL NON-CASH OVERHEAD COSTS				415	
TOTAL COSTS/ACRE				1,680	
Non-Cash Overhead:					
Land				364	
Drip Irrigation System				74	
Buildings				46	
Tools-Shop/Field				10	
Fuel Tanks				2	
Vineyard Establishment				590	
Equipment				67	
TOTAL NON-CASH OVERHEAD COSTS				1,153	
TOTAL COSTS/ACRE				2,834	
NET RETURNS ABOVE TOTAL COSTS				-434	

UC COOPERATIVE EXTENSION

Table 4. MONTHLY CASH to PRODUCE WINE GRAPES

SAN JOAQUIN VALLEY - 2005

Beginning JAN 05 Ending DEC 05	JAN 05	FEB 05	MAR 05	APR 05	MAY 05	JUN 05	JUL 05	AUG 05	SEP 05	OCT 05	NOV 05	DEC 05	TOTAL
Cultural:													
Vines: Layering Missing Vines	11												11
Trellis: Repair	32												32
Prune (mechanical)	85												85
Prune: Clean Up Vines (hand prune)	44												44
Prune: Rake Prunings (mechanical)	5												5
Weed: Winter Strip Spray (Roundup, Goal, Surflan)		79											79
Irrigate: (water & labor)			11	15	22	46	52	32	26				204
Weed: Mow 4X (March includes shred prunings)			8		5	5		5					22
Insect: Mealybug, (Lorsban)			49										49
Weed: Spot Spray 20% acres (Roundup)				14			14						28
Weed: Disc				7									7
Disease: Mildew (Wettable Sulfur)				44									44
Disease: Mildew (Dusting Sulfur)				9	9	9							26
Fertilize: through drip (UN32)					9	9							17
Insect: Worms (Kryocide). Disease: Mildew (Rubigan). Fertilizer: (Zn)					54								54
Prune: Skirt Vines						6	6						11
Disease: Mildew (Flint)						46							46
Insect: Leaf Hopper (Provado)							54						54
Pickup: Business use for vineyard	3	3	3	3	3	3	3	3	3	3	3	3	41
ATV 4WD: Miscellaneous vineyard use	3	3	3	3	3	3	3	3	3	3	3	3	33
TOTAL CULTURAL COSTS	184	85	74	94	104	126	132	43	32	6	6	6	893
Harvest:													
Harvest: Machine Harvest & Haul								345					345
TOTAL HARVEST COSTS								345					345
Interest on operating capital @ 7.65%	1	2	2	3	3	4	5	8	0	0	0	0	28
TOTAL OPERATING COSTS/ACRE	185	87	76	97	108	131	137	395	32	6	6	6	1,265
Cash Overhead:													
Office Expense	6	6	6	6	6	6	6	6	6	6	6	6	75
Liability Insurance	6												6
Sanitation	2	2	2	2	2	2	2	2	2				20
Property Taxes	54						54						107
Property Insurance	16						16						32
Investment Repairs	15	15	15	15	15	15	15	15	15	15	15	15	174
TOTAL CASH OVERHEAD COSTS/ACRE	99	23	23	23	23	23	93	23	23	21	21	21	415
TOTAL CASH COSTS/ACRE	284	110	99	120	131	154	230	418	55	27	27	27	1,680

UC COOPERATIVE EXTENSION
Table 5. RANGING ANALYSIS
SAN JOAQUIN VALLEY - 2005

COSTS PER ACRE AT VARYING YIELD TO PRODUCE WINE GRAPES

	YIELD (ton/acre)						
	8.00	9.00	10.00	11.00	12.00	13.00	14.00
OPERATING COSTS:							
Cultural Cost	893	893	893	893	893	893	893
Harvest Cost	305	315	325	335	345	355	365
Interest on operating capital	27	27	28	28	28	28	28
TOTAL OPERATING COSTS/ACRE	1,225	1,235	1,246	1,256	1,266	1,276	1,286
Total Operating Costs/ton	153	137	125	114	106	98	92
CASH OVERHEAD COSTS/ACRE	415	415	415	415	415	415	415
TOTAL CASH COSTS/ACRE	1,640	1,650	1,661	1,671	1,681	1,691	1,701
Total Cash Costs/ton	205	183	166	152	140	130	122
NON-CASH OVERHEAD COSTS/ACRE	1,153	1,153	1,153	1,153	1,153	1,153	1,153
TOTAL COSTS/ACRE	2,793	2,803	2,814	2,824	2,834	2,844	2,854
Total Costs/ton	349	311	281	257	236	219	204

NET RETURNS PER ACRE ABOVE OPERATING COSTS

PRICE	YIELD (ton/acre)						
$/ton	8.00	9.00	10.00	11.00	12.00	13.00	14.00
100.00	-425	-335	-246	-156	-66	24	114
125.00	-225	-110	4	119	234	349	464
150.00	-25	115	254	394	534	674	814
175.00	175	340	504	669	834	999	1,164
200.00	375	565	754	944	1,134	1,324	1,514
225.00	575	790	1,004	1,219	1,434	1,649	1,864
250.00	775	1,015	1,254	1,494	1,734	1,974	2,214

NET RETURNS PER ACRE ABOVE CASH COST

PRICE	YIELD (ton/acre)						
$/ton	8.00	9.00	10.00	11.00	12.00	13.00	14.00
100.00	-840	-750	-661	-571	-481	-391	-301
125.00	-640	-525	-411	-296	-181	-66	49
150.00	-440	-300	-161	-21	119	259	399
175.00	-240	-75	89	254	419	584	749
200.00	-40	150	339	529	719	909	1,099
225.00	160	375	589	804	1,019	1,234	1,449
250.00	360	600	839	1,079	1,319	1,559	1,799

NET RETURNS PER ACRE ABOVE TOTAL COST

PRICE	YIELD (ton/acre)						
$/ton	8.00	9.00	10.00	11.00	12.00	13.00	14.00
100.00	-1,993	-1,903	-1,814	-1,724	-1,634	-1,544	-1,454
125.00	-1,793	-1,678	-1,564	-1,449	-1,334	-1,219	-1,104
150.00	-1,593	-1,453	-1,314	-1,174	-1,034	-894	-754
175.00	-1,393	-1,228	-1,064	-899	-734	-569	-404
200.00	-1,193	-1,003	-814	-624	-434	-244	-54
225.00	-993	-778	-564	-349	-134	81	296
250.00	-793	-553	-314	-74	166	406	646

UC COOPERATIVE EXTENSION
Table 6. WHOLE FARM ANNUAL EQUIPMENT, INVESTMENT,
SAN JOAQUIN VALLEY - 2005

ANNUAL EQUIPMENT COSTS

						Cash Overhead		
Yr	Description	Price	Yrs Life	Salvage Value	Capital Recovery	Insur-ance	Taxes	Total
05	60HP 4WD Narrow Tractor	36,000	15	7,009	3,408	149	215	3,772
05	ATV 4WD	6,700	5	3,003	1,058	34	49	1,140
05	Brush Rake	6,500	10	1,149	796	27	38	861
05	Brush Shredder 6 ft	9,000	15	864	890	34	49	974
05	Cane Cutter	2,500	20	130	215	9	13	237
05	Disc - Tandem 8 ft	6,800	10	1,203	833	28	40	901
05	Duster - 3 Pt	5,000	5	1,629	898	23	33	954
05	Mower-Rotary 6 ft	2,050	10	363	251	8	12	272
05	Vine Sprayer 500 gal	20,378	5	6,638	3,662	94	135	3,890
05	Pickup Truck 1/2 Ton	26,000	7	9,863	3,484	124	179	3,788
05	Sprayer ATV 20 gal	350	10	62	43	1	2	46
05	Weed Sprayer 3PT 100 gal	3,500	10	619	429	14	21	464
	TOTAL	124778		32,532	15,968	545	787	17,300
	60% of New Cost *	74,867		19,519	9,581	327	472	10,380

* Used to reflect a mix of new and used equipment.

ANNUAL INVESTMENT COSTS

					Cash Overhead			
Description	Price	Yrs Life	Salvage Value	Capital Recovery	Insur-ance	Taxes	Repairs	Total
Building 2,400 sqft	60,000	20		5,235	208	300	1,200	6,943
Drip Irrigation System	38,000	25		2,975	132	190	760	4,057
Vineyard Establishment	284,160	22		23,619	985	1,421	5,683	31,707
Fuel Tanks 2-250 gal	3,500	30	350	250	13	19	70	353
Land	696,000	25	696,000	41,830	0	6,960	0	48,790
Tools: Shop/Field	12,000	15	1,133	1,188	46	66	240	1,539
TOTAL INVESTMENT	1,093,660		697,483	75,097	1,383	8,956	7,953	93,389

ANNUAL BUSINESS OVERHEAD COSTS

Description	Units/ Farm	Unit	Price/ Unit	Total Cost
Liability Insurance	115	acre	5.74	660
Office Expense	115	acre	75.00	8,625
Sanitation Fee	115	acre	20.43	2,349

UC COOPERATIVE EXTENSION
Table 7. HOURLY EQUIPMENT COSTS
SAN JOAQUIN VALLEY - 2005

		COSTS PER HOUR						
	Actual		Cash Overhead		Operating			
	Hours	Capital	Insur-			Fuel &	Total	Total
Yr Description	Used	Recovery	ance	Taxes	Repairs	Lube	Oper.	Costs/Hr.
05 60HP 4WD Narrow Tractor	1,066	1.96	0.08	0.12	.89	5.08	5.97	8.09
05 ATV 4WD	400	1.59	0.05	0.07	0.50	0.75	1.25	2.96
05 Brush Rake	250	1.91	0.06	0.09	0.91	0.00	0.91	2.98
05 Brush Shredder 6 ft	131	4.03	0.15	0.22	4.04	0.00	4.06	8.47
05 Cane Cutter	100	1.29	0.05	0.08	0.95	0.00	0.95	2.38
05 Disc - Tandem 8 ft	200	2.51	0.08	0.12	1.10	0.00	1.10	3.81
05 Duster - 3 Pt	240	2.25	0.06	0.08	0.73	0.00	0.73	3.12
05 Mower-Rotary 6 ft	200	0.75	0.03	0.04	0.98	0.00	0.98	1.79
05 Vine Sprayer 500 gal	401	5.49	0.14	0.20	3.59	0.00	3.59	9.42
05 Pickup Truck 1/2 Ton	285	7.34	0.26	0.38	1.91	10.28	12.19	20.16
05 Sprayer ATV 20 gal	150	0.17	0.01	0.01	0.10	0.00	0.10	0.28
05 Weed Sprayer 3PT 100 gal	200	1.28	0.04	0.06	0.61	0.00	0.61	1.99

UC COOPERATIVE EXTENSION
Table 8. OPERATIONS WITH EQUIPMENT
SAN JOAQUIN VALLEY - WINE GRAPES 2005

Operation	Operation Month	Tractor	Implement	Material	Broadcast Rate/acre	Unit
Cultural:						
Vines: Layer vines	January			Labor	1.00	hrs
Trellis: Repair	January			Labor	2.00	hrs
				Materials	10.00	ac
Prune (mechanical)	January	Custom				
Prune: Clean up vines (hand prune)	January			Labor	4.00	hrs
Prune: Rake Prunings (mechanical)	January	60HP 4WD	Brush Rake			
Prune: Skirt Vines (mechanical)	June	60HP 4WD	Cane Cutter			
	July	60HP 4WD	Cane Cutter			
Weed: Winter Strip	February	60HP 4WD	Weed Sprayer 3 Pt	Roundup	0.66	pt
				Goal	1.00	pt
				Surflan	2.64	pt
Weed: Mow	March	60HP 4WD	Shredder			
	May	60HP 4WD	Mower - Rotary			
	June	60HP 4WD	Mower - Rotary			
	August	60HP 4WD	Mower - Rotary			
Weed: Spot Spray	April	ATV	ATV Sprayer	Roundup	0.50	pt
	July	ATV	ATV Sprayer	Roundup	0.50	pt
Weed: Disc	April	60HP 4WD	Disc - Tandem			
Irrigate:	March			Water	1.00	acin
	April			Water	2.00	acin
	May			Water	3.00	acin
	June			Water	7.00	acin
	July			Water	8.00	acin
	August			Water	5.00	acin
	September			Water	4.00	acin
Disease: Mildew	April	60HP 4WD	Vine Sprayer	Wettable Sulfur	3.00	lb
	April	60HP 4WD	Vine Sprayer	Wettable Sulfur	3.00	lb
	April	60HP 4WD	Duster	Dusting Sulfur	10.00	lb
	May	60HP 4WD	Duster	Dusting Sulfur	10.00	lb
	June	60HP 4WD	Vine Sprayer	Flint	1.50	oz
	June	60HP 4WD	Duster	Dusting Sulfur	10.00	lb
Insect. Disease. Fertilize	May	60HP 4WD	Vine Sprayer	Kryocide (Skeletonizer)	6.00	lb N
				Rubigan (Mildew)	4.00	floz
				Neutral Zinc	5.00	lb
Insect: Mealybug	March	60HP 4WD	Vine Sprayer	Lorsban	6.00	pint
Insect: Leafhopper	July			Provado	0.75	oz
Fertilize: through drip	May			UN32	20.00	lb N
	June			UN32	20.00	lb N
Harvest: Machine Pick and Haul	August	Custom				

Table Grapes

Table Grape

Winter		Associated Cost/acre
Pruning		$309.00
Fertilizer Application		$28.00
Trellis Maintenance		$32.00
Plant layers		$11.00
Shred Prunings*		$8.00
Spring		
Action		
Irrigation		$165.00
Weed Control		$151.00
Cultivation		$25.00
Leaf & Shoot Removal		$532.00
Thinning		$213.00
Gibberellic Acid		$179.00
Girdling		$131.00
Fungicide Application		$241.00
Pest Control		$102.00
Summer/Fall		
Mow Weeds/Cut Canes		$15.00
Harvest & Market		$5,450.00
Overhead Expenses		
Cash: Taxes, Insurance, Office, Electricity, Permit Fees		$305.00
Non-Cash Overhead Expenses		$1,472.25
Total Cost		**$9,662.25**
Total Income		**$10,022.05**
Avg. Price/box	$11.35	
Avg. Box/acre	883	
Net Return/acre		**$359.80**

Cost Data:

Cost & Return Data, Agricultural Economics UC Davis http://coststudies.ucdavis.edu/files/grapets_vs2007.pdf
Cost & Return Data, Agricultural Economics UC Davis http://coststudies.ucdavis.edu/files/grapecrimsonvs2007.pdf
Cost & Return Data, Agricultural Economics UC Davis http://coststudies.ucdavis.edu/files/graperedglobe_vs2007.pdf
Cost & Return Data, Agricultural Economics UC Davis http://coststudies.ucdavis.edu/files/grapeflame_vs2007.pdf

Income

Year	Yield Per Acre (Tons)	Yield Per Acre (lb)	Boxes Per Acre (21 lb = 1 box)	Bearing Acreage	Total Boxes	Avg. Box Price
2000	8.7	17,400	829	89,000	81,524,000	
2001	8.07	16,140	769	88,000	74,712,000	$11.07
2002	8.44	16,880	804	88,000	78,144,000	$10.55
2003	8.61	17,220	820	85,000	77,070,000	$11.09
2004	9.28	18,560	884	83,000	81,257,000	$11.36
2005	10.4	20,800	990	83,000	90,885,000	$11.48
2006	8.64	17,280	823	83,000	75,447,000	$12.24
2007	9.65	19,300	919	82,000	83,312,000	$11.99
2008	11.7	23,400	1,114	83,000	102,256,000	$11.00
Average	9.28	18,533	**883**			**$11.35**

Yield Per Acre: USDA-NASS Noncitrus Fruits & Nuts Summary (2006-08); http://usda.mannlib.cornell.edu/usda/nass/NoncFruiNu//2000s/2009/NoncFruiNu-07-08-2009.pdf
Noncitrus Fruits & Nuts Summary (2003-05); http://usda.mannlib.cornell.edu/usda/nass/NoncFruiNu//2000s/2005/NoncFruiNu-07-06-2005.pdf
Noncitrus Fruits & Nuts Summary (2000-02); http://usda.mannlib.cornell.edu/usda/nass/NoncFruiNu//2000s/2003/NoncFruiNu-07-08-2003_Annual_Summary.pdf

Bearing Acreage: USDA-NASS Noncitrus Fruits & Nuts Summary (2006-08); http://usda.mannlib.cornell.edu/usda/nass/NoncFruiNu//2000s/2009/NoncFruiNu-07-08-2009.pdf
Noncitrus Fruits & Nuts Summary (2003-05); http://usda.mannlib.cornell.edu/usda/nass/NoncFruiNu//2000s/2005/NoncFruiNu-07-06-2005.pdf
Noncitrus Fruits & Nuts Summary (2000-02); http://usda.mannlib.cornell.edu/usda/nass/NoncFruiNu//2000s/2003/NoncFruiNu-07-08-2003_Annual_Summary.pdf

Pullout Costs

Chipping (1)	
	Cost/Acre
Remove Trellis & Stakes (Labor & Equipment)	$508.64
Labor - $259.20, Equipment - $250	
Cut Wire & Remove from Field	$266.00
Labor - $216, Equipment - $50	
Could be multiple wires @ $180/wire	
Push and Pile Cost	$160.00
Chip Stacked Piles	$200.00
20 acres/day (varies)	
Dust Control ~$400/day	$20.00
Remove and Dump Roots and Stumps after Chipping	
~4 tons/acre	
Deliver and dump container at Composter ($225/load)	$90.00
10 tons/load	
$25.00/ton Composting	$100.00
Tractor /labor to load roots into Container	$54.00
Total Cost of Chipping	***$1,398.64***

Pullout Costs

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$25.00/ton Composting	$100.00
Tractor /labor to load roots into Container	$54.00
Total Cost of Chipping	***$1,398.64***

(1) - Commercial grinders state that if they remove non-vegetative material cost = 1,000/acre+, which does not include root and stump removal

Burning	
	Cost/Acre
Cut Wire	$5.40
Push and Pile Cost	$160.00
Burn Permit Fee	$26.00
Burn Control (supervise burn)	$11.82
Remove Roots and Stumps before Burn	
~4 tons/acre	
Tractor/trailer/labor to load roots into piles	$54.00
Remove Steel after Burn	
20 acres/8 hour	$11.82
Total Cost of Burning	***$269.04***

If steel is removed before burn, cost would increase

Burning and chipping costs are derived from growers, chippers, and farm labor contractors.

Table Grapes

Methodology: Cost Study data was collected based on the four most common varieties of table grapes (Thompson Seedless, Crimson Seedless, Red Globe, and Flame). These four varieties constitute approximately 70% of the total shipments of table grapes[1]. The cost study data is from 2007 and the four varieties are the only varieties for which the data exists. Costs are generally consistent across varieties, with the exception of pruning and harvesting. In these cases, costs were averaged across the four varieties to determine the cost for this exercise. In all cases, costs were verified by multiple growers. The cost study data for table grapes is based on 2007 data. Growers estimated that costs have increased approximately 10% since then, with higher costs for water, labor, and fuel being the main factors.

The non-cash overhead costs are based on the repayment of the establishment and other long-term costs of the vineyard. Costs associated with non-cash overhead include: land purchase, tools, fuel tanks, irrigation system, establishment costs, and equipment. Land and establishment costs are based over the 25 years of assumed production of the vineyard. 25 years is the standard production lifetime for a vineyard; after 25 years, the production deteriorates. Many vineyards continue to be in production past the 25 year mark, because growers cannot afford the up-front costs of establishing a new vineyard. The cost study information makes note of the fact that their costs do not take into account the cost of paying the owner a salary. The owner is assumed to be paid on any positive return at the end of the year.

Pullout Costs were calculated based on conversations with growers, chippers, and farm labor contractors. The vineyard trellis system would have a combination of metal stakes and cross arms, as well as multiple support wires which would have to be removed before the vineyard can be chipped. The labor rate used was $8.00 per hour (the state minimum wage), plus 35% to take into account all state and federal taxes, social security deductions, and worker's compensation insurance. The labor rate may be higher depending on the labor conditions. Another issue with chipping is that chippers are not always able to do their work on the farmer's schedule. It can take weeks or even months to have a field chipped, at which point it may be too late to plant for the next season.

The stakes would be removed by three workers operating a loader in the field. Two workers would use chains to remove the stakes and one employee would operate the loader. These workers would be able to complete approximately one acre in an 8 hour workday. When burning, the stakes are piled with the vines, and removed after the burn.

Wire must also be removed from the vineyard before it can be chipped. Depending on the chipper's equipment, wire must be removed completely from the vineyard or must be present only in very short lengths. This presents an issue for vineyards where a cordon is created by wrapping the vine around the wire in the second year. As the vine grows, the wire becomes more and more embedded in the vine, making it impossible to remove. In some trellis systems, there may be as many as four wires embedded in the cordon. Chippers reported this wire causing problems and getting wrapped around the moving

[1] Source: California Table Grape Commission, Total Shipments – 2008.

parts of their machinery. It was also reported that the bio mass facilities prefer not to receive material with wire, because the wire causes havoc with their equipment.

Wire removal is based on the cutting and removal of the wire from the field. For the chipping calculation, the wire removal cost estimate is significantly higher than the wire removal from burning. When wire is removed from a chipped vineyard, the wire has to be cut at every point where it is exposed. An individual wire would be cut between 700 and 800 times (depending on the number of vines in a row) per quarter mile. When burning, the wire has to be cut only once every 4-6 vines. This is only 45-60 per wire per row. The other issue for chipping is the removal of the clips or dog ears that hold the wire in place. These have to be removed from every stake in order to pull out the wire. Additionally, loose wire must also be picked up before the equipment can come into the field. Growers and contractors relayed that the wire removal for a single wire (the main wire) would take approximately 20 man-hours, as well as the use of a tractor or ATV to drive around picking up buckets full of pieces of wire. Each additional wire in the trellis system would cost $180 per wire. A typical trellis system for table grapes would have between 4-8 wires. Growers who are able to burn do not have this issue, as the wire stays with the vine until burned, and can then be picked up with a loader or forklift from the piles. This wire is then loaded onto a truck and taken to a recycling center.

Root removal also differs with regards to chipping or burning. Roots and stumps must be removed from the field before it can be replanted. In a typical vineyard, there will be approximately 4 tons of roots and stumps remaining in the field when the vines are laid over and piled. These roots will have to be excavated using a chisel to get them out of the ground, and hand and machine labor to remove them from the field. When burning, the roots and stumps can be placed into the burn piles along with the above-ground material. When chipping, the roots must be hauled from the field to either a composter or dump. Chippers stated that they do not like to chip roots because of the amount of dirt that is associated. This volume of dirt negatively affects the machinery and causes wear and tear. The rates listed on the attached sheets are for the most cost-effective removal and disposal of the roots. The roots and stumps would be hauled by truck to the composter that charges $25 per ton for the material. This compares favorably to the $60 per ton that was quoted at the waste disposal site.

GR-VS-07-4

UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

2007

SAMPLE COSTS TO ESTABLISH AND PRODUCE

TABLE GRAPES

FLAME SEEDLESS

SAN JOAQUIN VALLEY - SOUTH

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UC COOPERATIVE EXTENSION

SAMPLE COSTS TO ESTABLISH AND PRODUCE TABLE GRAPES

Flame Seedless

San Joaquin Valley – South 2007

CONTENTS

INTRODUCTION

Sample costs to establish a vineyard and produce Flame Seedless table grapes are presented in this study. This study is intended as a guide only, and can be used to make production decisions, determine potential returns, prepare budgets and evaluate production loans. Practices described are based on production practices considered typical for the crop and area, but these same practices will not apply to every farming operation. The sample costs for labor, materials, equipment and custom services are based on current figures. A blank column, "*Your Costs*", in Tables 2 and 3 is provided for entering your costs.

The hypothetical farm operation, production practices, overhead, and calculations are described under the assumptions. For additional information or an explanation of the calculations used in the study call the Department of Agricultural and Resource Economics, University of California, Davis, (530) 752-3589 or your local UC Cooperative Extension office.

Sample Cost of Production Studies for many commodities can be downloaded at http://coststudies.ucdavis.edu, requested through the Department of Agricultural and Resource Economics, UC Davis, (530) 752-1517 or obtained from the local county UC Cooperative Extension offices. Some archived studies are also available on the website.

The University of California and the United States Department of Agriculture, Risk Management Agency, cooperating.

ASSUMPTIONS

The assumptions refer to Tables 1 to 8 and pertain to sample costs to establish a vineyard and produce Flame Seedless table grapes in the San Joaquin Valley. The cultural practices shown represent production operations and materials considered typical of a well-managed vineyard in the region. Costs, materials, and practices in this study will not apply to all farms. Timing of and types of establishment and cultural practices will vary among growers within the region and from season to season due to variables such as weather, soil, and insect and disease pressure. **The use of trade names and cultural practices in this report does not constitute an endorsement or recommendation by the University of California nor is any criticism implied by omission of other similar products or cultural practices.**

Farm. The hypothetical farm consists of 120 contiguous acres. Vineyard establishment and Flame Seedless table grape production is on 40 acres. Other vineyards are on 75 acres and roads, irrigation systems, and farmstead occupy five acres. The farm is owned and managed by the grower.

Establishment Cultural Practices & Material Inputs
(Table 1)

Site Preparation. This vineyard is established on ground previously planted to vineyards or orchards. Land coming from vines or trees should be fallowed for two years except for a possible grain crop. The land is assumed to be fairly level. A custom operator chisels the ground (subsoils) twice to a depth of 4-5 feet. The grower floats the land to smooth and level the surface. Afterwards the ground is disced twice to apply and incorporate preplant herbicide. Nematode samples should be taken from land formerly in vines or trees and fumigated if necessary. Most operations that prepare the vineyard for planting are done in the year prior to planting, but costs are shown in the first year.

Plant. Planting the vineyard starts by laying out and marking vine sites in early spring. Holes are dug and vines planted and a two-inch by two-inch cardboard carton placed around the vine. In the second year, 2% or 10 vines per acre are replaced.

Vines. The Flame Seedless plants are dormant, bench-grafted rootstock vines purchased from a commercial nursery. The grapevines are planted during the first spring on a 7-foot x 12-foot spacing (vine x row) with 518 vines per acre. Vines are trained during the first and second years to quadrilateral cordons. The grapevines will begin yielding fruit in the third year and then be productive for an additional 22 years.

Trellis System. A commercial company installs the trellis system in the second year. The trellis system will be removed when the vineyard is removed; therefore it is considered part of the vineyard and included in the establishment costs. Materials for the open gable trellis are as follows: (1) Stakes with V structure are placed every 24-feet down the row. Metal stakes (2 lbs/ft strength) are 8.5-feet long and placed in the ground 3-feet. The open gable is 72-inches wide from tip to tip. (2) End assemblies consist of 9.5-foot metal post (4 lb/ft) with a V that matches those within the row and with 10-inch helix anchor. (3) Eight wires, 12.5 gauge high tensile, are used for canopy and cordon support; three wires, 14 gauge high tensile, are used for movable catch wires and drip hose support. For growers planting and training vines in the first year for harvest in the second year, trellis installation should be completed in the first year and the cost shown accordingly.

Train/Prune. Vines are pruned to one two bud spur in the first dormant season (December to February, January in this study).

Train. The following spring (second year), a single shoot is selected and trained up the stake to form the permanent structure of the vine. Training consists of tying the shoot; removing lateral shoots from the base and tipping the shoot when it reaches desired cordon height. Most of the training costs occur during the second summer. The third summer is devoted to training missing vines or vines delayed in growth.

Prune. In the third year (January), vines are pruned much like an established vine. The exception is that in the third year the cordons are essentially canes; therefore, short spurs or no spurs are left at node positions. With mature vines 6 two bud spurs are retained on each of the four cordons. Prunings are placed in the row middles and shredded. Selecting and tying canes to fruiting wires is required each year for the life of the vineyard. Suckers from vine trunks are removed in April, a practice that continues each year but diminishes as the vineyard matures.

Irrigate. Water pumping costs plus labor constitute the irrigation cost. In this study, water is calculated to cost $4.59 per acre-inch or $55.08 per acre-foot. The pumping cost is based on a 40 horsepower (HP) motor to pump from 130 feet deep. The vineyard is irrigated during the growing season from April through October during the establishment years. Price per acre-foot of water will vary by grower in this region depending on quantity used, water district, power cost, various well characteristics, and other irrigation factors. The amount of water applied to the vineyard varies through the establishment years and is shown in Table A.

Table A. Irrigation Water Applied

Year	AcIn/Year
1	8
2	18
3+	36

Fertilize. Liquid nitrogen fertilizer, UN32, is applied through the irrigation system in April of the first year at five pounds of N per acre. A single application is made in April of the second year. The amount of nitrogen applied each year increases as the vineyard matures and is shown in Table B. It is important to identify sources of nitrogen in order to properly manage the nitrogen budget. For example, sources of nitrogen such as irrigation well water should be calculated to determine future irrigation and fertilizer needs.

Table B. Applied Nitrogen (N) Per Acre

Year	Lbs of N
1	5
2	25
3+	50

Pest Management. For pest identification, monitoring, management and pesticide information, visit the UC IPM website at www.imp.ucdavis.edu. Written recommendations are required for many commercially applied pesticides, and are available from licensed pest control advisers (PCAs). For information on pesticide use permits, contact the local county Agricultural Commissioner's office. **Pesticides mentioned in this study are used to calculate rates and costs. Although the pesticides mentioned are commonly used by growers, many other pesticides are available. Check with your PCA and/or the UC IPM website for current recommendations.**

Weeds (Vineyard Floor Management). In October of the year prior to planting, Treflan is applied to the vineyard floor and incorporated by discing. After planting, weeds in the vine rows and middles are managed with discing, mowing, and/or herbicides. From March through July of the first year, the row middles are disced twice and mowed twice. The vine rows are hand weeded in April. The row middles are mowed three to four times during the growing season starting the second year. The vine rows are sprayed (strip spray) in January of the second year with Roundup and Surflan. The strip spray is applied to 30% of the acreage. Also in the second year, spot sprays using Roundup are applied to the vine row in April, June, and July. The spot sprays (weedy spots or areas) are applied using an all terrain vehicle (ATV) with a sprayer attached.

Insects. Beginning in the second year, western grapeleaf skeletonizer (*Harrisina brillians*) is controlled in April with an application of Kryocide insecticide (mixed with micronized sulfur sprays). Additionally insects such as mealybugs are monitored each year beginning in the spring and may increase production costs if found.

If mealybugs (*Pseudococcus sp.*) are found during vineyard establishment, the grower should consult with a PCA, farm advisor, and/or ag commissioner to develop management strategies.

Diseases. Although many pathogens attack grapevines, phomopsis cane and leafspot (*Phomopsis viticola)* and powdery mildew (*Erisphe necator)* are the two diseases managed in this study. In April of the second and third years, Microthiol plus Abound (strobilurin) are applied for phomopsis and mildew control. Mildew is controlled with various fungicide applications at 7 to 21 day intervals in the third year, depending on the fungicide used. For this study, the grower applies Kocide (copper), Rubigan (SI) mixture, and two Microthiol applications (one with Kryocide) in April; one Rubigan (SI) application and two dusting sulfur applications in May; one Rubigan (SI) application and two dusting sulfur applications in June. Growers have the option of using sulfur (dust, wettable, flowable or micronized), sterol inhibitors (SIs), or strobilurins, as well as other fungicides to control powdery mildew. Sterol inhibitors and strobilurins are two classes of fungicides with different modes of action than sulfur against powdery mildew. It is recommended that fungicides with different modes of action be used to avoid powdery mildew populations from developing fungicide resistance.

Vertebrate. Rabbits, gophers, squirrels and coyotes are pests that can cause damage to the vines and irrigation lines. Various forms of control such as baiting, trapping and/or building a rabbit fence are utilized as necessary throughout the year. For this study no specific control is used, but an estimated cost for one or two management practices are shown in March. Endangered Species: It is important to know if your vineyard is located in an area where endangered species reside (i.e. San Joaquin Kit Fox). Trapping and killing endangered species can result in fines. Contact your County Agricultural Commissioner for additional information.

Harvest/Yield/Returns. Growers sometimes plant and train vines in the same year, which produces a harvestable Flame Seedless table grape crop in the second year. Yields in the third year are approximately 50 to 75% of mature production. For this study, 400 boxes (19 pounds per box) of table grapes are assumed in the third year. If the crop in the third year is harvested for wine, a labor contractor may be needed.

Mature Production Cultural Practices and Material Inputs
(Tables 2-8)

Prune/Sucker/Canopy Management (CM). The quad-cordon trained vines are spur-pruned during the winter months (January) and the prunings are placed in the row middles and shredded. Suckers and sterile shoots are removed from the vine trunks and crowns in early April. Shoot thinning, shoot positioning and basil leaf removal are done by hand in April. Mechanical cane cutting (canopy skirting) is done in June with the grower's equipment.

Fruit Management (FM). Gibberellic acid (GA), a growth regulator, is applied at 6 grams per acre during bloom in May for blossom thinning (combined with mildew spray). GA is applied two times at 48 grams per acre for each application to increase berry size. The first application is applied at completion of shatter, about two weeks after full bloom (June) (combined with mildew spray) and the second spray is applied a week later (combined with mildew and insect spray). Gibberellic acid rates should be reduced for berry sizing when color development has been a historical problem. Vines are girdled to increase berry size 2 to 3 weeks after full bloom (June). Cluster tipping and hand thinning are done in late May to early June to loosen clusters and adjust cluster length and crop load. The growth regulator, Ethrel, is applied in late June to color the fruit.

Trellis/Vines. Trellis repairs are done annually (January in this study) and the cost is not taken from any specific data. Weak or missing vines are replaced by layering which is usually not an issue until the vineyard is over 10 years old. One year-old canes from neighboring vines are buried (layered) in the soil next to the stake. These vines are trained the following spring. The layer is severed after 3 to 4 years when the new vine is fully established. Trellis repair and vine replacement increases with vineyard age.

Irrigate. The vineyard is irrigated during the growing season from April through October. Deficit irrigation (80% ET) may be applied post harvest to promote vine growth and vine maturity. Deficit irrigation may also be applied three to four weeks before harvest to advance maturity and decrease decay. Deficit irrigation may not work well on weak or low vigor vineyards. Water pumping costs plus labor constitute the irrigation cost. In this study, water is calculated to cost $4.59 per acre-inch or $55.08 per acre-foot. The pumping cost is based on a 40 horsepower (HP) motor to pump from 130 feet depth and pressurized to 20 psi. A total of 36 acre-inches is applied to the vineyard. Price per acre-foot of water will vary by grower in this region depending on quantity used, water district, power cost, various well characteristics, and other irrigation factors.

Fertilize. Nitrogen (N) at 50 pounds per acre as UN32 is applied through the irrigation drip system in April or post harvest. Neutral zinc is applied to prevent zinc deficiencies and is combined with the late April mildew (Microthiol, Rally) application.

Pest Management. The pesticides and rates mentioned in this cost study are listed in *UC Integrated Pest Management Guidelines, Grapes*. For information on other pesticides available, pest identification, monitoring, and management visit the UC IPM website at www.ipm.ucdavis.edu. For information and pesticide use permits, contact the local county agricultural commissioner's office. **Pesticides mentioned in this study are used to calculate rates and costs. Although the pesticides mentioned are commonly used by growers, many other pesticides are available. Check with your PCA and/or the UC IPM website for current recommendations.** Adjuvants are recommended for use with many pesticides for effective control, but the adjuvants and their costs are not included in this study. Pesticide costs may vary by location, brand, and grower volume. Pesticide costs in this study are taken from a single dealer and shown as full retail.

Pest Control Adviser (PCA). Written recommendations are required for many commercially applied pesticides and are written by licensed pest control advisers. In addition the PCA will monitor the field for agronomic problems including pests, diseases, and nutritional status. Growers may hire private PCA's or receive the service as part of a service agreement with an agricultural chemical and fertilizer company. Costs for a PCA are not included in this study.

Weeds (Vineyard Floor Management). Vineyard middles are mowed three times each season: March, May, July. Surflan and Roundup herbicides are applied to the vine row/berm in February. Roundup, a contact herbicide, is applied as a spot spray to the vine row in June.

Insects. Mealybugs (*Pseudococcus sp.*) are treated with Lorsban insecticide in March (dormant vines). Western grapeleaf skeletonizer (*Harrisina brillians*) is treated with Kryocide (mixed with Microthiol, Flint) during the first bloom spray in May. Grape leafhoppers (*Erythroneura elegantula*) are controlled with Provado insecticide (mixed with GA, Microthiol, Rally) during the second berry sizing spray in June. An effective alternative material for mealybugs is to apply Admire insecticide through the drip system, but at a higher cost than a Lorsban application. If mealybugs are found, they should be identified in order to determine if additional management strategies will be needed.

Diseases. Diseases treated in this study are phomopsis cane and leafspot (*Phomopsis viticola)* and powdery mildew (*Ersiphe necator).* Phomopsis and powdery mildew are both treated in late March (shoot length averages 2-inches) with Abound and Microthiol (micronized sulfur). Mildew is controlled during the season with various fungicide applications at 7 to 21 day intervals, depending on the fungicide used. In this study, sulfur dust is applied three times - April, June, July. Microthiol and Rally, an SI, (with zinc) are applied in late April. Microthiol and Flint (with Kryocide) are applied with the first bloom spray in May. Microthiol (with GA) is applied at the second bloom spray in May. Rally and Microthiol (with GA) are applied during the first berry sizing in June and Microthiol and Rally (with GA, Provado) during the second berry size spray in June. Growers have the option of using sterol inhibitors (SI), quinolins, strobilurins, or sulfur (micronized, wettable, dust, flowable), as well as other fungicides to control powdery mildew. These materials are classes of fungicides with different modes of action. Check the IPM website under grapes for management options to control powdery mildew. It is recommended that applicators use fungicides with different modes of action in order to avoid fungicide resistance in powdery mildew populations.

Vertebrate. Gophers, squirrels coyotes and birds are pests that can cause damage to the vines and irrigation lines. Various forms of control such as baiting, trapping and/or shooting are utilized as necessary throughout the year. For this study no specific control is used, but per acre costs are shown from March through October and are an estimate not based on any specific data. Endangered Species: It is important to know if your vineyard is located in an area where endangered species reside (i.e. San Joaquin Kit Fox). Trapping and killing endangered species can result in fines. Contact your County Agricultural Commissioner for additional information.

Harvest. The crop is picked beginning in July or August and packed in the field. Harvest crews work in teams of three or four. Depending on crop quality, the team can pick and pack an average of 3 to 6 boxes per hour per individual. For this study, we use four packed boxes per hour per individual. Two or three pickers field pick and trim the grapes, and put them in reusable field boxes. Approximately four field boxes are loaded on a wheelbarrow type cart and delivered to the packing person who trims, puts them in bags that are then placed in shipping boxes. The box holds 9 bags and weighs 19 pounds when filled. The packed boxes are loaded on a truck and hauled to storage. The swamp and haul cost includes the boxes, plastic bags, hauling and related labor. Pre cooling and palletization (P&P) costs may in some cases be a grower cost but are generally charged to the buyer. After 30 days of cold storage, the grower is charged approximately $0.35 per box per month ($0.25-0.45) until the fruit is sold. Brokerage fees are paid by the grower and range from 7 to 10% of the selling price. A figure of 9% of the selling price is used in this study.

Table C: Table Grapes (all varieties)

Average Yields	
Year	Tons/Acre (boxes)
2002	8.13 (856)
2003	7.60 (800)
2004	7.76 (815)
2005	11.34 (1,194)
2006	9.66 (1,016)

Source: Fresno County Crop Reports, 2002-2006.
Boxes = 19 lbs.

Yields. This study uses an average yield of 700, 19-pound boxes over the productive life of the vineyard to calculate returns. Average county yields for all table grape varieties are shown in Table C. The averages include all vineyards in production regardless of maturity and varieties.

Returns. Return prices for grapes at different yields and prices are shown in Table 5. Based on grower information, an estimated price of $12 per box for Flame grapes is used in this study.

Assessments/Inspection. The California Table Grape Commission (CTGC) assesses $0.1156 per 19-pound box or $0.006087 per pound. Early in the season, growers often have the county Agricultural Commissioner inspect their fruit for maturity at a cost of $0.035 per box. Approximately one-third of the entire crop is inspected to determine that maturity requirements are met, which includes soluble solids:acid ratios (20:1) and color.

Pickup/ATV. It is assumed that the grower uses the pickup for business and personal use. Estimated business mileage for the ranch is 5,250 miles. The all terrain vehicle (ATV) is used for spot spraying weeds and is included in that cost. It is assumed that the ATV will be used two hours per acre for checking the vineyards including the irrigation system.

Labor. Hourly wages for workers are $11.00 for machine operators and $8.50 per hour non-machine labor. Adding 33% for the employer's share of federal and state payroll taxes, workers compensation insurance for vine crops (0040) and other possible benefits gives the labor rates shown of $14.63 and $11.31 per hour for machine labor and non-machine labor, respectively. Workers' compensation costs will vary among growers, but for this study the cost is based upon the average industry final rate as of January 1, 2007 (personal email from California Department of Insurance, May 18, 2007, unreferenced). Labor for operations involving machinery are 20% higher than the operation time given in Table 2 to account for the extra labor involved in equipment set up, moving, maintenance, work breaks, and field repair.

Equipment Operating Costs. Repair costs are based on purchase price, annual hours of use, total hours of life, and repair coefficients formulated by the American Society of Agriculture Engineers (ASAE). Fuel and lubrication costs are also determined by ASAE equations based on maximum PTO horsepower, and fuel type. . Prices for on-farm delivery of diesel and gasoline are $2.30 and $2.80 per gallon, respectively. Fuel costs are derived from American Automobile Association (AAA) and Energy Information Administration 2006 monthly data. The cost includes a 2.25% sales tax (effective September 2001) on diesel fuel and 7.25% sales tax on gasoline. Gasoline also includes federal and state excise tax, which can be refunded for on-farm use when filing your income tax. The fuel, lube, and repair cost per acre for each operation in Table 2 is determined by multiplying the total hourly operating cost in Table 7 for each piece of equipment used for the selected operation by the hours per acre. Tractor time is 10% higher than implement time for a given operation to account for setup, travel and down time.

Interest on Operating Capital. Interest on operating capital is based on cash operating costs and is calculated monthly until harvest at a nominal rate of 10.00% per year. A nominal interest rate is the typical market cost of borrowed funds. The interest cost of post harvest operations is discounted back to the last harvest month using a negative interest charge. The rate will vary depending upon various factors, but the rate in this study is considered a typical lending rate by a farm lending agency as of January 2007.

Risk. The risks associated with crop production should not be minimized. While this study makes every effort to model a production system based on typical, real world practices, it cannot fully represent financial, agronomic and market risks, which affect profitability and economic viability. Growers may purchase Federal crop insurance to reduce the production risk associated with specific natural hazards. Insurance policies vary and range from a basic catastrophic loss policy to one that insures losses for up to 75% of a crop. Insurance costs will depend on the type and level of coverage.

Cash Overhead

Cash overhead consists of various cash expenses paid out during the year that are assigned to the whole farm and not to a particular operation.

Property Taxes. Counties charge a base property tax rate of 1% on the assessed value of the property. In some counties special assessment districts exist and charge additional taxes on property including equipment, buildings, and improvements. For this study, county taxes are calculated as 1% of the average value of the property. Average value equals new cost plus salvage value divided by 2 on a per acre basis.

Insurance. Insurance for farm investments varies depending on the assets included and the amount of coverage. Property insurance provides coverage for property loss and is charged at 0.714% of the average value of the assets over their useful life. Liability insurance covers accidents on the farm and costs $674 for the entire farm.

Office Expense. Office and business expenses are estimated at $80 per producing acre or $9,200 annually for the ranch. These expenses include office supplies, telephones, bookkeeping, accounting, legal fees, road maintenance, etc.

Sanitation Services. Sanitation services provide double portable toilets with washbasins for 10 months. The cost includes delivery and weekly cleaning service. The number of sanitation facilities will vary depending upon local regulations and size of labor force. In many cases labor contractors furnish the sanitation facilities for their crews and the costs are included in the contractor's labor overhead.

Management/Supervisor Wages. Salary is not included. Returns above costs are considered a return to management

Investment Repairs. Annual maintenance is calculated as 2% of the purchase price.

Non-Cash Overhead Costs

Non-cash overhead is calculated as the capital recovery cost for equipment and other farm investments.

Capital Recovery Costs. Capital recovery cost is the annual depreciation and interest costs for a capital investment. It is the amount of money required each year to recover the difference between the purchase price and salvage value (unrecovered capital). It is equivalent to the annual payment on a loan for the investment with the down payment equal to the discounted salvage value. This is a more complex method of calculating ownership costs than straight-line depreciation and opportunity costs, but more accurately represents the annual costs of ownership because it takes the time value of money into account (Boehlje and Eidman). The formula for the calculation of the annual capital recovery costs is ((Purchase Price – Salvage Value) x Capital Recovery Factor) + (Salvage Value x Interest Rate).

Salvage Value. Salvage value is an estimate of the remaining value of an investment at the end of its useful life. For farm machinery (tractors and implements) the remaining value is a percentage of the new cost of the investment (Boehlje and Eidman). The percent remaining value is calculated from equations developed by the American Society of Agricultural Engineers (ASAE) based on equipment type and years of life. The life in years is estimated by dividing the wear out life, as given by ASAE by the annual hours of use in this operation. For other investments including irrigation systems, buildings, and miscellaneous equipment, the value at the end of its useful life is zero. The salvage value for land is the purchase price because land does not depreciate. The purchase price and salvage value for equipment and investments are shown in Table 6.

Capital Recovery Factor. Capital recovery factor is the amortization factor or annual payment whose present value at compound interest is 1. The amortization factor is a table value that corresponds to the interest rate used and the life of the machine.

Interest Rate. An interest rate of 7.25% is used to calculate capital recovery. The rate will vary depending upon loan amount and other lending agency conditions, but is the basic suggested rate by a farm lending agency as of January 2007.

Land. The land was formerly a vineyard, but has been out of production for two years. The open land was planted to grain crops. Land in the San Joaquin Valley with table grape production ranges from $6,000 to $13,400 per acre (depending on vineyard age, variety and location). Cropland with district or well water in the area ranges from $2,500 to $12,000. For this study, the land value was established based on 2007 real estate values (2007 Trends & Leases); therefore a cost of $7,000 per acre or $7,304 per producing acre is used.

Tools. This is an assumed value for shop, hand, and miscellaneous field tools and not based on any grower's tool inventory.

Fuel Tanks. Two 300-gallon fuel tanks using gravity feed are on metal stands. The tanks are setup in a cement containment pad that meets federal, state, and county regulations.

Drip Irrigation System. The drip lines, filters, booster pump and the labor to install the components are included in the irrigation system cost. The previous vineyard is assumed to have a pumping system that had been refurbished and therefore is not included as a cost. Water is delivered from a 130-foot depth using a 40-horsepower pump. The drip irrigation lines are laid directly on the ground prior to planting and the labor cost is included in the drip irrigation system cost.

Establishment Cost. The establishment cost is the sum of the costs for land preparation, trellis system, planting, vines, cash overhead and production expenses for growing the vines through the third year, the first year that grapes are harvested. It is used to determine the non-cash overhead expense, capital recovery cost, during the production years. In this study, no crop was produced in the second year; therefore, the Total Accumulated Net Cash Cost on Table 1, in the third year represents the establishment cost. For this study the cost is $7,207 per acre or $288,280 for the 40 producing acres. The establishment cost is spread over the remaining 22 years of the 25 years the vineyard is in production.

Equipment. Farm equipment is purchased new or used, but the study shows the current purchase price for new equipment. The new purchase price is adjusted to 60% to indicate a mix of new and used equipment. Annual ownership costs for equipment and other investments are shown in Table 6. Equipment costs are composed of three parts: non-cash overhead, cash overhead, and operating costs. Both of the overhead factors have been discussed in previous sections. The operating costs consist of repairs, fuel, and lubrication and are discussed under operating costs.

Table Values. Due to rounding, the totals may be slightly different from the sum of the components.

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For information concerning the above or other University of California publications, contact your local county UC Cooperative Extension office or UC DANR Communications Services online at http://ucanr.org .

UC COOPERATIVE EXTENSION

Table 1. COSTS PER ACRE TO ESTABLISH A FLAME SEEDLESS TABLE GRAPE VINEYARD

SAN JOAQUIN VALLEY SOUTH - 2007

	Cost Per Acre		
Year:	1st	2nd	3rd
Boxes Per Acre:	0	0	400
Planting Costs:			
Site Prep: Subsoil 2X	400		
Site Prep: Float (Level)	12		
Site Prep: Disc/Apply Herbicide (Treflan)	17		
Site Prep: Disc/Incorporate Herbicide	12		
Plant: Survey & Layout Vineyard	70		
Plant: Plant, Wrap Vines	166	2	
Vines: 518 Per Acre (2% Replant In 2nd Year)	1,606	31	
Trellis: Trellis System (custom)		4,000	
TOTAL PLANTING COSTS	2,282	4,033	
Cultural Costs:			
Vertebrate: (Rabbit, Gopher, Squirrel)	40	15	15
Fertilize: Nitrogen (UN32)	3	12	23
Irrigate: Water/Labor	54	107	181
Weed: Disc Middle - 2X/Yr 1	16		
Weed: Mow Middle - 2X/Yr 1, 4X/Yr 2, 3X/Yr 3	16	31	24
Weed: Hand Hoe	34		
Prune: Dormant		73	79
Training: (Sucker, Tie)		271	136
Insect: Skeletonizer (Kryocide). **Disease**: Mildew (Microthiol)		36	36
Weed: Spot Spray (Roundup)		42	42
Weed: Winter Strip Spray (Roundup, Surflan)		53	53
Prune: Shred prunings			15
Disease: Phomopsis (Microthiol, Abound)			51
Disease: Mildew Control (Microthiol)			20
Insect: Leafhoppers 1X (Provado)			46
Disease: Mildew (Kocide, Rubigan)			50
Disease: Mildew 4X (Sulfur Dust)			39
Disease: Mildew 2X, (Rubigan)			56
Pickup: Business use	82	82	82
ATV: Field use	30	38	38
TOTAL CULTURAL COSTS	274	761	985
Harvest Costs:			
Pick & Field Pack (labor)			1,131
Spread/Stack boxes, Swamp, Haul (includes boxes, bags, labor)			921
Brokerage Fee			432
Assessment & Inspection Fees			51
TOTAL HARVEST COSTS			2,535
Interest On Operating Capital @ 10.00%	210	373	54
TOTAL OPERATING COSTS/ACRE	2,539	5,163	3,573
Cash Overhead Costs:			
Office Expense	80	80	80
Liability Insurance	6	6	6
Sanitation Service	19	19	19
Property Taxes	85	87	88
Property Insurance	9	10	11
Investment Repairs (non-cash overhead items)	42	42	42
TOTAL CASH OVERHEAD COSTS	242	244	246
TOTAL CASH COSTS/ACRE	2,781	5,407	3,819
INCOME/ACRE FROM PRODUCTION	0	0	4,800
NET CASH COSTS/ACRE FOR THE YEAR	2,781	5,407	0
PROFIT/ACRE ABOVE CASH COSTS	0	0	981
ACCUMULATED NET CASH COSTS/ACRE	2,781	8,187	**7,207**

UC COOPERATIVE EXTENSION

Table 1. continued

	Cost Per Acre		
Year:	1st	2nd	3rd
Boxes Per Acre:	0	0	400
Non-Cash Overhead Costs (Capital Recovery):			
Land	530	530	530
Irrigation System	110	110	110
Shop Building	57	57	57
Shop Tools	14	14	14
Fuel Tank & Pump	2	2	2
Equipment	37	74	90
TOTAL CAPITAL RECOVERY COST	751	787	803
TOTAL COST/ACRE FOR THE YEAR	3,531	6,194	4,623
INCOME/ACRE FROM PRODUCTION	0	0	4,800
TOTAL NET COST/ACRE FOR THE YEAR	3,531	6,194	0
NET PROFIT/ACRE ABOVE TOTAL COST	0	0	177
TOTAL ACCUMULATED NET COST/ACRE	3,531	9,726	9,548

UC COOPERATIVE EXTENSION

Table 2. COSTS PER ACRE TO PRODUCE FLAME TABLE GRAPES

SAN JOAQUIN VALLEY SOUTH - 2007

Operation **Bold** indicates corresponding section in assumptions	Operation Time (Hrs/A)	Cash and Labor Cost per acre: Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
Cultural:							
Vine: Layering Missing Vines	1.00	11	0	0	0	11	
Prune: Vines	15.00	170	0	0	0	170	
Prune: Brush Disposal	0.50	9	7	0	0	15	
Trellis: Repair	2.00	23	0	10	0	33	
Weed: Winter Strip (Surflan, Roundup)	0.49	9	5	40	0	53	
Vertebrate: Gopher, Squirrel, Coyote, Bird (various methods)	0.00	0	0	15	0	15	
Insect: Mealybug (Lorsban)	0.50	9	7	25	0	41	
Disease: Phomopsis (Abound)/Mildew (Microthiol)	0.50	9	7	35	0	51	
Weed: Mow Middles 3X	0.74	13	11	0	0	24	
Disease: Mildew 3X (Dusting Sulfur)	0.84	15	9	6	0	30	
Sucker: Remove Trunk Suckers	2.00	23	0	0	0	23	
Disease: Mildew (Rally, Microthiol). **Fertilize**: Foliar Zinc (Neutral Zinc)	0.50	9	7	28	0	44	
Fertilize: N through drip system (UN32)	0.00	0	0	23	0	23	
Irrigate: (Water)	2.55	29	0	165	0	194	
***CM**: Shoot Thin/Position & Leaf Removal	50.00	566	0	0	0	566	
Disease: Mildew (Microthiol, Flint). **Insect**: Skeletonizer (Kryocide)	0.50	9	7	52	0	68	
***FM**: Bloom Thin (GA). **Disease**: Mildew (Microthiol)	0.50	9	7	12	0	27	
FM: Berry Size (GA). **Disease**: Mildew (Rally, Microthiol)	0.50	9	7	103	0	119	
CM: Cane Cutting (Mechanical)	0.29	5	3	0	0	8	
FM: Cluster Tipping and Thinning	20.00	226	0	0	0	226	
FM: Girdling	12.00	136	0	0	0	136	
FM: Berry Size:(GA). **Disease**: Mildew (Rally, Microthiol). **Insect**: Leafhopper (Provado)	0.50	9	7	147	0	163	
Weed: Spot Spray (Roundup)	0.53	9	1	4	0	14	
FM: Color Fruit (Ethrel)	0.50	9	7	8	0	24	
Pickup: Business Use	2.39	42	40	0	0	82	
ATV: Irrigation and other	2.00	35	3	0	0	38	
TOTAL CULTURAL COSTS/ACRE	116.33	1,389	132	675	0	2,196	
TOTAL CULTURAL COSTS/Box		1.98	0.19	0.96	0.00	3.14	
Harvest (400 boxes/acre):							
Pick and Field Pack	175.00	1,979	0	0	0	1,979	
Boxes, Spread, Swamp & Haul	1.25	254	10	1,341	0	1,604	
Brokerage Fee	0.00	0	0	0	756	756	
Assessment & Inspection Fees	0.00	0	0	89	0	89	
TOTAL HARVEST COSTS/ACRE	176.25	2,233	10	1,430	756	4,429	
TOTAL HARVEST COSTS/Box		3.19	0.01	2.04	1.08	6.33	
Interest on operating capital @ 10.00%						114	
TOTAL OPERATING COSTS/ACRE		3,622	142	2,104	756	6,739	
TOTAL OPERATING COSTS/Box		5.17	0.20	3.01	1.08	9.63	
CASH OVERHEAD:							
Office Expense						80	
Liability Insurance						6	
Sanitation Fees						19	
Property Taxes						125	
Property Insurance						37	
Investment Repairs						42	
TOTAL CASH OVERHEAD COSTS						309	
TOTAL CASH COSTS/ACRE						7,048	

*CM = Canopy Management. FM = Fruit Management.

**To find cost per box divide by 700

UC COOPERATIVE EXTENSION

Table 2. continued

Operation	Operation Time (Hrs/A)	Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
		Cash and Labor Cost per acre					
NON-CASH OVERHEAD:		Per producing Acre		-- Annual Cost -- Capital Recovery			
Land		7,304		530		530	
Drip Irrigation System		1,250		110		110	
Building		696		57		57	
Tools-Shop/Field		130		14		14	
Fuel Tanks 2-300G		30		2		2	
Vineyard Establishment		7,207		665		665	
Equipment		765		103		103	
TOTAL NON-CASH OVERHEAD COSTS		17,383		1,481		1,481	
TOTAL COSTS/ACRE						8,529	
TOTAL COSTS/box						12.18	

UC COOPERATIVE EXTENSION

Table 3. MATERIAL & CUSTOM COSTS & NET RETURN PER ACRE FOR FLAME TABLE GRAPES

SAN JOAQUIN VALLEY SOUTH - 2007

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
GROSS RETURNS					
Flame Seedless Table Grapes (19 lb box)	700.00	box	12.00	8,400	
OPERATING COSTS					
Trellis System:					
Miscellaneous Repair Materials	1.00	acre	10.00	10	
Herbicide:					
Surflan 4 AS	2.40	pint	14.52	35	
Roundup Ultra Max	1.10	pint	7.80	9	
Fungicide:					
Abound (Strobilurin)	12.00	floz	2.86	34	
Microthiol Disperss (micronized wettable sulfur)	10.00	lb	0.83	8	
Dusting Sulfur	30.00	lb	0.22	6	
Rally 40W (Sterol Inhibitor)	12.00	oz	5.23	63	
Flint (Strobilurin)	2.00	oz	16.50	33	
Vertebrate Control:					
Shoot, Bait, Trap	1.00	acre	15.00	15	
Insecticide:					
Lorsban 4E	4.00	pint	6.35	25	
Kryocide	6.00	lb	3.08	18	
Provado 1.6 Solupak	1.00	oz	44.21	44	
Fertilizer:					
Neutral Zinc 50% (foliar)	5.00	lb	1.08	5	
UN 32	50.00	lb N	0.46	23	
Water:					
Water Pumped	36.00	acin	4.59	165	
Growth Regulator:					
ProGibb 4% (Gibberelic Acid)	102.00	grams	1.68	171	
Ethrel	1.00	pint	8.04	8	
Harvest Supplies:					
Box 19 lb	700.00	box	1.60	1,120	
Plastic Bags 9/box	6,300.00	box	0.04	221	
Contract:					
Brokerage Fee (9% of selling price)	700.00	box	1.08	756	
Assessment:					
Table Grape Commission	700.00	box	0.12	81	
Quality Inspection (1/3 of yield)	233.00	box	0.04	8	
Labor (machine)	15.63	hrs	14.63	229	
Labor (non-machine)	300.05	hrs	11.31	3,394	
Fuel - Gas	11.78	gal	2.80	33	
Fuel - Diesel	23.49	gal	2.30	54	
Lube				13	
Machinery repair				42	
Interest on operating capital @ 10.00%				114	
TOTAL OPERATING COSTS/ACRE				6,739	
NET RETURNS ABOVE OPERATING COSTS				1,661	
CASH OVERHEAD COSTS:					
Office Expense				80	
Liability Insurance				6	
Sanitation				19	
Property Taxes				125	
Property Insurance				37	
Investment Repairs				42	
TOTAL CASH OVERHEAD COSTS/ACRE				309	
TOTAL CASH COSTS/ACRE				7,048	

UC COOPERATIVE EXTENSION
Table 3. continued

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
NON-CASH OVERHEAD COSTS (Capital Recovery)					
Land				530	
Drip Irrigation System				110	
Building				57	
Tools-Shop/Field				14	
Fuel Tanks 2-300G				2	
Establishment Costs				665	
Equipment				103	
TOTAL NON-CASH OVERHEAD COSTS/ACRE				1,481	
TOTAL COSTS/ACRE				8,529	
NET RETURNS ABOVE TOTAL COSTS				-129	

UC COOPERATIVE EXTENSION

Table 4. MONTHLY CASH COSTS PER ACRE to PRODUCE FLAME TABLE GRAPES

SAN JOAQUIN VALLEY SOUTH - 2007

Beginning JAN 07 Ending DEC 07	JAN 07	FEB 07	MAR 07	APR 07	MAY 07	JUN 07	JUL 07	AUG 07	SEP 07	OCT 07	NOV 07	DEC 07	TOTAL
Cultural: **Bold** = see section in assumptions													
Vine: Layering Missing Vines	11												11
Prune: Vines	170												170
Prune: Brush Disposal	15												15
Trellis: Repair	33												33
Weed: Winter Strip (Surflan, Roundup)		53											53
Vertebrate: Gopher, Squirrel, Coyote, Bird (various methods)			2	2	2	2	2	2	2	2			15
Insect: Mealybug (Lorsban)			41										41
Disease: Phomopsis (Abound)/Mildew (Microthiol)			51										51
Weed: Mow Middles 3X			8		8		8						24
Disease: Mildew 3X (Dusting Sulfur)				10		10	10						30
Sucker: Remove Trunk Suckers				23									23
Disease: Mildew (Rally, Microthiol). **Fertilize**: Foliar Zinc (Neutral Zinc)				44									44
Fertilize: N through drip system (UN32)				23									23
Irrigate: (Water)				6	22	37	48	44	31	6			194
***CM**: Shoot Thin/Position & Leaf Removal				566									566
Disease: Mildew (Microthiol, Flint). **Insect**: Skeletonizer (Kryocide)					68								68
***FM**: Bloom Thin (GA). **Disease**: Mildew (Microthiol)					27								27
FM: Berry Size (GA). **Disease**: Mildew (Rally, Microthiol)						119							119
CM: Cane Cutting (Mechanical)						8							8
FM: Cluster Tipping and Thinning						226							226
FM: Girdling						136							136
FM: Berry Size:(GA). **Disease**: Mildew (Rally, Microthiol). **Insect**: Leafhopper (Provado)						163							163
Weed: Spot Spray (Roundup)						14							14
FM: Color Fruit (Ethrel)						24							24
Pickup: Business Use	7	7	7	7	7	7	7	7	7	7	7	7	82
ATV: Irrigation and other	3	3	3	3	3	3	3	3	3	3	3	3	38
TOTAL CULTURAL COSTS	239	63	111	683	137	749	78	55	43	18	10	10	2,196
Harvest:													
Pick & Field Pack**								1,979					1,979
Boxes, Spread, Swamp & Haul								1,604					1,604
Commission (precool, palletize, store, sell)								756					756
Assessment & Inspection Fees								89					89
TOTAL HARVEST COSTS								4,429					4,429
Interest on operating capital	2	3	3	9	10	17	17	55	-1	0	0	0	114
TOTAL OPERATING COSTS/ACRE	241	66	115	692	147	765	95	4,539	42	18	10	10	6,739
OVERHEAD:													
Office Expense	7	7	7	7	7	7	7	7	7	7	7	7	80
Liability Insurance									6				6
Sanitation Fees	2	2	2	2	2	2	2	2	2	2			19
Property Taxes	62						62						125
Property Insurance	18						18						37
Investment Repairs	4	4	4	4	4	4	4	4	4	4	4	4	42
TOTAL CASH OVERHEAD COSTS	93	12	12	12	12	12	93	12	18	12	10	10	309
TOTAL CASH COSTS/ACRE	334	78	127	704	159	777	188	4,551	60	30	20	20	7,048

*CM = Canopy Management. FM = Fruit Management **In some areas of the valley, the majority of the harvest is in July

UC COOPERATIVE EXTENSION
Table 5. RANGING ANALYSIS
SAN JOAQUIN VALLEY SOUTH - 2007

COSTS PER ACRE AT VARYING YIELD TO PRODUCE FLAME SEEDLESS TABLE GRAPES

	YIELD (19 lb box/acre)						
	400	500	600	700	800	900	1,000
OPERATING COSTS:							
Cultural Cost	2,196	2,196	2,196	2,196	2,196	2,196	2,196
Harvest Cost	2,048	2,560	3,072	3,583	4,095	4,607	5,119
Brokerage Fee	432	540	648	756	864	972	1080
Assessment/Inspection Cost	51	64	77	89	102	115	128
Interest on operating capital	99	104	109	114	120	125	130
TOTAL OPERATING COSTS/ACRE	4,826	5,464	6,102	6,738	7,377	8,015	8,653
Total Operating Costs/box	12.07	10.93	10.17	9.63	9.22	8.91	8.65
CASH OVERHEAD COSTS/ACRE	308	308	308	309	309	309	309
TOTAL CASH COSTS/ACRE	5,134	5,772	6,410	7,047	7,686	8,324	8,962
Total Cash Costs/box	12.84	11.54	10.68	10.07	9.61	9.25	8.96
NON-CASH OVERHEAD COSTS/ACRE	1,472	1,475	1,478	1,481	1,484	1,486	1,489
TOTAL COSTS/ACRE	6,606	7,247	7,888	8,528	9,170	9,810	10,451
Total Costs/box	16.52	14.49	13.15	12.18	11.46	10.90	10.45

NET RETURNS PER ACRE **ABOVE OPERATING COSTS**

PRICE	YIELD (19 lb box/acre)						
$/box	400	500	600	700	800	900	1,000
7.00	-1,626	-1,464	-1,302	-1,138	-977	-815	-653
8.00	-1,226	-964	-702	-438	-177	85	347
9.00	-826	-464	-102	262	623	985	1,347
10.00	-426	36	498	962	1,423	1,885	2,347
11.00	-26	536	1,098	1,662	2,223	2,785	3,347
12.00	374	1,036	1,698	2,362	3,023	3,685	4,347
13.00	774	1,536	2,298	3,062	3,823	4,585	5,347

NET RETURNS PER ACRE **ABOVE CASH COSTS**

PRICE	YIELD (19 lb box/acre)						
$/box	400	500	600	700	800	900	1,000
7.00	-1,934	-1,772	-1,610	-1,447	-1,286	-1,124	-962
8.00	-1,534	-1,272	-1,010	-747	-486	-224	38
9.00	-1,134	-772	-410	-47	314	676	1,038
10.00	-734	-272	190	653	1,114	1,576	2,038
11.00	-334	228	790	1,353	1,914	2,476	3,038
12.00	66	728	1,390	2,053	2,714	3,376	4,038
13.00	466	1,228	1,990	2,753	3,514	4,276	5,038

NET RETURNS PER ACRE **ABOVE TOTAL COSTS**

PRICE	YIELD (19 lb box/acre)						
$/box	400	500	600	700	800	900	1,000
7.00	-3,406	-3,247	-3,088	-2,928	-2,770	-2,610	-2,451
8.00	-3,006	-2,747	-2,488	-2,228	-1,970	-1,710	-1,451
9.00	-2,606	-2,247	-1,888	-1,528	-1,170	-810	-451
10.00	-2,206	-1,747	-1,288	-828	-370	90	549
11.00	-1,806	-1,247	-688	-128	430	990	1,549
12.00	-1,406	-747	-88	572	1,230	1,890	2,549
13.00	-1,006	-247	512	1,272	2,030	2,790	3,549

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Table 6. WHOLE FARM ANNUAL EQUIPMENT, INVESTMENT, & BUSINESS OVERHEAD COSTS
SAN JOAQUIN VALLEY SOUTH - 2007

ANNUAL EQUIPMENT COSTS

						Cash Overhead		
			Yrs	Salvage	Capital	Insur-		
Yr	Description	Price	Life	Value	Recovery	ance	Taxes	Total
07	60 HP 4WD Narrow Tractor	47,000	15	9,150	4,885	200	281	5,366
07	ATV 4WD	6,700	5	3,003	1,125	35	49	1,209
07	Brush Shredder 6 ft	8,000	15	768	862	31	44	937
07	Cane Cutter	3,500	20	182	333	13	18	364
07	Duster - 3 Pt 12'	5,500	5	1,792	1,040	26	36	1,103
07	Mower-Flail 8'	10,500	15	1,008	1,132	41	58	1,230
07	Orchard/Vine Sprayer 500 gal	21,000	5	6,840	3,973	99	139	4,211
07	Pickup Truck 1/2 T	28,000	7	10,621	4,023	138	193	4,354
07	Sprayer ATV 20 gal	350	10	62	46	1	2	50
07	Truck – Flatbed (10 ton)	56,000	10	16,542	6,882	259	363	7,504
07	Weed Sprayer 3 PT 100 gal	4,000	10	707	526	17	24	566
	TOTAL	190,550		50,675	24,827	861	1,206	26,894
	60% of New Cost *	114,330		30,405	14,896	517	724	16,136

* Used to reflect a mix of new and used equipment.

ANNUAL INVESTMENT COSTS

					Cash Overhead			
		Yrs	Salvage	Capital	Insur-			
Description	Price	Life	Value	Recovery	ance	Taxes	Repairs	Total
Building 2,400 sqft.	80,000	20		6,610	286	400	1,600	8,895
Drip Irrigation System 115 acres	50,000	25		4,388	179	250	1,000	5,816
Vineyard Establishment	288,280	22		26,605	1,029	1,441	0	29,075
Fuel Tanks 2-300 gal	3,500	30	350	286	14	19	70	389
Land	840,000	25	840,000	60,900	0	8,400	0	69,300
Tools-Shop/Field	15,000	15	1,500	1,614	59	83	300	2,056
TOTAL INVESTMENT	1,276,780		841,850	100,402	1,566	10,593	2,970	115,531

ANNUAL BUSINESS OVERHEAD COSTS

	Units/		Price/	Total
Description	Farm	Unit	Unit	Cost
Liability Insurance	115	acre	5.86	674
Office Expense	115	acre	80.00	9,200
Sanitation Fee	115	acre	19.35	2,225

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Table 7. HOURLY EQUIPMENT COSTS
SAN JOAQUIN VALLEY SOUTH - 2007

			COSTS PER HOUR						
		Actual		Cash Overhead		Operating			
		Hours	Capital	Insur-			Fuel &	Total	Total
Yr	Description	Used	Recovery	ance	Taxes	Repairs	Lube	Opera.	Costs/Hr.
07	60 HP 4WD Narrow Tractor	1,065	2.75	0.11	0.16	1.12	7.79	8.91	11.93
07	ATV 4WD	400	1.69	0.05	0.07	0.49	1.07	1.56	3.37
07	Brush Shredder 6 ft	134	3.88	0.14	0.20	3.49	0.00	3.49	7.71
07	Cane Cutter	100	1.99	0.08	0.11	1.29	0.00	1.29	3.47
07	Duster - 3 Pt 12'	240	2.60	0.07	0.09	0.79	0.00	0.79	3.55
07	Mower-Flail 8'	133	5.12	0.19	0.26	4.58	0.00	4.58	10.15
07	Orchard/Vine Sprayer 500 gal	400	5.96	0.15	0.21	3.67	0.00	3.67	9.99
07	Pickup Truck 1/2 T	286	8.46	0.29	0.41	2.04	14.76	16.80	25.96
07	Sprayer ATV 20 gal	150	0.18	0.01	0.01	0.09	0.00	0.09	0.29
07	Truck – Flatbed (10 ton)	200	20.65	0.78	1.08	5.30	2.64	7.94	30.45
07	Weed Sprayer 3 PT 100 gal	200	1.58	0.05	0.07	0.68	0.00	0.68	2.38

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Table 8. OPERATIONS WITH EQUIPMENT

SAN JOAQUIN VALLEY SOUTH - FLAME TABLE GRAPES 2007

Operation	Operation Month	Tractor	Implement	Material	Broadcast Rate/acre	Unit
Weed: Winter Strip	March	60HP 4WD	Weed Sprayer	Surflan	2.40	pt
				Roundup	0.60	pt
Weed: Mow Middles	March	60HP 4WD	Mower Flail 8'			
	May	60HP 4WD	Mower Flail 8'			
	July	60HP 4WD	Mower Flail 8'			
	August	60HP 4WD	Mower Flail 8'			
Weed: Spot Spray	June	ATV 4WD	Weed Sprayer	Roundup	0.50	pt
Fertilizer through Drip	April			UN 32	50.00	lb N
Irrigation	April			Water	1.00	acin
	May			Water	4.00	acin
	June			Water	7.00	acin
	July			Water	9.00	acin
	August			Water	8.00	acin
	September			Water	6.00	acin
	October			Water	1.00	acin
Disease:Phomopsis/Mildew	March	60HP 4WD	Air Blast Sprayer	Abound	12.00	floz
				Microthiol	1.00	lb
Vertebrate: Squirrel, Gopher, Coyote, Bird	Mar – Oct			Various Methods	15.00	acre
Disease: Mildew 3X	April	60HP 4WD	Duster	Sulfur Dust	10.00	lb
	June	60HP 4WD	Duster	Sulfur Dust	10.00	lb
	July	60HP 4WD	Duster	Sulfur Dust	10.00	lb
Disease: Mildew. **Fertilize**: Zinc	April	60HP 4WD	Air Blast Sprayer	Microthiol (Mildew)	2.00	lb
				Rally (Mildew)	4.00	oz
				Neutral Zinc	5.00	lb
Disease: Mildew. **Insect**: Skeletonizer	May	60HP 4WD	Air Blast Sprayer	Microthiol (Mildew)	1.00	lb
				Flint (Mildew)	2.00	oz
				Kryocide (Skeletonizer)	6.00	lb
FM: Bloom Thin. **Disease**: Mildew	May	60HP 4WD	Air Blast Sprayer	GA (Thin)	6.00	floz
				Microthiol (Mildew)	2.00	lb
				Flint (Mildew)	2.00	oz
FM: Berry Size. **Disease**: Mildew	June	60HP 4WD	Air Blast Sprayer	GA (Size)	48.00	floz
				Microthiol (Mildew)	2.00	lb
				Rally (Mildew)	4.00	oz
FM: Berry Size. **Disease**: Mildew. **Insect**: Leafhopper	June	60HP 4WD	Air Blast Sprayer	GA (Size)	48.00	floz
				Microthiol (Mildew)	2.00	lb
				Rally (Mildew)	4.00	oz
				Provado (Leafhopper)	1.00	oz
FM: Color Fruit (Ethrel)				Ethrel	1.00	pt
Trellis: Repair	January			Labor	2.00	hrs
				Trellis Materials	10.00	acre
Vine: Layering Vines	January			Labor	1.00	hrs
Prune: Dormant	January			Labor	20.00	hrs
Prune: Shred Brush	January	60HP 4WD	Mower Flail 8'			
Insect: Mealybug	March	60HP 4WD	Air Blast Sprayer	Lorsban	4.00	pt
CM: Shoot Thin/Position & Leaf Removal	April			Labor	50.00	hrs
CM: Cane Cutting (Mechanical)	June	60HP 4WD	Cane Cutter			
Sucker: Remove Trunk Suckers	April			Labor	2.00	hrs
FM: Cluster Tipping & Thinning	June			Labor	20.00	hrs
FM: Girdle	June			Labor	12.00	hrs
Pickup: Truck Use	Annual	Pickup 1/2 ton				
ATV:	Annual	ATV				
Harvest: Pick & Pack	August			Labor	175.00	hrs
Harvest: Swamp, Spread, Haul	August	Truck Flatbed		Labor	20.50	hrs
				Boxes	700.00	boxes
				Plastic bags	6,300	bags

*CM = Canopy Management. FM = Fruit Management

GR-VS-07-3

UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

2007

SAMPLE COSTS TO ESTABLISH AND PRODUCE
TABLE GRAPES

REDGLOBE

SAN JOAQUIN VALLEY - SOUTH

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UC COOPERATIVE EXTENSION

SAMPLE COSTS TO ESTABLISH AND PRODUCE TABLE GRAPES

Redglobe

San Joaquin Valley South - 2007

CONTENTS

INTRODUCTION

Sample costs to establish and produce Redglobe table grapes are presented in this study. This study is intended as a guide only, and can be used to make production decisions, determine potential returns, prepare budgets and evaluate production loans. Practices described are based on production practices considered typical for the crop and area, but these same practices will not apply to every farming operation. The sample costs for labor, materials, equipment and custom services are based on current figures. A blank column, "*Your Costs*", in Tables 2 and 3 is provided for entering your costs.

The hypothetical farm operation, production practices, overhead, and calculations are described under the assumptions. For additional information or an explanation of the calculations used in the study call the Department of Agricultural and Resource Economics, University of California, Davis, (530) 752-3589 or your local UC Cooperative Extension office.

Sample Cost of Production Studies for many commodities can be downloaded at http://coststudies.ucdavis.edu, requested through the Department of Agricultural and Resource Economics, UC Davis, (530) 752-1517 or obtained from the local county UC Cooperative Extension offices. Some archived studies are also available on the website.

ASSUMPTIONS

The assumptions refer to Tables 1 to 8 and pertain to sample costs to establish the vineyard and produce Redglobe table grapes in the San Joaquin Valley. The cultural practices described represent production operations and materials considered typical of a well-managed vineyard in the region. Costs, materials, and practices in this study will not apply to all farms. Timing of and types of establishment and cultural practices will vary among growers within the region and from season to season due to variables such as weather, soil, and insect and disease pressure. **The use of trade names and cultural practices in this report does not constitute an endorsement or recommendation by the University of California nor is any criticism implied by omission of other similar products or cultural practices.**

Farm. The hypothetical farm consists of 120 contiguous acres. Redglobe table grape vineyard establishment and production are on 40 acres. Other table grape varieties are on 75 acres and roads, irrigation systems, and farmstead occupy five acres. The farm is owned and managed by the grower.

Establishment Cultural Practices & Material Inputs
(Table 1)

Site Preparation. This vineyard is established on ground previously planted to vineyards or orchards. Land coming from vines or trees should be fallowed for two years except for a possible grain crop. The land is assumed to be fairly level. A custom operator chisels the ground (subsoils) twice to a depth of 4-5 feet. The grower floats the land to smooth and level the surface. Afterwards the ground is disced twice to apply and incorporate preplant herbicide. Nematode samples should be taken from land formerly in vines or trees and fumigated if necessary. Most operations that prepare the vineyard for planting are done in the year prior to planting, but costs are shown in the first year.

Plant. Planting the vineyard starts by laying out and marking vine sites in early spring. Holes are dug and vines planted and a two-inch by two-inch cardboard carton placed around the vine. In the second year, 2% or 10 vines per acre are replaced.

Vines. The Redglobe plants are dormant, bench-grafted rootstock vines purchased from a commercial nursery. The grapevines are planted during the first spring on a 7-foot x 12-foot spacing (vine x row) with 518 vines per acre. Vines are trained during the first and second years to quadrilateral cordons. The grapevines will begin yielding fruit in the third year and then be productive for an additional 22 years.

Trellis System. A commercial company installs the trellis system in the second year. The trellis system will be removed when the vineyard is removed; therefore it is considered part of the vineyard and included in the establishment costs. Materials for the open gable trellis are as follows: (1) Stakes with V structure are placed every 24-feet down the row. Metal stakes (2 lbs/ft strength) are 8.5-feet long and placed in the ground 3-feet. The open gable is 72-inches wide from tip to tip. (2) End assemblies consist of 9.5-foot metal post (4 lb/ft) with a V that matches those within the row and with 10-inch helix anchor. (3) Eight wires, 12.5 gauge high tensile, are used for fruit and cordon support; three wires, 14 gauge high tensile, are used for movable catch wires and drip hose support. For growers planting and training vines in the first year to harvest in the second year, trellis installation should be completed in the first year and the cost shown accordingly

Train/Prune. Vines are pruned to one two bud spur in the first dormant season (December to February, January in this study).

Train. The following spring (second year), a single shoot is selected and trained up the stake to form the permanent structure of the vine. Training consists of tying the shoot; removing lateral shoots from the base and tipping the shoot when it reaches desired cordon height. Most of the training costs occur during the second summer. The third summer is devoted to training missing vines or vines delayed in growth.

Prune. In the third year (January), vines are pruned much like an established vine. The exception is that in the third year the cordons are essentially canes; therefore, short spurs or no spurs are left at node positions. With mature vines 6 two bud spurs are retained on each of the four cordons. Prunings are placed in the row middles and shredded. Selecting and tying canes to fruiting wires is required each year for the life of the vineyard. Suckers from vine trunks are removed in April, a practice that continues each year, but diminishes as the vineyard matures.

Irrigate. Water pumping costs plus labor constitute the irrigation cost. In this study, water is calculated to cost $4.59 per acre-inch or $55.08 per acre-foot. The pumping cost is based on a 40 horsepower (HP) motor to pump from 130 feet deep. The vineyard is irrigated during the growing season from April through October during the establishment years. Price per acre-foot of water will vary by grower in this region depending on quantity used, water district, power cost, various well characteristics, and other irrigation factors. The amount of water applied to the vineyard varies through the establishment years and is shown in Table A.

Table A. Irrigation Water Applied

Year	AcIn/Year
1	8
2	18
3+	36

Fertilize. Liquid nitrogen fertilizer, UN32, is applied through the irrigation system in April of the first year at five pounds of N per acre. A single application is made in April of the second year. The amount of nitrogen applied each year increases as the vineyard matures and is shown in Table B. It is important to identify sources of nitrogen in order to properly manage the nitrogen budget. For example, sources of nitrogen such as irrigation well water should be calculated to determine future irrigation and fertilizer needs.

Table B. Applied Nitrogen (N) Per Acre

Year	Lbs of N
1	5
2	25
3+	50

Pest Management. For pest identification, monitoring, management and pesticide information, visit the UC IPM website at www.imp.ucdavis.edu. Written recommendations are required for many commercially applied pesticides, and are available from licensed pest control advisers (PCAs). For information on pesticide use permits, contact the local county Agricultural Commissioner's office. **Pesticides mentioned in this study are used to calculate rates and costs. Although the pesticides mentioned are commonly used by growers, many other pesticides are available. Check with your PCA and/or the UC IPM website for current recommendations.**

Weeds (Vineyard Floor Management). In October of the year prior to planting, Treflan is applied to the vineyard floor and incorporated by discing. After planting, weeds in the vine rows and middles are managed with discing, mowing, and/or herbicides. From March through July of the first year, the row middles are disced twice and mowed twice. The vine rows are hand weeded in April. The row middles are mowed three to four times during the growing season starting the second year. The vine rows are sprayed (strip spray) in January of the second year with Roundup and Surflan. The strip spray is applied to 30% of the acreage. Also in the second year, spot sprays using Roundup are applied to the vine row in April, June, and July. The spot sprays (weedy spots or areas) are applied using an all terrain vehicle (ATV) with a sprayer attached.

Insects. Beginning in the second year, western grapeleaf skeletonizer (*Harrisina brillians*) is controlled in April with an application of Kryocide insecticide (mixed with micronized sulfur sprays). Additionally insects such as mealybugs are monitored each year beginning in the spring and may increase production costs if found.

If mealybugs (*Pseudococcus sp.*) are found during vineyard establishment, the grower should consult with a PCA, farm advisor, and/or ag commissioner to develop management strategies.

Diseases. Although many pathogens attack grapevines, phomopsis cane and leafspot (*Phomopsis viticola)* and powdery mildew (*Uncinula necator)* are the two diseases managed in this study. In April of the second and third years, Microthiol plus Abound (strobilurin) are applied for phomopsis and mildew control. Mildew is controlled with various fungicide applications at 7 to 21 day intervals in the third year, depending on the fungicide used. For this study, the grower applies a Kocide (copper) and Rubigan (SI) combination, and two Microthiol applications (one with Kryocide) in April; one Rubigan (SI) application and two dusting sulfur applications in May; one Rubigan (SI) application and two dusting sulfur applications in June. Growers have the option of using sulfur (dust, wettable, flowable or micronized), sterol inhibitors (SIs), or strobilurins, as well as other fungicides to control powdery mildew. Sterol inhibitors and strobilurins are two classes of fungicides with different modes of action than sulfur against powdery mildew. It is recommended that fungicides with different modes of action be used to avoid powdery mildew populations from developing fungicide resistance.

Vertebrate. Rabbits, gophers, squirrels and coyotes are pests that can cause damage to the vines and irrigation lines. Various forms of control such as baiting, trapping and/or building a rabbit fence are utilized as necessary throughout the year. For this study no specific control is used, but an estimated cost for one or two management practices are shown in March. Endangered Species: It is important to know if your vineyard is located in an area where endangered species reside (i.e. San Joaquin Kit Fox). Trapping and killing endangered species can result in fines. Contact your County Agricultural Commissioner for additional information.

Harvest/Yield/Returns. Growers sometimes plant and train vines in the same year, which produces a harvestable RedGlobe table grape crop in the second year. Yields in the third year are approximately 50 to 75% of mature production. If the crop in the third year is harvested for wine, a labor contractor may be needed. For this study, 500 boxes (19 pounds per box) of table grapes are assumed in the third year.

Mature Production Cultural Practices and Material Inputs
(Tables 2-8)

Prune/Sucker/Canopy Management (CM). The quad-cordon trained vines are spur-pruned during the winter months (January) and the prunings are placed in the row middles and shredded. Suckers and sterile shoots are removed from the vine trunks and crowns during April. Shoot thinning, shoot positioning and basil leaf removal are done by hand in April. Mechanical cane cutting (canopy skirting) is done in June with the grower's equipment.

Fruit Management (FM). Girdling of the trunk or bases of individual canes (trunk in this study) to increase berry size is done by hand in June. Cluster tipping and hand thinning are done in late May to early June after girdling to adjust berry set, cluster length, and crop load. Girdling in not recommended in weak vineyards and should be closely supervised to avoid deep cuts into the xylem.

Trellis/Vines. Trellis repairs are done annually (January in this study) and the cost is not taken from any specific data. Weak or missing vines are replaced by layering which is usually not an issue until the vineyard is over 10 years old. One year-old canes from neighboring vines are buried (layered) in the soil next to the stake. These vines are trained the following spring. The layer is severed after 3 to 4 years when the new vine is fully established. Trellis repair and vine replacement increases with vineyard age.

Irrigate. The vineyard is drip irrigated during the growing season from April through October. Deficit irrigation may also be applied three to four weeks before harvest to advance maturity and decrease decay. Deficit irrigation may not work well on weak or low vigor vineyards. Water pumping costs plus labor constitute the irrigation cost. In this study, water is calculated to cost $4.59 per acre-inch or $55.08 per acre-foot. The pumping cost is based on a 40 horsepower (HP) motor to pump from 130 feet depth and pressurized to 20 psi. A total of 36 acre-inches is applied to the vineyard. Price per acre-foot of water will vary by grower in this region depending on quantity used, water district, power cost, various well characteristics, and other irrigation factors.

Fertilize. Nitrogen (N) at 50 pounds per acre as UN32 is applied through the irrigation drip system in April. Neutral zinc is applied to prevent zinc deficiencies and is combined with the late April mildew (Microthiol, Rally) application.

Pest Management. The pesticides and rates mentioned in this cost study are listed in *UC Integrated Pest Management Guidelines, Grapes.* For information on other pesticides available, pest identification, monitoring, and management visit the UC IPM website at www.ipm.ucdavis.edu. For information and pesticide use permits, contact the local county agricultural commissioner's office. **Pesticides mentioned in this study are used to calculate rates and costs. Although the pesticides mentioned are commonly used by growers, many other pesticides are available. Check with your PCA and/or the UC IPM website for current recommendations.** Adjuvants are recommended for use with many pesticides for effective control, but the adjuvants and their costs are not included in this study. Pesticide costs may vary by location, brand, and grower volume. Pesticide costs in this study are taken from a single dealer and shown as full retail.

Pest Control Adviser (PCA). Written recommendations are required for many commercially applied pesticides and are written by licensed pest control advisers. In addition the PCA will monitor the field for agronomic problems including pests, diseases, and nutritional status. Growers may hire private PCA's or receive the service as part of a service agreement with an agricultural chemical and fertilizer company. Costs for a PCA are not included in this study.

Weeds (Vineyard Floor Management). Vineyard middles are mowed three times each season: March, May, July. Surflan and Roundup herbicides are applied to the vine row/berm in February. Roundup, a contact herbicide, is applied as a spot spray to the vine row in June.

Insects. Mealybugs (*Pseudococcus sp.*) are treated with Lorsban insecticide in early March (dormant vines). Western grapeleaf skeletonizer (*Harrisina brillians*) is treated with Kryocide (mixed with Microthiol) during the second disease spray (bloom) in May. Leafhoppers are controlled with Provado insecticide (mixed with Microthiol, Rally) during the second disease spray in June. An effective alternative material for mealybugs is to apply Admire insecticide through the drip system, but at a higher cost than a Lorsban application. It may be necessary to use multiple insecticides to control some mealybug species.

Diseases. Diseases treated in this study are phomopsis and powdery mildew. Phomopsis and powdery mildew are both treated in late March (shoots average 2-inches) with Abound and Microthiol (micronized sulfur). Mildew is controlled during the season with various fungicide applications at 7 to 21 day intervals, depending on the fungicide used. In this study, sulfur dust is applied three times - April, June, July. Microthiol and Rally (with zinc fertilizer) are applied in late April. Microthiol and Flint are applied in May during bloom. Microthiol (Kryocide insecticide included) is applied at the second spray in May. Rally and Microthiol are applied twice in June (Provado insecticide included with second application). Growers have the option of using sulfur (dust, wettable, flowable or micronized), sterol inhibitors (SIs), or strobilurins, as well as other fungicides to control powdery mildew. Sterol inhibitors and strobilurins are two classes of fungicides with different modes of action than sulfur against powdery mildew. It is recommended that fungicides with different modes of action be used to prevent powdery mildew populations from developing fungicide resistance.

Vertebrate. Gophers, squirrels, coyotes and birds are pests that can cause damage to the vines and irrigation lines. Various forms of control such as baiting, trapping and/or shooting are utilized as necessary throughout the year. For this study no specific control is used, but per acre costs are shown from March through October and are an estimate not based on any specific data. Endangered Species: It is important to know if your vineyard is located in an area where endangered species reside (i.e. San Joaquin Kit Fox). Trapping and killing endangered species can result in fines. Contact your County Agricultural Commissioner for additional information.

Harvest. The grapes are picked for table grapes in August and packed in the field. Harvesting crews work in teams of three or four. Depending on fruit quality, the team can pick and pack an average of 3 to 6 boxes per hour per individual and for this study; the picker picks four shipping boxes per hour. Two or three pickers field pick and trim the grapes, and put them in reusable field boxes. Approximately four field boxes are loaded on a wheelbarrow type cart and delivered to the packing person who trims, puts them in bags that are then placed in shipping boxes. The box holds 12 bags and weighs 21-pounds when filled. The packed boxes are loaded on a truck and hauled to storage. The swamp and haul cost includes the boxes, plastic bags, hauling and related labor. Pre cooling and palletization (P&P) costs may in some cases be a grower cost but are generally charged to the buyer. After 30 days of cold storage, the grower is charged approximately $0.35 per box per month ($0.25-0.45) until the fruit is sold. Brokerage fees are paid by the grower and range from 7 to 10% of the selling price. A figure of 9% of the selling price is used in this study.

Table C: Table Grapes (all varieties)

Average Yields	
Year	Tons/Acre (boxes)
2002	8.13 (856)
2003	7.60 (800)
2004	7.76 (815)
2005	11.34 (1,194)
2006	9.66 (1,016)

Source: Fresno County Crop Reports, 2002-2006.
Boxes = 19 lbs

Yields. This study uses a yield of 900, 21-pound boxes to calculate returns. Average county yields for all table grape varieties are shown in Table C. The averages include all vineyards in production regardless of maturity and varieties.

Returns. Return prices for grapes at different yields and price are shown in Table 5. Based on grower information, an estimated price of $12 per box for Redglobe grapes is used in this study.

Assessments/Inspection. The California Table Grape Commission (CTGC) assesses $0.1278 per 21-pound box or $0.006087 per pound. Table grapes are inspected for quality control and charged an additional $0.035 per box. Early in the season, growers often have the county Agricultural Commissioner inspect their fruit for maturity at a cost of $0.035 per box. Approximately one-third of the entire crop is inspected to determine that maturity requirements are met, which includes soluble solids:acid ratios (20:1) and color.

Pickup/ATV. It is assumed that the grower uses the pickup for business and personal use. Estimated business mileage for the ranch is 5,250 miles. The all terrain vehicle (ATV) is used for spot spraying weeds and is included in that cost. It is assumed that the ATV will be used two hours per acre on the ranch for checking the vineyards including the irrigation system.

Labor. Hourly wages for workers are $11.00 for machine operators and $8.50 per hour non-machine labor. Adding 33% for the employer's share of federal and state payroll taxes, workers compensation insurance for vine crops (0040) and other possible benefits gives the labor rates shown of $14.63 and $11.31 per hour for machine labor and non-machine labor, respectively. Workers' compensation costs will vary among growers, but for this study the cost is based upon the average industry final rate as of January 1, 2007 (personal email from California Department of Insurance, May 18, 2007, unreferenced). Labor for operations involving machinery are 20% higher than the operation time given in Table 2 to account for the extra labor involved in equipment set up, moving, maintenance, work breaks, and field repair.

Equipment Operating Costs. Repair costs are based on purchase price, annual hours of use, total hours of life, and repair coefficients formulated by the American Society of Agriculture Engineers (ASAE). Fuel and lubrication costs are also determined by ASAE equations based on maximum PTO horsepower, and fuel type. Prices for on-farm delivery of diesel and gasoline are $2.30 and $2.80 per gallon, respectively. Fuel costs are derived from American Automobile Association (AAA) and Energy Information Administration 2006 monthly data. The cost includes a 2.25% sales tax (effective September 2001) on diesel fuel and 7.25% sales tax on gasoline. Gasoline also includes federal and state excise tax, which can be refunded for on-farm use when filing your income tax. The fuel, lube, and repair cost per acre for each operation in Table 2 is determined by multiplying the total hourly operating cost in Table 7 for each piece of equipment used for the selected operation by the hours per acre. Tractor time is 10% higher than implement time for a given operation to account for setup, travel and down time.

Interest on Operating Capital. Interest on operating capital is based on cash operating costs and is calculated monthly until harvest at a nominal rate of 10.00% per year. A nominal interest rate is the typical market cost of borrowed funds. The interest cost of post harvest operations is discounted back to the last harvest month using a negative interest charge. The rate will vary depending upon various factors, but the rate in this study is considered a typical lending rate by a farm lending agency as of January 2007.

Risk. The risks associated with crop production should not be minimized. While this study makes every effort to model a production system based on typical, real world practices, it cannot fully represent financial, agronomic and market risks, which affect profitability and economic viability. Growers may purchase Federal crop insurance to reduce the production risk associated with specific natural hazards. Insurance policies vary and range from a basic catastrophic loss policy to one that insures losses for up to 75% of a crop. Insurance costs will depend on the type and level of coverage.

Cash Overhead

Cash overhead consists of various cash expenses paid out during the year that are assigned to the whole farm and not to a particular operation.

Property Taxes. Counties charge a base property tax rate of 1% on the assessed value of the property. In some counties special assessment districts exist and charge additional taxes on property including equipment, buildings, and improvements. For this study, county taxes are calculated as 1% of the average value of the property. Average value equals new cost plus salvage value divided by 2 on a per acre basis.

Insurance. Insurance for farm investments varies depending on the assets included and the amount of coverage. Property insurance provides coverage for property loss and is charged at 0.714% of the average value of the assets over their useful life. Liability insurance covers accidents on the farm and costs $674 for the entire farm.

Office Expense. Office and business expenses are estimated at $80 per producing acre or $9,200 annually for the ranch. These expenses include office supplies, telephones, bookkeeping, accounting, legal fees, road maintenance, etc.

Sanitation Services. Sanitation services provide double portable toilets with washbasins for 10 months. The cost includes delivery and weekly cleaning service. The number of sanitation facilities will vary depending upon local regulations and size of labor force. In many cases labor contractors furnish the sanitation facilities for their crews and the costs are included in the contractor's labor overhead.

Management/Supervisor Wages. Salary is not included. Returns above costs are considered a return to management

Investment Repairs. Annual maintenance is calculated as 2% of the purchase price.

Non-Cash Overhead Costs

Non-cash overhead is calculated as the capital recovery cost for equipment and other farm investments.

Capital Recovery Costs. Capital recovery cost is the annual depreciation and interest costs for a capital investment. It is the amount of money required each year to recover the difference between the purchase price and salvage value (unrecovered capital). It is equivalent to the annual payment on a loan for the investment with the down payment equal to the discounted salvage value. This is a more complex method of calculating ownership costs than straight-line depreciation and opportunity costs, but more accurately represents the annual costs of ownership because it takes the time value of money into account (Boehlje and Eidman). The formula for the calculation of the annual capital recovery costs is ((Purchase Price – Salvage Value) x Capital Recovery Factor) + (Salvage Value x Interest Rate).

Salvage Value. Salvage value is an estimate of the remaining value of an investment at the end of its useful life. For farm machinery (tractors and implements) the remaining value is a percentage of the new cost of the investment (Boehlje and Eidman). The percent remaining value is calculated from equations developed by the American Society of Agricultural Engineers (ASAE) based on equipment type and years of life. The life in years is estimated by dividing the wear out life, as given by ASAE by the annual hours of use in this operation. For other investments including irrigation systems, buildings, and miscellaneous equipment, the value at the end of its useful life is zero. The salvage value for land is the purchase price because land does not depreciate. The purchase price and salvage value for equipment and investments are shown in Table 6.

Capital Recovery Factor. Capital recovery factor is the amortization factor or annual payment whose present value at compound interest is 1. The amortization factor is a table value that corresponds to the interest rate used and the life of the machine.

Interest Rate. An interest rate of 7.25% is used to calculate capital recovery. The rate will vary depending upon loan amount and other lending agency conditions, but is the basic suggested rate by a farm lending agency as of January 2007.

Land. The land was formerly a vineyard, but has been out of production for two years. The open land was planted to grain crops. Land in the San Joaquin Valley with table grape production ranges from $6,000 to $13,400 per acre (depending on vineyard age, variety and location). Cropland with district or well water in the area ranges from $2,500 to $12,000. For this study, the land value was established based on 2007 real estate values (2007 Trends & Leases); therefore a cost of $7,000 per acre or $7,304 per producing acre is used.

Tools. This is an assumed value for shop, hand, and miscellaneous field tools and not based on any grower's tool inventory.

Fuel Tanks. Two 300-gallon fuel tanks using gravity feed are on metal stands. The tanks are setup in a cement containment pad that meets federal, state, and county regulations.

Drip Irrigation System. The drip lines, filters, booster pump and the labor to install the components are included in the irrigation system cost. The previous vineyard is assumed to have a pumping system that had been refurbished and therefore is not included as a cost. Water is delivered from a 130-foot depth using a 40-horsepower pump. The drip irrigation lines are laid directly on the ground prior to planting and the labor cost is included in the drip irrigation system cost.

Establishment Cost. The establishment cost is the sum of the costs for land preparation, trellis system, planting, vines, cash overhead and production expenses for growing the vines through the third year the first year that grapes are harvested. It is used to determine the non-cash overhead expense, capital recovery cost, during the production years. In this study, no crop was produced in the second year; therefore, the Total Accumulated Net Cash Cost on Table 1, in the third year represents the establishment cost. For this study the cost is $6,642 per acre or $265,680 for the 40 producing acres. The establishment cost is spread over the remaining 22 years of the 25 years the vineyard is in production.

Equipment. Farm equipment is purchased new or used, but the study shows the current purchase price for new equipment. The new purchase price is adjusted to 60% to indicate a mix of new and used equipment. Annual ownership costs for equipment and other investments are shown in Table 6. Equipment costs are composed of three parts: non-cash overhead, cash overhead, and operating costs. Both of the overhead factors have been discussed in previous sections. The operating costs consist of repairs, fuel, and lubrication and are discussed under operating costs.

Table Values. Due to rounding, the totals may be slightly different from the sum of the components.

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For information concerning the above or other University of California publications, contact your local county UC Cooperative Extension office or UC DANR Communications Services online at http://ucanr.org .

UC COOPERATIVE EXTENSION

Table 1. COSTS PER ACRE TO ESTABLISH A RED GLOBE TABLE GRAPE VINEYARD

SAN JOAQUIN VALLEY SOUTH - 2007

	Cost Per Acre		
Year:	1st	2nd	3rd
Boxes Per Acre:	0	0	500
Planting Costs:			
Site Prep: Subsoil 2X	400		
Site Prep: Float (Level)	12		
Site Prep: Disc/Apply Herbicide (Treflan)	17		
Site Prep: Disc/Incorporate Herbicide	12		
Plant: Survey & Layout Vineyard	70		
Plant: Plant, Wrap Vines	166	2	
Vines: 518 Per Acre (2% Replant In 2nd Year)	1,606	31	
Trellis: Trellis System (custom)		4,000	
TOTAL PLANTING COSTS	2,282	4,033	
Cultural Costs:			
Vertebrate: (Rabbit, Gopher, Squirrel)	40	15	15
Fertilize: Nitrogen (UN32)	3	12	23
Irrigate: Water/Labor	54	107	181
Weed: Disc Middle - 2X/Yr 1	16		
Weed: Mow Middle - 2X/Yr 1, 4X/Yr 2, 3X/Yr 3	16	31	24
Weed: Hand Hoe	34		
Prune: Dormant		73	79
Training: (Sucker, Tie)		271	136
Insect: Skeletonizer (Kryocide). **Disease**: Mildew (Microthiol)		36	36
Weed: Spot Spray (Roundup)		42	42
Weed: Winter Strip Spray (Roundup, Surflan)		53	53
Prune: Shred prunings			15
Disease: Phomopsis (Microthiol, Abound)			51
Disease: Mildew Control (Microthiol)			20
Insect: Leafhoppers 1X (Provado)			46
Disease: Mildew (Kocide, Rubigan)			50
Disease: Mildew 4X (Sulfur Dust)			39
Disease: Mildew 2X, (Rubigan)			56
Pickup: Business use	82	82	82
ATV: Field use	30	38	38
TOTAL CULTURAL COSTS	274	761	985
Harvest Costs:			
Pick & Field Pack (labor)			1,414
Spread/Stack boxes, Swamp, Haul (includes boxes, bags, labor)			1,147
Brokerage Fee			540
Assessment & Inspection Fees			64
TOTAL HARVEST COSTS			3,165
Interest On Operating Capital @ 10.00%	210	373	59
TOTAL OPERATING COSTS/ACRE	2,539	5,163	4,208
Cash Overhead Costs:			
Office Expense	80	80	80
Liability Insurance	6	6	6
Sanitation Service	19	19	19
Property Taxes	85	87	88
Property Insurance	9	10	11
Investment Repairs (non-cash overhead items)	42	42	42
TOTAL CASH OVERHEAD COSTS	242	244	246
TOTAL CASH COSTS/ACRE	2,781	5,407	4,455
INCOME/ACRE FROM PRODUCTION	0	0	6,000
NET CASH COSTS/ACRE FOR THE YEAR	2,781	5,407	0
PROFIT/ACRE ABOVE CASH COSTS	0	0	1,545
ACCUMULATED NET CASH COSTS/ACRE	2,781	8,187	**6,642**

UC COOPERATIVE EXTENSION

Table 1. continued

	Cost Per Acre		
Year:	1st	2nd	3rd
Boxes Per Acre:	0	0	500
Non-Cash Overhead Costs (Capital Recovery):			
Land	530	530	530
Irrigation System	110	110	110
Shop Building	57	57	57
Shop Tools	14	14	14
Fuel Tank & Pump	2	2	2
Equipment	37	74	95
TOTAL CAPITAL RECOVERY COST	751	787	809
TOTAL COST/ACRE FOR THE YEAR	3,531	6,194	5,263
INCOME/ACRE FROM PRODUCTION	0	0	6,000
TOTAL NET COST/ACRE FOR THE YEAR	3,531	6,194	0
NET PROFIT/ACRE ABOVE TOTAL COST	0	0	737
TOTAL ACCUMULATED NET COST/ACRE	3,531	9,726	8,989

UC COOPERATIVE EXTENSION
Table 2. COSTS PER ACRE TO PRODUCE REDGLOBE TABLE GRAPES
SAN JOAQUIN VALLEY SOUTH - 2007

Operation	Operation Time (Hrs/A)	Cash and Labor Cost per acre Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
Cultural:							
Vine: Layering Missing Vines	1.00	11	0	0	0	11	
Prune: Vines	15.00	170	0	0	0	170	
Prune: Brush Disposal	0.50	9	7	0	0	15	
Trellis: Repair	2.00	23	0	10	0	33	
Weed: Winter Strip (Surflan, Roundup)	0.49	9	5	40	0	53	
Vertebrate: Gopher, Squirrel, Coyote, Bird (various methods)	0.00	0	0	15	0	15	
Insect: Mealybug (Lorsban)	0.50	9	7	25	0	41	
Disease: Phomopsis (Abound)/Mildew (Sulfur)	0.50	9	7	35	0	51	
Weed: Mow Middles 4X	0.74	13	11	0	0	24	
Disease: Mildew 3X (Dusting Sulfur)	0.84	15	9	6	0	30	
Sucker: Remove Trunk Suckers	2.00	23	0	0	0	23	
Disease: Mildew (Rally, Sulfur). **Fertilize**: Foliar Zinc (Neutral Zinc)	0.50	9	7	28	0	44	
Fertilize: N through drip system (UN32)	0.00	0	0	23	0	23	
Irrigate: (Water)	2.55	29	0	165	0	194	
***CM**: Shoot Thin/Position & Leaf Removal	40.00	452	0	0	0	452	
Disease: Mildew (Sulfur, Flint)	0.50	9	7	34	0	49	
Disease: Mildew (Sulfur). **Insect**: Skeletonizer (Kryocide)	0.50	9	7	19	0	35	
Disease: Mildew (Sulfur, Rally)	0.50	9	7	23	0	38	
CM: Cane Cutting (Mechanical)	0.29	5	3	0	0	8	
***FM**: Cluster Tipping and Thinning	25.00	283	0	0	0	283	
FM: Girdling	12.00	136	0	0	0	136	
Disease: Mildew (Rally, Sulfur)/**Insect**: Leafhopper (Provado)	0.50	9	7	67	0	82	
Weed: Spot Spray (Roundup)	0.53	9	1	4	0	14	
Pickup: Business Use	2.39	42	40	0	0	82	
ATV: Irrigation and other	2.00	35	3	0	0	38	
**TOTAL CULTURAL COSTS/ACRE	110.83	1,324	126	494	0	1,944	
TOTAL CULTURAL COSTS/Box		1.47	0.14	0.55	0.00	2.16	
Harvest (900 boxes/acre):							
Pick and Field Pack	225.00	2,545	0	0	0	2,545	
Boxes, Spread, Swamp & Haul	1.75	325	14	1,818	0	2,157	
Brokerage Fee	0.00	0	0	0	972	972	
Assessment & Inspection Fees	0.00	0	0	126	0	126	
TOTAL HARVEST COSTS/ACRE	226.75	2,870	14	1,944	972	5,799	
TOTAL HARVEST COSTS/Box		3.19	0.02	2.16	1.08	6.44	
Interest on operating capital @ 10.00%						117	
TOTAL OPERATING COSTS/ACRE		4,193	140	2,438	972	7,860	
TOTAL OPERATING COSTS/Box		4.66	0.16	2.71	1.08	8.73	
CASH OVERHEAD:							
Office Expense						80	
Liability Insurance						6	
Sanitation Fees						19	
Property Taxes						122	
Property Insurance						35	
Investment Repairs						42	
TOTAL CASH OVERHEAD COSTS						305	
TOTAL CASH COSTS/ACRE						8,165	

*CM = Canopy Management. FM = Fruit Management

**To find cost per box divide by 900

UC COOPERATIVE EXTENSION
Table 2. continued

Operation	Operation Time (Hrs/A)	Labor Cost	Fuel,Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
		Cash and Labor Cost per acre					
NON-CASH OVERHEAD:		Per producing		-- Annual Cost --			
Investment		Acre		Capital Recovery			
Land		7,304		530		530	
Drip Irrigation System		1,250		110		110	
Building		696		57		57	
Tools-Shop/Field		130		14		14	
Fuel Tanks 2-300G		30		2		2	
Vineyard Establishment		6,642		613		613	
Equipment		820		109		109	
TOTAL NON-CASH OVERHEAD COSTS		16,872		1,435		1,435	
TOTAL COSTS/ACRE						9,600	
TOTAL COSTS/box						10.67	

UC COOPERATIVE EXTENSION

Table 3. MATERIAL & CUSTOM COSTS & NET RETURN PER ACRE FOR REDGLOVE TABLE GRAPES

SAN JOAQUIN VALLEY SOUTH - 2007

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
GROSS RETURNS					
Redglobe Table Grapes (21 lb box)	900	box	12.00	10,800	
OPERATING COSTS					
Trellis System:					
Miscellaneous Repair Materials	1.00	acre	10.00	10	
Herbicide:					
Surflan 4 AS	2.40	pint	14.52	35	
Roundup Ultra Max	1.10	pint	7.80	9	
Vertebrate Control:					
Shoot, Bait, Trap	1.00	acre	15.00	15	
Fungicide:					
Abound (Strobilurin)	12.00	floz	2.86	34	
Microthiol Disperss (micronized wettable sulfur)	9.00	lb	0.83	7	
Dusting Sulfur	30.00	lb	0.22	6	
Rally 40W (Sterol Inhibitor)	12.00	oz	5.23	63	
Flint (Strobilurin)	2.00	oz	16.50	33	
Insecticide:					
Lorsban 4E	4.00	pint	6.35	25	
Kryocide	6.00	lb	3.08	18	
Provado 1.6 Solupak	1.00	oz	44.21	44	
Fertilizer:					
Neutral Zinc 50% (foliar)	5.00	lb	1.08	5	
UN 32	50.00	lb N	0.46	23	
Water:					
Water Pumped SJV	36.00	acin	4.59	165	
Harvest Supplies:					
Box 21 lb	900.00	box	1.60	1,440	
Plastic Bags 12/box	10,800.00	bags	0.04	378	
Contract:					
Brokerage Fee (9% of selling price)	900.00	box	1.08	972	
Assessment:					
Table Grape Commission	900.00	box	0.13	115	
Quality Inspection (1/3 of yield)	300.00	box	0.04	11	
Labor (machine)	15.63	hrs	14.63	229	
Labor (non-machine)	350.55	hrs	11.31	3,965	
Fuel - Gas	11.78	gal	2.80	33	
Fuel - Diesel	22.37	gal	2.30	51	
Lube				13	
Machinery repair				43	
Interest on operating capital @ 10.00%				117	
TOTAL OPERATING COSTS/ACRE				7,861	
NET RETURNS ABOVE OPERATING COSTS				2,939	
CASH OVERHEAD COSTS:					
Office Expense				80	
Liability Insurance				6	
Sanitation				19	
Property Taxes				122	
Property Insurance				35	
Investment Repairs				42	
TOTAL CASH OVERHEAD COSTS/ACRE				305	
TOTAL CASH COSTS/ACRE				8,165	

UC COOPERATIVE EXTENSION

Table 3. continued

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
NON-CASH OVERHEAD COSTS (Capital Recovery)					
Land				530	
Drip Irrigation System				110	
Building				57	
Tools-Shop/Field				14	
Fuel Tanks 2-300G				2	
Establishment Costs				613	
Equipment				109	
TOTAL NON-CASH OVERHEAD COSTS/ACRE				1,435	
TOTAL COSTS/ACRE				9,600	
NET RETURNS ABOVE TOTAL COSTS				1,200	

UC COOPERATIVE EXTENSION

Table 4. MONTHLY CASH COSTS PER ACRE to PRODUCE REDGLOBE TABLE GRAPES

SAN JOAQUIN VALLEY SOUTH - 2007

Beginning JAN 07 Ending DEC 07	JAN 07	FEB 07	MAR 07	APR 07	MAY 07	JUN 07	JUL 07	AUG 07	SEP 07	OCT 07	NOV 07	DEC 07	TOTAL
Cultural:													
Vine: Layering Missing Vines	11												11
Prune: Vines	170												170
Prune: Brush Disposal	15												15
Trellis: Repair	33												33
Weed: Winter Strip (Surflan)		53											53
Vertebrate: Gopher, Squirrel, Coyote, Bird (various methods)			2	2	2	2	2	2	2	2			15
Insect: Mealybug (Lorsban)			41										41
Disease: Phomopsis (Abound)/Mildew (Sulfur)			51										51
Weed: Mow Middles 3X			8		8		8						24
Disease: Mildew (Sulfur Dust)				10		10	10						30
Sucker: Trunk				23									23
Disease: Mildew (Sulfur Rally)/**Fertilize**: (Zn)				44									44
Fertilize: (UN32) through drip				23									23
Irrigate: (water & labor)				6	22	37	48	44	31	6			194
***CM**: Shoot Thin/Position & Leaf Removal				452									452
Disease: Mildew (Sulfur, Flint)					49								49
Disease: Mildew (Sulfur). **Insect**: Skeletonizer (Kryocide)					35								35
Disease: Mildew (Rally, Sulfur)						38							38
CM: Cane Cutting (Mechanical)						8							8
***FM**: Cluster Tipping & Thinning						283							283
FM: Girdle						136							136
Disease: Mildew (Rally, Sulfur). **Insect**: Leafhopper (Provado)						82							82
Weed: Spot Spray (Roundup)						14							14
Pickup Truck Use	7	7	7	7	7	7	7	7	7	7	7	7	82
ATV	3	3	3	3	3	3	3	3	3	3	3	3	38
TOTAL CULTURAL COSTS	239	63	111	570	126	620	78	55	43	18	10	10	1,944
Harvest:													
Pick & Field Pack								2,545					2,545
Boxes, Spread, Swamp & Haul								2,157					2,157
Brokerage Fee								972					972
Assessment & Inspection Fees								126					126
TOTAL HARVEST COSTS								5,799					5,799
Interest on operating capital @ 10.00%	2	3	3	8	9	14	15	64	0	0	0	0	117
TOTAL OPERATING COSTS/ACRE	241	66	115	578	135	635	93	5,918	42	18	10	10	7,861
OVERHEAD:													
Office Expense	7	7	7	7	7	7	7	7	7	7	7	7	80
Liability Insurance									6				6
Sanitation Fees	2	2	2	2	2	2	2	2	2	2			19
Property Taxes	61						61						122
Property Insurance	18						18						35
Investment Repairs	4	4	4	4	4	4	4	4	4	4	4	4	42
TOTAL CASH OVERHEAD COSTS	91	12	12	12	12	12	91	12	18	12	10	10	305
TOTAL CASH COSTS/ACRE	332	78	127	590	147	647	184	5,931	60	30	20	20	8,165

* CM = Canopy Management. FM = Fruit Management. ** To find cost per box divide by 900

UC COOPERATIVE EXTENSION

Table 5. RANGING ANALYSIS

SAN JOAQUIN VALLEY SOUTH - 2007

COSTS PER ACRE AT VARYING YIELD TO PRODUCE REDGLOBE TABLE GRAPES

	YIELD (21 lb box/acre)						
	600	700	800	900	1,000	1,100	1,200
OPERATING COSTS:							
Cultural Cost	1,944	1,944	1,944	1,944	1,944	1,944	1,944
Harvest Cost	3,134	3,657	4,179	4,701	5,224	5,746	6,269
Brokerage Fee	648	756	864	972	1,080	1,188	1,296
Assessment/Inspection Cost	84	98	112	126	140	154	168
Interest on operating capital @ 10.00%	101	107	112	117	123	128	134
TOTAL OPERATING COSTS/ACRE	5,911	6,562	7,211	7,860	8,511	9,160	9,811
Total Operating Costs/box	9.85	9.37	9.01	8.73	8.51	8.33	8.18
CASH OVERHEAD COSTS/ACRE	304	304	304	305	305	305	305
TOTAL CASH COSTS/ACRE	6,215	6,866	7,515	8,165	8,816	9,465	10,116
Total Cash Costs/box	10.36	9.81	9.39	9.07	8.82	8.60	8.43
NON-CASH OVERHEAD COSTS/ACRE	1,426	1,429	1,432	1,435	1,437	1,440	1,442
TOTAL COSTS/ACRE	7,641	8,295	8,947	9,600	10,253	10,905	11,558
Total Costs/box	12.73	11.85	11.18	10.67	10.25	9.91	9.63

NET RETURNS PER ACRE **ABOVE OPERATING COSTS**

PRICE	YIELD (21 lb box/acre)						
$/box	600	700	800	900	1,000	1,100	1,200
8.00	-1,111	-962	-811	-660	-511	-360	-211
9.00	-511	-262	-11	240	489	740	989
10.00	89	438	789	1,140	1,489	1,840	2,189
11.00	689	1,138	1,589	2,040	2,489	2,940	3,389
12.00	1,289	1,838	2,389	2,940	3,489	4,040	4,589
13.00	1,889	2,538	3,189	3,840	4,489	5,140	5,789
14.00	2,489	3,238	3,989	4,740	5,489	6,240	6,989

NET RETURNS PER ACRE **ABOVE CASH COSTS**

PRICE	YIELD (21 lb box/acre)						
$/box	600	700	800	900	1,000	1,100	1,200
8.00	-1,415	-1,266	-1,115	-965	-816	-665	-516
9.00	-815	-566	-315	-65	184	435	684
10.00	-215	134	485	835	1,184	1,535	1,884
11.00	385	834	1,285	1,735	2,184	2,635	3,084
12.00	985	1,534	2,085	2,635	3,184	3,735	4,284
13.00	1,585	2,234	2,885	3,535	4,184	4,835	5,484
14.00	2,185	2,934	3,685	4,435	5,184	5,935	6,684

NET RETURNS PER ACRE **ABOVE TOTAL COSTS**

PRICE	YIELD (21 lb box/acre)						
$/box	600	700	800	900	1,000	1,100	1,200
8.00	-2,841	-2,695	-2,547	-2,400	-2,253	-2,105	-1,958
9.00	-2,241	-1,995	-1,747	-1,500	-1,253	-1,005	-758
10.00	-1,641	-1,295	-947	-600	-253	95	442
11.00	-1,041	-595	-147	300	747	1,195	1,642
12.00	-441	105	653	1,200	1,747	2,295	2,842
13.00	159	805	1,453	2,100	2,747	3,395	4,042
14.00	759	1,505	2,253	3,000	3,747	4,495	5,242

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Table 6. WHOLE FARM ANNUAL EQUIPMENT, INVESTMENT,

SAN JOAQUIN VALLEY SOUTH - 2007

ANNUAL EQUIPMENT COSTS

						Cash Overhead		
Yr	Description	Price	Yrs Life	Salvage Value	Capital Recovery	Insur-ance	Taxes	Total
07	60 HP 4WD Narrow Tractor	47,000	15	9,150	4,885	200	281	5,366
07	ATV 4WD	6,700	5	3,003	1,125	35	49	1,209
07	Brush Shredder 6 ft	8,000	15	768	862	31	44	937
07	Cane Cutter	3,500	20	182	333	13	18	364
07	Duster - 3 Pt 12'	5,500	5	1,792	1,040	26	36	1,103
07	Mower-Flail 8'	10,500	15	1,008	1,132	41	58	1,230
07	Orchard/Vine Sprayer 500 gal	21,000	5	6,840	3,973	99	139	4,211
07	Pickup Truck 1/2 T	28,000	7	10,621	4,023	138	193	4,354
07	Sprayer ATV 20 gal	350	10	62	46	1	2	50
07	Truck Flatbed (10 ton)	56,000	10	16,542	6,882	259	363	7,504
07	Weed Sprayer 3 PT 100 gal	4,000	10	707	526	17	24	566
	TOTAL	190,550		50,675	24,827	861	1,206	26,894
	60% of New Cost *	114,330	0	30,405	14,896	517	724	16,136

* Used to reflect a mix of new and used equipment.

ANNUAL INVESTMENT COSTS

					Cash Overhead			
Description	Price	Yrs Life	Salvage Value	Capital Recovery	Insur-ance	Taxes	Repairs	Total
Building 2,400 sqft	80,000	20		6,610	286	400	1,600	8,895
Drip Irrigation System 115 acres	50,000	25		4,388	179	250	1,000	5,816
Vineyard Establishment	265,680	23		24,519	948	1,328	0	26,796
Fuel Tanks 2-300 gal	3,500	30	350	286	14	19	70	389
Land	840,000	25	840,000	60,900	0	8,400	0	69,300
Tools-Shop/Field	15,000	15	1,500	1,614	59	83	300	2,056
TOTAL INVESTMENT	1,254,180		841,850	98,316	1,485	10,480	2,970	113,252

ANNUAL BUSINESS OVERHEAD COSTS

Description	Units/ Farm	Unit	Price/ Unit	Total Cost
Liability Insurance	115	acre	5.86	674
Office Expense	115	acre	80.00	9,200
Sanitation Fee	115	acre	19.35	2,225

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Table 7. HOURLY EQUIPMENT COSTS

SAN JOAQUIN VALLEY SOUTH - 2007

			COSTS PER HOUR						
		Actual		Cash Overhead		Operating			
Yr	Description	Hours Used	Capital Recovery	Insur-ance	Taxes	Repairs	Fuel & Lube	Total Opera.	Total Costs/Hr.
07	60 HP 4WD Narrow Tractor	1,066	2.75	0.11	0.16	1.12	7.79	8.91	11.93
07	ATV 4WD	400	1.69	0.05	0.07	0.49	1.07	1.56	3.37
07	Brush Shredder 6 ft	133	3.89	0.14	0.20	3.49	0.00	3.49	7.72
07	Cane Cutter	100	1.99	0.08	0.11	1.29	0.00	1.29	3.47
07	Duster - 3 Pt 12'	240	2.60	0.07	0.09	0.79	0.00	0.79	3.55
07	Mower-Flail 8'	133	5.12	0.19	0.26	4.58	0.00	4.58	10.15
07	Orchard/Vine Sprayer 500 gal	400	5.96	0.15	0.21	3.67	0.00	3.67	9.99
07	Pickup Truck 1/2 T	286	8.46	0.29	0.41	2.04	14.76	16.80	25.96
07	Truck Flatbed (10 ton)	150	0.18	0.01	0.01	0.09	0.00	0.09	0.29
07	Sprayer ATV 20 gal	200	20.65	0.78	1.09	5.30	2.64	7.94	30.46
07	Weed Sprayer 3 PT 100 gal	200	1.58	0.05	0.07	0.68	0.00	0.68	2.38

UC COOPERATIVE EXTENSION

Table 8. OPERATIONS WITH EQUIPMENT FOR RED GLOBE TABLE GRAPES

SAN JOAQUIN VALLEY SOUTH - 2007

Operation	Operation Month	Tractor	Implement	Material	Broadcast Rate/acre	Unit
Weed: Winter Strip	March	60HP 4WD	Weed Sprayer	Surflan	2.40	pt
				Roundup	.60	pt
Weed: Mow Middles	March	60HP 4WD	Mower Flail 8'			
	May	60HP 4WD	Mower Flail 8'			
	July	60HP 4WD	Mower Flail 8'			
Weed: Spot Spray	June	ATV 4WD	Weed Sprayer	Roundup	0.50	pt
Fertilizer through Drip	April			UN 32	50.00	lb N
Irrigation	April			Water	1.00	acin
	May			Water	4.00	acin
	June			Water	7.00	acin
	July			Water	9.00	acin
	August			Water	8.00	acin
	September			Water	6.00	acin
	October			Water	1.00	acin
Disease:Phomopsis/Mildew	March	60HP 4WD	Air Blast Sprayer	Abound	12.00	floz
				Microthiol	1.00	lb
Vertebrate Control:	Mar – Oct			Various Methods	15.00	acre
Disease: Mildew 3X	April	60HP 4WD	Duster	Sulfur Dust	10.00	lb
	June	60HP 4WD	Duster	Sulfur Dust	10.00	lb
	July	60HP 4WD	Duster	Sulfur Dust	10.00	lb
Disease: Mildew. **Fertilize**: Zinc	April	60HP 4WD	Air Blast Sprayer	Microthiol (Mildew)	2.00	lb
				Rally (Mildew)	4.00	oz
				Neutral Zinc	5.00	lb
Disease: Mildew	May	60HP 4WD	Air Blast Sprayer	Microthiol (Mildew)	2.00	lb
				Flint (Mildew)	2.00	oz
Disease: Mildew. **Insect**: Skeletonizer	May	60HP 4WD	Air Blast Sprayer	Microthiol (Mildew)	1.00	lb
				Kryocide (Skeletonizer)	6.00	lb
Disease: Mildew	June	60HP 4WD	Air Blast Sprayer	Microthiol (Mildew)	2.00	lb
				Rally (Mildew)	4.00	oz
Disease: Mildew. **Insect**: Leafhopper	June	60HP 4WD	Air Blast Sprayer	Microthiol (Mildew)	2.00	lb
				Rally (Mildew)	4.00	oz
				Provado (Leafhopper)	1.00	oz
Trellis: Repair	January			Labor	2.00	hrs
				Trellis Materials	10.00	acre
Vine: Layering Vines	January			Labor	1.00	hrs
Prune: Dormant	January			Labor	20.00	hrs
Prune: Shred Brush	January	60HP 4WD	Mower Flail 8'			
Insect: Mealybug	March	60HP 4WD	Air Blast Sprayer	Lorsban	4.00	pt
***CM**: Shoot Thin/Position & Leaf Removal	April			Labor	40.00	hrs
CM: Cane Cutting (Mechanical)	June	60HP 4WD	Cane Cutter			
Sucker: Remove Trunk Suckers	April			Labor	2.00	hrs
***FM**: Cluster Tipping & Thinning	June			Labor	25.00	hrs
FM: Girdle	June			Labor	12.00	hrs
Pickup: Truck Use	Annual	Pickup 1/2 ton				
ATV:	Annual	ATV				
Harvest: Pick & Pack	August			Labor	175.00	hrs
Harvest: Swamp, Spread, Haul	August	Truck Flatbed		Labor	26.00	hrs
				Boxes	900.00	boxes
				Plastic bags	10,800	bags

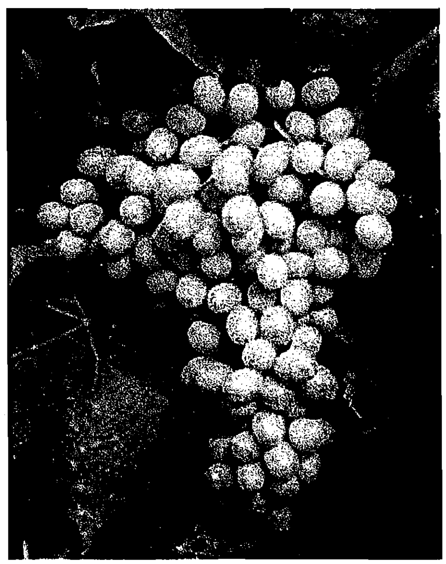
*CM = Canopy Management. FM = Fruit Management

GR-VS-07-1

UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

2007

SAMPLE COSTS TO ESTABLISH AND PRODUCE
TABLE GRAPES
THOMPSON SEEDLESS



SAN JOAQUIN VALLEY - South

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UC COOPERATIVE EXTENSION

SAMPLE COSTS TO ESTABLISH A VINEYARD AND PRODUCE TABLE GRAPES

Thompson Seedless

San Joaquin Valley – South 2007

CONTENTS

INTRODUCTION

Sample costs to establish a vineyard and produce Thompson Seedless table grapes are presented in this study. This study is intended as a guide only, and can be used to make production decisions, determine potential returns, prepare budgets and evaluate production loans. Practices described are based on production practices considered typical for the crop and area, but these same practices will not apply to every farming operation. The sample costs for labor, materials, equipment and custom services are based on current figures. A blank column, "*Your Costs*", in Tables 2 and 3 is provided for entering your costs.

The hypothetical farm operation, production practices, overhead, and calculations are described under the assumptions. For additional information or an explanation of the calculations used in the study call the Department of Agricultural and Resource Economics, University of California, Davis, (530) 752-3589 or your local UC Cooperative Extension office.

Sample Cost of Production Studies for many commodities can be downloaded at http://coststudies.ucdavis.edu, requested through the Department of Agricultural and Resource Economics, UC Davis, (530) 752-1517 or obtained from the local county UC Cooperative Extension offices. Some archived studies are also available on the website.

The University of California and the United States Department of Agriculture, Risk Management Agency, cooperating.

ASSUMPTIONS

The assumptions refer to Tables 1 to 8 and pertain to sample costs to establish a vineyard and produce Thompson Seedless table grapes in the San Joaquin Valley. The cultural practices described and materials used are considered typical for a well-managed vineyard in the region. The costs, materials, and practices will not apply to all farms. Timing of and types of establishment and cultural practices will vary among growers within the region and from season to season due to variables such as weather, soil, and insect and disease pressure. **The use of trade names and cultural practices in this report does not constitute an endorsement or recommendation by the University of California nor is any criticism implied by omission of other similar products or cultural practices.**

Farm. The hypothetical farm consists of 120 contiguous acres. Thompson Seedless vineyard establishment and table grape production is on 40 acres. Other varieties are on 75 acres and roads, irrigation systems, and farmstead occupy five acres. The farm is owned and managed by the grower.

Establishment Cultural Practices & Material Inputs (Table 1)

Site Preparation. This vineyard is established on ground previously planted to vineyards or orchards. Land coming from vines or trees should be fallowed for two years except for a possible grain crop. The land is assumed to be fairly level. A custom operator chisels the ground (subsoils) twice to a depth of 4 to 5 feet. The grower floats the land to smooth and level the surface. Afterwards the ground is disced twice to apply and incorporate preplant herbicide. Nematode samples should be taken from land formerly in vines or trees and fumigated if necessary. Most operations that prepare the vineyard for planting are done in the year prior to planting, but costs are shown in the first year.

Plant. Planting the vineyard starts by laying out and marking vine sites in early spring. Holes are dug and vines planted and a two-inch by two-inch cardboard carton placed around the vine. The grapevines are planted during the first spring on an 8-foot x 12-foot spacing (vine x row) with 454 vines per acre. In the second year, 2% or 9 vines per acre are replaced.

Vines. The Thompson Seedless plants are dormant, bench-grafted rootstock vines purchased from a commercial nursery. Vines are trained during the second and third years. The grapevines are expected to begin yielding fruit in three years and then be productive for an additional 22 years.

Trellis System. A commercial company installs the trellis system in the second year. The trellis system will be removed when the vineyard is removed; therefore it is considered part of the vineyard and included in the establishment costs. Materials for the open gable trellis are as follows: (1) Stakes with V structure are placed every 24-feet down the row. Metal stakes (2 lbs/ft strength) are 8.5-feet long and placed in the ground 3-feet. The open gable is 72-inches wide from tip to tip. (2) End assemblies consist of 9.5-foot metal post (4 lb/ft) with a V that matches those within the row and with 10-inch helix anchor. (3) Eight wires, 12.5 gauge high tensile, are used for fruit and canopy support, and three wires, 14 gauge high tensile, are used for movable catch wires and drip hose support.

Train/Prune. Vines are pruned to one two bud spur in the first dormant season (December to February). Pruning costs are shown in January in this study.

Train. The following spring (second year), a single shoot is selected and trained up the stake to form the permanent structure of the vine. Training consists of tying the shoot, removing lateral shoots from the base and tipping the shoot when it reaches the top of the stake to form the head of the vine. Most of the training costs occur during the second summer. The third summer is devoted to replacing and training missing vines or vines delayed in growth.

Prune. In the third year (January), vines are pruned much like an established vine. The exception being the number of canes retained – 2-3 canes on young vines and 5-8 canes on mature vines. Prunings are placed in the row middles and shredded. Selecting and tying canes to fruiting wires is required each year for the life of the vineyard. Suckers from vine trunks are removed in April, a practice that continues each year but diminishes as the vineyard matures.

Irrigate. Water pumping costs plus labor constitute the irrigation cost. In this study, water is calculated to cost $4.59 per acre-inch or $55.08 per acre-foot. The pumping cost is based on a 40 horsepower (HP) motor to pump from 130 feet deep. The vineyard is irrigated during the growing season from April through October during the establishment years. Price per acre-foot of water will vary by grower in this region depending on quantity used, water district, power cost, various well characteristics, and other irrigation factors. The amount of water applied to the vineyard varies through the establishment years and is shown in Table A.

Table A. Irrigation Water Applied

Year	AcIn/Year
1	8
2	18
3+	36

Fertilize. Liquid nitrogen fertilizer, UN32, is applied through the irrigation system in April of the first year at five pounds of N per acre. A single application is made in April of the second year and equally split applications in May and June of the third year. The amount of nitrogen applied each year increases as the vineyard matures and is shown in Table B. It is important to identify sources of nitrogen in order to properly manage the nitrogen budget. For example, sources of nitrogen found in irrigation well water should be calculated to determine future irrigation and fertilizer needs.

Table B. Applied Nitrogen (N) Per Acre

Year	Lbs of N
1	5
2	20
3	40
4+	50

Pest Management. For pest identification, monitoring, management and pesticide information, visit the UC IPM website at www.ipm.ucdavis.edu. Written recommendations are required for many commercially applied pesticides, and are available from licensed pest control advisers (PCAs). For information on pesticide use permits, contact the local county Agricultural Commissioner's office. **Pesticides mentioned in this study are used to calculate rates and costs. Although the pesticides mentioned are commonly used by growers, many other pesticides are available. Check with your PCA and/or the UC IPM website for current recommendations.**

Weeds (Vineyard Floor Management). In October of the year prior to planting, Treflan is applied to the vineyard floor and incorporated by discing. After planting, weeds in the vine rows and middles are managed with discing, mowing, and/or herbicides. From March through July of the first year, the row middles are disced twice and mowed twice. The vine rows are hand weeded in April. The row middles are mowed four times in the second year and three times in the third year. The vine rows are sprayed (strip spray) in January of the second year with Roundup and Surflan. The strip spray is applied to 30% of the acreage. Also in the second year, spot sprays using Roundup are applied to the vine row in April, June, and July. The spot sprays (weedy spots or areas) are applied using an all terrain vehicle (ATV) with a sprayer attached.

Insects. Western grapeleaf skeletonizer (*Harrisina brillians*) is controlled in April of the second and third years with an application of Kryocide insecticide (mixed with micronized sulfur disease sprays). In the third year, Provado insecticide is applied in June to control grape leafhoppers (*Erythroneura elegantula*). Insects such as mealybugs (*Pseudococcus sp.*) are monitored each year beginning in the spring and may increase production costs if found.

Diseases. Although many pathogens attack grapevines, phomopsis cane and leafspot (*Phomopsis viticola)* and powdery mildew (*Erysiphe necator)* are the two diseases managed in this study. In the second year, Microthiol (micronized sulfur) for mildew is applied (with Kryocide insecticide application) in April. In March of the third year, Microthiol plus Abound (strobilurin) are applied for phomopsis and mildew control. Mildew is controlled with various fungicide applications at 7 to 21 day intervals in the third year, depending on the fungicide used. For this study, the grower applies Kocide (copper) and Rubigan (SI), and two Microthiol applications (one with Kryocide) in April; one Rubigan (SI) application and two dusting sulfur applications in May; one Rubigan (SI) application and three dusting sulfur applications in June. Growers have the option of using sulfur (dust, wettable, flowable or micronized), sterol inhibitors (SIs), or strobilurins, as well as other fungicides to control powdery mildew. Sterol inhibitors and strobilurins are two classes of fungicides with different modes of action than sulfur against powdery mildew. It is recommended that fungicides with different modes of action be used to avoid powdery mildew populations from developing fungicide resistance.

Vertebrate. Rabbits, gophers, squirrels and coyotes are pests that can cause damage to the vines and irrigation lines. Various forms of control such as baiting, trapping and/or building a rabbit fence are utilized as necessary throughout the year. For this study no specific control is used, but an estimated cost for one or two management practices are shown in March. Endangered Species: It is important to know if your vineyard is located in an area where endangered species reside (i.e. San Joaquin Kit Fox). Trapping and killing endangered species can result in fines. Contact your County Agricultural Commissioner for additional information.

Harvest/Yield/Returns. Harvest begins the third year and the fruit is picked for wine. A contractor hand harvests the crop for $60 per ton. Harvest includes hand picking the grapes into bins that are furnished by the contractor. Hauling to the winery will vary depending on the hauling distance. For this study, the haul is less than 20 miles and cost $10 per ton. A six-ton per acre yield is assumed in the third year.

Mature Production Cultural Practices and Material Inputs
(Tables 2-8)

Prune/Sucker/Canopy Management (CM). The vines are cane-pruned during the winter months (December to early February) and the prunings are placed in the row middles and shredded. In mid February, the canes are tied to a trellis wire(s) by wrapping around the trellis wire and tying with twist-ties. Suckers are removed from the vine trunks and crowns beginning in April. Shoot positioning is done in May. Cane cutting is done as needed beginning in June (June only in this study) with the grower's equipment.

Fruit Management (FM). Gibberellic acid (GA), a plant growth regulator, is applied four times. Two times in May during bloom for thinning at 12 grams per acre per application and two times in June, two weeks after full bloom and one week later for berry sizing at 60 grams per acre per application (disease and insect materials are included with these applications). A third sizing application (not included in this study) at 40 grams per acre is sometimes applied about one-week later to delay maturity. Vines are girdled in June at berry set, two to three weeks after full bloom. Cluster tipping and hand thinning are done after berry set in late May to early June to loosen clusters, and adjust cluster length and crop load.

Trellis/Vines. Trellis repairs are done annually and the cost is not taken from any specific data. Sick vines are replaced by layering. One year-old canes from vines are buried in the soil next to the stake and allowed to root. After rooting the canes are cut and the plant trained on the trellis. Trellis repair and vine replacement costs increase with vineyard age.

Irrigate. The vineyard is drip irrigated during the growing season from April through October. Deficit irrigation (80% ET) is applied post-harvest to control vine growth and promote cane maturity. Deficit irrigation may also be applied three to four weeks before harvest to advance maturity and decrease decay, but should be used with caution. Vineyards with poor root systems or high populations of soil pests should be monitored closely under deficit irrigation. Water pumping costs plus labor constitute the irrigation cost. In this study, water is calculated to cost $4.59 per acre-inch or $55.08 per acre-foot. The pumping cost is based on a 40 horsepower (HP) motor to pump from 130 feet deep pressurized to 20 pounds per square inch (PSI). A total of 36 acre-inches is applied to the vineyard. Price per acre-foot of water will vary by grower in this region depending on quantity used, water district, power cost, various well characteristics, and other irrigation factors. In some years, irrigation may be needed in March for frost protection.

Fertilize. Nitrogen (N) at 50 pounds per acre as UN32 is applied through the irrigation drip system in April (or can be applied post harvest). Neutral zinc is applied to prevent zinc deficiencies and is combined with the late April mildew (Microthiol, Rally) application.

Pest Management. The pesticides and rates mentioned in this cost study are listed in *UC Integrated Pest Management Guidelines, Grapes.* For information on other pesticides available, pest identification, monitoring, and management visit the UC IPM website at www.ipm.ucdavis.edu. For information and pesticide use permits, contact the local county agricultural commissioner's office. **Pesticides mentioned in this study are used to calculate rates and costs. Although the pesticides mentioned are commonly used by growers, many other pesticides are available. Check with your PCA and/or the UC IPM website for current recommendations.** Adjuvants are recommended for use with many pesticides for effective control, but the adjuvants and their costs are not included in this study. Pesticide costs may vary by location, brand, and grower volume. Pesticide costs in this study are taken from a single dealer and shown as full retail.

Pest Control Adviser (PCA). Written recommendations are required for many commercially applied pesticides and are written by licensed pest control advisers. In addition the PCA will monitor the field for agronomic problems including pests, diseases, and nutritional status. Growers may hire private PCAs or receive the service as part of a service agreement with an agricultural chemical and fertilizer company. Costs for a PCA are not included in this study.

Weeds (Vineyard Floor Management). Vineyard middles are mowed three times each season: March, May, July. Surflan and Roundup herbicides are applied to the vine row in February. Roundup, a contact herbicide, is applied as a spot spray to the vine row in June.

Insects. Mealybug (*Pseudococcus sp.*) is treated with Lorsban insecticide in early March (dormant vines). Western grapeleaf skeletonizer (*Harrisina brillians*) is treated with Kryocide (mixed with a GA and/or sulfur application) during the second bloom thinning spray in May. Grape leafhoppers (*Erythroneura elegantula*) are controlled with Provado insecticide (mixed with GA, Microthiol, Flint) during the second berry size spray in June. An effective alternative material for mealybugs is to apply Admire insecticide through the drip system, but at a higher cost than a Lorsban application. It may be necessary to use multiple insecticides to control some mealybug species.

Diseases. Diseases treated in this study are phomopsis cane and leafspot (*Phomopsis viticola)* and powdery mildew (*Eryshiphe necator)*. Phomopsis and powdery mildew are both treated in late March (shoot length 2 inches) with Microthiol (micronized sulfur) and Abound (strobilurin). Mildew is controlled during the season with various fungicide applications at 7 to 21 day intervals, depending on the fungicide used. In this study, Dusting Sulfur is applied three times - April, June, July. Microthiol and Rally, an SI (with zinc) are applied in late April. Microthiol and Flint, a strobilurin (with GA) are applied with the first May bloom thin spray. Microthiol (with GA and Kryocide) is applied with the second bloom thin spray in May. Microthiol and Rally, an SI (with GA) are applied with the first berry size spray in June and Microthiol and Flint, a strobilurin (with GA and Provado) with the second berry size spray in June. Growers have the option of using sterol inhibitors (SI), quinolins, strobilurins, or sulfur (micronized, wettable, dust, flowable), as well as other fungicides to control powdery mildew. These materials are classes of fungicides with different modes of action. Check the IPM website under grapes for management options to control powdery mildew. It is recommended that applicators use fungicides with different modes of action in order to avoid fungicide resistance in powdery mildew populations.

Vertebrate. Rabbits, gophers, squirrels coyotes and birds are pests that can cause damage to the vines and irrigation lines. Various forms of control such as baiting, trapping and/or building a rabbit fence are utilized as necessary throughout the year. For this study no specific control is used, but per acre costs are shown from March through October and are an estimate not based on any specific data. Endangered Species: It is important to know if your vineyard is located in an area where endangered species reside (i.e. San Joaquin Kit Fox). Trapping and killing endangered species can result in fines. Contact your County Agricultural Commissioner for additional information.

Harvest. Beginning in the fourth year, the grapes are harvested for table grapes and packed in the field. Harvest crews work in teams of three or four people. Depending upon fruit quality, a crew can pick 3 to 6 boxes per hour per individual. In this cost analysis it is assumed that each individual packs four boxes per hour. Two or three crew members field pick and trim grape clusters and place them into boxes, which are then palletized. Approximately four field boxes are loaded on a wheelbarrow and delivered to the packer who finish trims and bags the bunches, which are then placed in shipping boxes. The box holds 9 bags of grapes and contains 19 pounds of fruit. The filled boxes are loaded on a flat bed truck and hauled to a cold storage facility. The swamp and haul costs includes the boxes, plastic bags and related labor. Pre cooling and palletization (P&P) costs may in some cases be a grower cost but are generally charged to the buyer. After 30 days of cold storage, the grower is charged approximately $0.35 per box per month ($0.25-0.45) until the fruit is sold. Brokerage fees are paid by the grower and range from 7 to 10% of the selling price. A figure of 9% of the selling price is used in this study.

Yields. This study based on grower input uses an average yield of 800 19-pound boxes over the remaining life of the vineyard. Average yields shown in Table C are the average of all table grape varieties.

Table C. Table Grapes

Average Yields	
Year	Tons/Acre (boxes)
2002	8.13 (856)
2003	7.60 (800)
2004	7.76 (815)
2005	11.34 (1,194)
2006	9.66 (1,016)

Source: Fresno County Crop Reports, 2002-2006.
Boxes = 19 lbs.

Returns. Return prices for grapes at different yields and price are shown in Table 5. Based on grower input, an estimated price of $12 per box for Thompson Seedless grapes is used in this study.

Assessments/Inspection. The California Table Grape Commission (CTGC) assesses $0.1156 per 19-pound box or $0.006087 per pound. Early in the season, growers often have the county Agricultural Commissioner inspect their fruit for maturity at a cost of $0.035 per box. Approximately one-third of the entire crop is inspected to determine that maturity requirements are met, which includes soluble solids:acid ratios (20:1) and color.

Pickup/ATV. It is assumed that the grower uses the pickup for business and personal use. Estimated business mileage for the ranch is 5,250 miles. The all terrain vehicle (ATV) is used for spot spraying weeds and is included in that cost. It is assumed that the ATV will be used another 800 miles on the ranch for checking the vineyards including the irrigation system.

Labor. Hourly wages for workers are $11.00 for machine operators and $8.50 per hour non-machine labor. Adding 33% for the employer's share of federal and state payroll taxes, workers compensation insurance for vine crops (0040) and other possible benefits gives the labor rates shown of $14.63 and $11.31 per hour for machine labor and non-machine labor, respectively. Workers' compensation costs will vary among growers, but for this study the cost is based upon the average industry final rate as of January 1, 2007 (personal email from California Department of Insurance, May 18, 2007, unreferenced). Labor for operations involving machinery are 20% higher than the operation time given in Table 2 to account for the extra labor involved in equipment set up, moving, maintenance, work breaks, and field repair.

Equipment Operating Costs. Repair costs are based on purchase price, annual hours of use, total hours of life, and repair coefficients formulated by American Society of Agricultural Engineers (ASAE). Fuel and lubrication costs are also determined by ASAE equations based on maximum power takeoff (PTO) horsepower, and fuel type. Prices for on-farm delivery of diesel and gasoline are $2.30 and $2.80 per gallon, respectively. Fuel costs are derived from American Automobile Association (AAA) and Energy Information Administration 2006 monthly data. The cost includes a 2% local sales tax on diesel fuel and 8% sales tax on gasoline. Gasoline also includes federal and state excise tax, which are refundable for on-farm use when filing your income tax. The fuel, lube, and repair costs per acre for each operation in Table 2 are determined by multiplying the total hourly operating cost in Table 7 for each piece of equipment used for the selected operation by the hours per acre. Tractor time is 10% higher than implement time for a given operation to account for setup, travel and down time.

Interest on Operating Capital. Interest on operating capital is based on cash operating costs and is calculated monthly until harvest at a nominal rate of 10.00% per year. A nominal interest rate is the typical market cost of borrowed funds. The interest cost of post harvest operations is discounted back to the last harvest month using a negative interest charge. The rate will vary depending upon various factors, but the rate in this study is considered a typical lending rate by a farm lending agency as of January 2007.

Risk. The risks associated with crop production should not be minimized. While this study makes every effort to model a production system based on typical, real world practices, it cannot fully represent financial, agronomic and market risks, which affect profitability and economic viability. Growers may purchase Federal crop insurance to reduce the production risk associated with specific natural hazards. Insurance policies vary and range from a basic catastrophic loss policy to one that insures losses for up to 75% of a crop. Insurance costs will depend on the type and level of coverage.

Cash Overhead

Cash overhead consists of various cash expenses paid out during the year that are assigned to the whole farm and not to a particular operation. These costs include property taxes, interest on operating capital, office expense, liability and property insurance, sanitation services, equipment repairs, and management.

Property Taxes. Counties charge a base property tax rate of 1% on the assessed value of the property. In some counties special assessment districts exist and charge additional taxes on property including equipment, buildings, and improvements. For this study, county taxes are calculated as 1% of the average value of the property. Average value equals new cost plus salvage value divided by 2 on a per acre basis.

Insurance. Insurance for farm investments varies depending on the assets included and the amount of coverage. Property insurance provides coverage for property loss and is charged at 0.714% of the average value of the assets over their useful life. Liability insurance covers accidents on the farm and costs $674 for the entire farm.

Office Expense. Office and business expenses are estimated at $80 per producing acre or $9,200 annually for the ranch. These expenses include office supplies, telephones, bookkeeping, accounting, legal fees, road maintenance, etc. The cost is assumed and not taken from any specific data.

Sanitation Services. Sanitation services provide double portable toilets with washbasins for 10 months. The cost includes delivery and weekly cleaning service. The number of sanitation facilities will vary depending upon local regulations and size of labor force. In many cases labor contractors furnish the sanitation facilities for their crews and it is included in the contractor's labor overhead.

Management/Supervisor Wages. Salary is not included. Returns above costs are considered a return to management

Investment Repairs. Annual maintenance is calculated as 2% of the purchase price.

Non-Cash Overhead Costs

Non-cash overhead is calculated as the capital recovery cost for equipment and other farm investments.

Capital Recovery Costs. Capital recovery cost is the annual depreciation and interest costs for a capital investment. It is the amount of money required each year to recover the difference between the purchase price and salvage value (unrecovered capital). It is equivalent to the annual payment on a loan for the investment with the down payment equal to the discounted salvage value. This is a more complex method of calculating ownership costs than straight-line depreciation and opportunity costs, but more accurately represents the annual costs of ownership because it takes the time value of money into account (Boehlje and Eidman). The formula for the calculation of the annual capital recovery costs is ((Purchase Price – Salvage Value) x Capital Recovery Factor) + (Salvage Value x Interest Rate).

Salvage Value. Salvage value is an estimate of the remaining value of an investment at the end of its useful life. For farm machinery (tractors and implements) the remaining value is a percentage of the new cost of the investment (Boehlje and Eidman). The percent remaining value is calculated from equations developed by the American Society of Agricultural Engineers (ASAE) based on equipment type and years of life. The life in years is estimated by dividing the wear out life, as given by ASAE by the annual hours of use in this operation. For other investments including irrigation systems, buildings, and miscellaneous equipment, the value at the end of its useful life is zero. The salvage value for land is the purchase price because land does not depreciate. The purchase price and salvage value for equipment and investments are shown in Table 6.

Capital Recovery Factor. Capital recovery factor is the amortization factor or annual payment whose present value at compound interest is 1. The amortization factor is a table value that corresponds to the interest rate used and the life of the machine.

Interest Rate. An interest rate of 7.25% is used to calculate capital recovery. The rate will vary depending upon loan amount and other lending agency conditions, but is the basic suggested rate by a farm lending agency as of January 2007.

Land. The land was formerly a vineyard, but has been out of production for two years. The open land was planted to grain crops. Land values in the San Joaquin Valley with table grape production ranges from $6,000 to $13,400 per acre (depending on vineyard age, variety and location). Cropland with district or well water in the area ranges from $2,500 to $12,000. For this study, the land value was established based on 2007 real estate values (2007 Trends & Leases); therefore a cost of $7,000 per acre or $7,304 per producing acre is used.

Tools. This is an assumed value for shop, hand, and miscellaneous field tools and not based on any grower's tool inventory.

Fuel Tanks. Two 300-gallon fuel tanks using gravity feed are on metal stands. The tanks are setup in a cement containment pad that meets federal, state, and county regulations.

Drip Irrigation System. The drip lines, filters, booster pump and the labor to install the components are included in the irrigation system cost. The previous vineyard is assumed to have a pumping system that had been refurbished and therefore is not included as a cost. Water is delivered from a 130-foot depth using a 40-horsepower pump. The drip irrigation lines are laid directly on the ground prior to planting and the labor cost is included in the drip irrigation system cost.

Establishment Cost. The establishment cost is the sum of the costs for land preparation, trellis system, planting, vines, cash overhead and production expenses for growing the vines through the first year that grapes are harvested (year three). It is used to determine the non-cash overhead expense, capital recovery cost, during the production years. The Total Accumulated Net Cash Cost on Table 1, in the third year represents the establishment cost. For this study the cost is $8,999 per acre or $359,960 for the 40 producing acres. The establishment cost is spread over the remaining 22 years of the 25 years the vineyard is in production.

Equipment. Farm equipment is purchased new or used, but the study shows the current purchase price for new equipment. The new purchase price is adjusted to 60% to indicate a mix of new and used equipment. Annual ownership costs for equipment and other investments are shown in Table 6. Equipment costs are composed of three parts: non-cash overhead, cash overhead, and operating costs. Both of the overhead factors have been discussed in previous sections. The operating costs consist of repairs, fuel, and lubrication and are discussed under operating costs.

Table Values. Due to rounding, the totals may be slightly different from the sum of the components.

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UC COOPERATIVE EXTENSION

Table 1. SAMPLE COSTS PER ACRE TO ESTABLISH A TABLE GRAPE VINEYARD-Thompson Seedless

SAN JOAQUIN VALLEY - SOUTH 2007

	Cost Per Acre		
Year:	1st	2nd	3rd
Tons Per Acre:	0	0	6.00
Planting Costs:			
Site Prep: Subsoil 2X	400		
Site Prep: Float (Level)	12		
Site Prep: Disc/Apply Herbicide (Treflan)	17		
Site Prep: Disc/Incorporate Herbicide	12		
Plant: Survey & Layout Vineyard	61		
Plant: Plant, Wrap Vines	145	2	
Vines: 454 Per Acre (2% Replant In 2nd Year)	1,407	28	
Trellis: Install Trellis System		4,000	
TOTAL PLANTING COSTS	2,055	4,030	
Cultural Costs:			
Vertebrate: Rabbit, Squirrel, Gopher (various methods)	40	15	15
Fertilize: Nitrogen	3	9	18
Irrigate: Water/Labor	54	109	161
Weed: Disc Middle - 2X/Yr 1	16		
Weed: Mow Middle - 2X/Yr 1, 4X/Yr 2, 3X/Yr 3	16	31	24
Weed: Hand Hoe	34		
Prune: (& Tie): Dormant		73	147
Training: (Sucker, Tie)		271	113
Insect: Skeletonizer (Kryocide). **Disease**: Mildew (Microthiol)		36	36
Weed: Spot Spray (Roundup)		42	42
Weed: Winter Strip Spray (Roundup, Surflan)		53	53
Prune: Shred Prunings (every middle)			15
Disease: Phomopsis (Microthiol, Abound)			51
Disease: Mildew Control (Microthiol)			20
Insect: Leafhoppers 1X (Provado)			46
Disease: Mildew - (Kocide, Rubigan)			50
Disease: Mildew 5X (Sulfur Dust)			48
Disease: Mildew 2X, (Rubigan)			56
Pickup Truck Use	82	82	82
ATV Use	30	38	38
TOTAL CULTURAL COSTS	274	760	1,016
Harvest Costs:			
Harvest: Contract			420
TOTAL HARVEST COSTS			420
Interest On Operating Capital @ 10.00%	213	355	50
TOTAL OPERATING COSTS/ACRE	2,542	5,144	1,485
Cash Overhead Costs:			
Office Expense	80	80	80
Liability Insurance	6	6	6
Sanitation Service	19	19	19
Property Taxes	85	86	87
Property Insurance	9	9	10
Investment Repairs	42	42	42
TOTAL CASH OVERHEAD COSTS	242	242	245
TOTAL CASH COSTS/ACRE	2,783	5,386	1,730
INCOME/ACRE FROM PRODUCTION	0	0	900
NET CASH COSTS/ACRE FOR THE YEAR	2,783	5,386	830
PROFIT/ACRE ABOVE CASH COSTS	0	0	0
ACCUMULATED NET CASH COSTS/ACRE	2,783	8,169	**8,999**

UC COOPERATIVE EXTENSION

Table 1. continued

	Cost Per Acre		
Year:	1st	2nd	3rd
Tons Per Acre:	0	0	6.00
Non Cash Overhead (Capital Recovery) Cost:			
Land	530	530	530
Irrigation System	110	110	110
Shop Building	57	57	57
Shop Tools	14	14	14
Fuel Tank & Pump	2	2	2
Equipment	37	41	76
TOTAL CAPITAL RECOVERY COST	751	755	789
TOTAL COST/ACRE FOR THE YEAR	3,534	6,141	2,519
INCOME/ACRE FROM PRODUCTION	0	0	900
NET COST/ACRE FOR THE YEAR	3,534	6,141	1,619
NET PROFIT/ACRE ABOVE TOTAL COST	0	0	0
TOTAL ACCUMULATED NET COST/ACRE	3,534	9,675	11,294

UC COOPERATIVE EXTENSION

Table 2. COSTS PER ACRE TO PRODUCE TABLE GRAPES – Thompson Seedless

SAN JOAQUIN VALLEY - SOUTH 2007

Operation	Operation Time (Hrs/A)	Cash and Labor Cost per acre: Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
Cultural:							
Vines: Layering Missing Vines	1.00	11	0	0	0	11	
Prune: Vines	35.00	396	0	0	0	396	
Prune: Brush Disposal (Every Middle)	0.50	9	7	0	0	15	
Trellis: Repair	2.00	23	0	10	0	33	
***CM**: Tie Canes	9.00	102	0	14	0	115	
Weed: Winter Strip (Surflan, Roundup)	0.49	9	5	40	0	53	
Vertebrate: Gopher, Squirrel, Coyotes, Birds (various methods)	0.00	0	0	15	0	15	
Disease: Phomopsis (Abound)/Mildew (Microthiol)	0.50	9	7	35	0	51	
Insect: Mealybug (Lorsban)	0.50	9	7	25	0	41	
Weed: Mow Middles 3X	0.74	13	11	0	0	24	
Disease: Mildew 3X (Dusting Sulfur)	0.84	15	9	6	0	30	
Sucker: Remove Trunk Suckers	2.00	23	0	0	0	23	
Disease: Mildew (Rally, Microthiol). **Fertilize**: Foliar Zinc (Neutral Zinc)	0.50	9	7	28	0	44	
Fertilize: N through drip system (UN32)	0.00	0	0	23	0	23	
Irrigate: (Water)	2.55	29	0	165	0	194	
CM: Shoot Positioning	10.00	113	0	0	0	113	
FM: Bloom Thin: (GA). **Disease**: Mildew (Microthiol, Flint)	0.50	9	7	55	0	70	
FM: Bloom Thin: (GA). **Disease**: Mildew (Microthiol). **Insect**: Skeletonizer (Kryocide)	0.50	9	7	40	0	56	
FM: Berry Size (GA). **Disease**: Mildew (Rally, Microthiol)	0.50	9	7	123	0	139	
FM: Cluster Tipping and Thinning	50.00	566	0	0	0	566	
FM: Girdling	12.00	136	0	0	0	136	
CM: Cane Cutting (Mechanical)	0.31	5	3	0	0	9	
FM: Berry Size (GA). **Disease**: Mildew (Flint, Microthiol). **Insect**: Leafhopper (Provado)	0.50	9	7	180	0	195	
Weed: Spot Spray (Roundup)	0.53	9	1	4	0	14	
Pickup: Business Use	2.39	42	40	0	0	82	
ATV Use	2.00	35	3	0	0	38	
TOTAL CULTURAL COSTS/ACRE	134.85	1,596	126	764	0	2,485	
TOTAL CULTURAL COSTS/Box		1.99	0.16	0.95	0.00	3.11	
Harvest: (800 boxes per acre)							
Pick and Field Pack	200.00	2,262	0	0	0	2,262	
Boxes, Spread, Swamp & Haul	1.50	292	12	1,532	0	1,836	
Brokerage Fees	0.00	0	0	0	864	864	
Assessment & Inspection Fees	0.00	0	0	102	0	102	
TOTAL HARVEST COSTS/ACRE	201.50	2,554	12	1,634	864	5,064	
TOTAL HARVEST COSTS/Box		3.19	0.01	2.04	1.08	6.33	
Interest on operating capital @ 10.00%						131	
TOTAL OPERATING COSTS/ACRE		4,150	138	2,398	864	7,681	
TOTAL OPERATING COSTS/Box		5.19	0.17	3.00	1.08	9.60	
CASH OVERHEAD:							
Office Expense						80	
Liability Insurance						6	
Sanitation Fees						19	
Property Taxes						134	
Property Insurance						43	
Investment Repairs						42	
TOTAL CASH OVERHEAD COSTS						324	
TOTAL CASH COSTS/ACRE						8,005	

*CM = Canopy Management. FM = Fruit Management

UC COOPERATIVE EXTENSION

Table 2. continued

Operation	Operation Time (Hrs/A)	Cash and Labor Cost per acre: Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
NON-CASH OVERHEAD (Capital Recovery):		Per producing Acre		Annual Cost Capital Recovery			
Land		7,304		530		530	
Drip Irrigation System		1,250		110		110	
Building		696		57		57	
Tools-Shop/Field		130		14		14	
Fuel Tanks 2-300G		30		2		2	
Vineyard Establishment Costs		8,999		831		831	
Equipment		779		104		104	
TOTAL NON-CASH OVERHEAD COSTS		19,189		1,647		1,647	
TOTAL COSTS/ACRE						9,652	
TOTAL COSTS/Box						12.07	

UC COOPERATIVE EXTENSION
Table 3. COSTS AND RETURNS PER ACRE to PRODUCE TABLE GRAPES – Thompson Seedless
SAN JOAQUIN VALLEY - SOUTH 2007

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
GROSS RETURNS					
Table Grapes Fresh (box = 19 lbs)	800.00	box	12.00	9,600	
OPERATING COSTS					
Trellis System:					
Miscellaneous Repair Materials	1.00	acre	10.00	10	
Vine Aids:					
Tying Materials	4,540.00	each	0.00	14	
Herbicide:					
Surflan 4 AS	2.40	pint	14.52	35	
Roundup Ultra Max	1.10	pint	7.80	9	
Fungicide:					
Abound (Strobilurin)	12.00	floz	2.86	34	
Microthiol Disperss (micronized wettable sulfur)	11.00	lb	0.83	9	
Dusting Sulfur	30.00	lb	0.22	6	
Rally 40W (Sterol Inhibitor)	8.00	oz	5.23	42	
Flint (Strobilurin)	4.00	oz	16.50	66	
Vertebrate Control:					
Shooting, Trapping, Baiting	1.00	acre	15.00	15	
Insecticide:					
Lorsban 4E	4.00	pint	6.35	25	
Kryocide	6.00	lb	3.08	18	
Provado 1.6 Solupak	1.00	oz	44.21	44	
Fertilizer:					
Neutral Zinc 50% (foliar)	5.00	lb	1.08	5	
UN 32	50.00	lb N	0.46	23	
Water:					
Water Pumped	36.00	acin	4.59	165	
Growth Regulator:					
ProGibb 4% Solution (Gibberelic Acid)	144.00	grams	1.68	242	
Harvest Supplies:					
Box (19 lb)	800.00	box	1.60	1,280	
Plastic Bags (9/box)	7,200.00	each	0.04	252	
Contract:					
Brokerage Fees (9% of selling price)	800.00	box	1.08	864	
Assessment:					
Table Grape Commission	800.00	box	0.12	93	
Quality Inspection (1/3 of yield)	264.00	box	0.04	9	
Labor (machine)	15.36	hrs	14.63	225	
Labor (non-machine)	347.05	hrs	11.31	3,925	
Fuel - Gas	11.78	gal	2.80	33	
Fuel - Diesel	22.19	gal	2.30	51	
Lube				13	
Machinery repair				41	
Interest on operating capital @ 10.00%				131	
TOTAL OPERATING COSTS/ACRE				7,681	
NET RETURNS ABOVE OPERATING COSTS				1,919	
CASH OVERHEAD COSTS:					
Office Expense				80	
Liability Insurance				6	
Sanitation				19	
Property Taxes				134	
Property Insurance				43	
Investment Repairs				42	
TOTAL CASH OVERHEAD COSTS/ACRE				324	
TOTAL CASH COSTS/ACRE				8,005	

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Table 3. continued

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
NON-CASH OVERHEAD COSTS (Capital Recovery)					
Land				530	
Drip Irrigation System				110	
Building				57	
Tools-Shop/Field				14	
Fuel Tanks 2-300G				2	
Vineyard Establishment Costs				831	
Equipment				104	
TOTAL NON-CASH OVERHEAD COSTS/ACRE				1,647	
TOTAL COSTS/ACRE				9,652	
NET RETURNS ABOVE TOTAL COSTS				-52	

UC COOPERATIVE EXTENSION

Table 4. MONTHLY CASH COSTS PER ACRE to PRODUCE TABLE GRAPES – Thompson Seedless

SAN JOAQUIN VALLEY - SOUTH 2007

Beginning JAN 07 Ending DEC 07	JAN 07	FEB 07	MAR 07	APR 07	MAY 07	JUN 07	JUL 07	AUG 07	SEP 07	OCT 07	NOV 07	DEC 07	TOTAL
Cultural:													
Vine: Layering Missing Vines	11												11
Prune: Vines	396												396
Prune: Brush Disposal	15												15
Trellis: Repair	33												33
***CM**: Tie Canes		115											115
Weed: Winter Strip (Surflan, Roundup)		53											53
Vertebrate: Gopher, Squirrel, Coyotes, Birds (various methods)			2	2	2	2	2	2	2	2			15
Disease: Phomopsis (Abound)/Mildew (Microthiol)			51										51
Insect: Mealybug (Lorsban)			41										41
Weed: Mow Middles 3X			8		8		8						24
Disease: Mildew (Dusting Sulfur)				10		10	10						30
Sucker: Trunk				23									23
Disease: Mildew (Rally, Microthiol)/**Fertilize**: Foliar Zinc (Neutral Zinc)				44									44
Fertilize: (UN32) through drip				23									23
Irrigate: Water & Labor				6	22	37	48	44	31	6			194
CM: Shoot Position					68		45						113
FM: Bloom Thin (GA). **Disease**: Mildew (Microthiol, Flint)					70								70
FM: Bloom Thin (GA). **Disease**: Mildew (Microthiol). **Insect**: Skeletonizer (Kryocide)					56								56
FM: Berry Size (GA). **Disease**: Mildew (Rally, Microthiol)						139							139
FM: Cluster Tipping & Thinning						566							566
FM: Girdle						136							136
CM: Cane Cutting (Mechanical)						9							9
FM: Berry Size (GA). **Disease**: Mildew (Flint, Microthiol). **Insect**: Leafhopper (Provado)						195							195
Weed: Spot Spray (Roundup)						14							14
Pickup: Business Use	7	7	7	7	7	7	7	7	7	7	7	7	82
ATV:	3	3	3	3	3	3	3	3	3	3	3	3	38
TOTAL CULTURAL COSTS	465	179	111	117	236	1,117	123	55	43	18	10	10	2,485
Harvest: (800 box/acre)													
Pick & Field Pack								2,262					2,262
Spread, Swamp, Haul & Boxes								1,836					1,836
Brokerage Fees								864					864
Assessment & Inspection Fees								102					102
**TOTAL HARVEST COSTS								5,064					5,064
Interest on operating capital @ 10.00%	4	5	6	7	9	19	20	62	0	0	0	0	131
TOTAL OPERATING COSTS/ACRE	469	184	118	125	245	1,136	143	5,182	42	18	10	10	7,681

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Table 4. Continued

SAN JOAQUIN VALLEY - SOUTH 2007

Beginning JAN 07 Ending DEC 07	JAN 07	FEB 07	MAR 07	APR 07	MAY 07	JUN 07	JUL 07	AUG 07	SEP 07	OCT 07	NOV 07	DEC 07	TOTAL
OVERHEAD:													
Office Expense	7	7	7	7	7	7	7	7	7	7	7	7	80
Liability Insurance									6				6
Sanitation Fees	2	2	2	2	2	2	2	2	2	2			19
Property Taxes	67						67						134
Property Insurance	22						22						43
Investment Repairs	4	4	4	4	4	4	4	4	4	4	4	4	42
TOTAL CASH OVERHEAD COSTS	101	12	12	12	12	12	101	12	18	12	10	10	324
TOTAL CASH COSTS/ACRE	570	196	130	137	257	1,148	243	5,194	60	30	20	20	8,005

UC COOPERATIVE EXTENSION

Table 5. RANGING ANALYSIS for TABLE GRAPES – Thompson Seedless

SAN JOAQUIN VALLEY - SOUTH 2007

COSTS PER ACRE AT VARYING YIELDS TO PRODUCE TABLE GRAPES

	YIELD (19 lb box/acre)						
	400	500	600	700	800	900	1,000
OPERATING COSTS:							
Cultural Cost	2,485	2,485	2,485	2,485	2,485	2,485	2,485
Harvest Cost (pick, pack, stack, swamp, haul)	2,049	2,561	3,074	3,586	4,098	4,610	5,123
Brokerage Fees	432	540	648	756	864	972	1080
Assessment/Inspection Cost	51	64	77	89	102	115	128
Interest on operating capital	110	115	121	126	131	136	142
TOTAL OPERATING COSTS/ACRE	5,127	5,765	6,405	7,042	7,680	8,318	8,958
(Total Operating Costs/box)	12.82	11.53	10.68	10.06	9.60	9.24	8.96
CASH OVERHEAD COSTS/ACRE	323	323	324	324	324	325	325
TOTAL CASH COSTS/ACRE	5,450	6,088	6,729	7,366	8,004	8,643	9,283
(Total Cash Costs/box)	13.63	12.18	11.22	10.52	10.01	9.60	9.28
NON-CASH OVERHEAD COSTS/ACRE	1,635	1,638	1,642	1,645	1,647	1,650	1,652
TOTAL COSTS/ACRE	7,085	7,726	8,371	9,011	9,651	10,293	10,935
(Total Costs/box)	17.71	15.45	13.95	12.87	12.06	11.44	10.94

NET RETURNS PER ACRE ABOVE OPERATING COSTS

PRICE	YIELD (19 lb box/acre)						
$/box	400	500	600	700	800	900	1,000
9.00	-1,527	-1,265	-1,005	-742	-480	-218	42
10.00	-1,127	-765	-405	-42	320	682	1,042
11.00	-727	-265	195	658	1,120	1,582	2,042
12.00	-327	235	795	1,358	1,920	2,482	3,042
13.00	73	735	1,395	2,058	2,720	3,382	4,042
14.00	473	1,235	1,995	2,758	3,520	4,282	5,042
15.00	873	1,735	2,595	3,458	4,320	5,182	6,042

NET RETURNS PER ACRE ABOVE CASH COSTS

PRICE	YIELD (19 lb box/acre)						
$/box	400	500	600	700	800	900	1,000
9.00	-1,850	-1,588	-1,329	-1,066	-804	-543	-283
10.00	-1,450	-1,088	-729	-366	-4	357	717
11.00	-1,050	-588	-129	334	796	1,257	1,717
12.00	-650	-88	471	1,034	1,596	2,157	2,717
13.00	-250	412	1,071	1,734	2,396	3,057	3,717
14.00	150	912	1,671	2,434	3,196	3,957	4,717
15.00	550	1,412	2,271	3,134	3,996	4,857	5,717

NET RETURNS PER ACRE ABOVE TOTAL COSTS

PRICE	YIELD (19 lb box/acre)						
$/box	400	500	600	700	800	900	1,000
9.00	-3,485	-3,226	-2,971	-2,711	-2,451	-2,193	-1,935
10.00	-3,085	-2,726	-2,371	-2,011	-1,651	-1,293	-935
11.00	-2,685	-2,226	-1,771	-1,311	-851	-393	65
12.00	-2,285	-1,726	-1,171	-611	-51	507	1,065
13.00	-1,885	-1,226	-571	89	749	1,407	2,065
14.00	-1,485	-726	29	789	1,549	2,307	3,065
15.00	-1,085	-226	629	1,489	2,349	3,207	4,065

UC COOPERATIVE EXTENSION

Table 6. WHOLE FARM ANNUAL EQUIPMENT, INVESTMENT, & BUSINESS OVERHEAD COSTS

SAN JOAQUIN VALLEY - SOUTH 2007

ANNUAL EQUIPMENT COSTS

						Cash Overhead		
Yr	Description	Price	Yrs Life	Salvage Value	Capital Recovery	Insur-ance	Taxes	Total
07	60 HP 4WD Narrow Tractor	47,000	15	9,150	4,885	200	281	5,366
07	ATV 4WD	6,700	5	3,003	1,125	35	49	1,209
07	Brush Shredder 6'	8,000	15	768	862	31	44	937
07	Cane Cutter 12'	3,500	20	182	333	13	18	364
07	Duster - 3 Point 12'	5,500	5	1,792	1,040	26	36	1,103
07	Mower-Flail 8'	10,500	15	1,008	1,132	41	58	1,230
07	Orchard/Vine Sprayer 500 gal	21,000	5	6,840	3,973	99	139	4,211
07	Pickup Truck 1/2 T	28,000	7	10,621	4,023	138	193	4,354
07	Sprayer ATV 20 gal	350	10	62	46	1	2	50
07	Truck Flatbed (10 ton)	56,000	10	16,542	6,882	259	363	7,504
07	Weed Sprayer 3 Point 100 gal	4,000	10	707	526	17	24	566
	TOTAL	190,550		50,675	24,826	861	1,206	26,894
	60% of New Cost *	114,330		30,405	14,896	517	724	16,136

* Used to reflect a mix of new and used equipment.

ANNUAL INVESTMENT COSTS

					Cash Overhead			
Description	Price	Yrs Life	Salvage Value	Capital Recovery	Insur-ance	Taxes	Repairs	Total
Building 2400 sqft	80,000	20		6,610	286	400	1,600	8,895
Drip Irrigation System 40 acres	50,000	25		4,388	179	250	1,000	5,816
Vineyard Establishment	359,960	22		33,220	1,285	1,800	0	36,305
Fuel Tanks 2-300 gal	3,500	30	350	286	14	19	70	389
Land	840,000	25	840,000	60,900	0	8,400	0	69,300
Tools-Shop/Field	15,000	15	1,500	1,614	59	83	300	2,056
TOTAL INVESTMENT	1,348,460		841,850	107,017	1,822	10,952	2,970	122,761

ANNUAL BUSINESS OVERHEAD COSTS

Description	Units/ Farm	Unit	Price/ Unit	Total Cost
Liability Insurance	115	acre	5.86	674
Office Expense	115	acre	80.00	9,200
Sanitation Fee	115	acre	19.35	2,225

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Table 7. HOURLY EQUIPMENT COSTS

SAN JOAQUIN VALLEY - SOUTH 2007

			COSTS PER HOUR						
				Cash Overhead		Operating			
Yr	Description	Actual Hours Used	Capital Recovery	Insur-ance	Taxes	Repairs	Fuel & Lube	Total Opera.	Total Costs/Hr.
07	60 HP 4WD Narrow Tractor	1,066	2.75	0.11	0.16	1.12	7.79	8.91	11.93
07	ATV 4WD	400	1.69	0.05	0.07	0.49	1.07	1.56	3.37
07	Brush Shredder 6'	133	3.91	0.14	0.20	3.49	0.00	3.49	7.74
07	Cane Cutter 12'	101	1.97	0.08	0.11	1.29	0.00	1.29	3.45
07	Duster - 3 Pt 12'	240	2.60	0.07	0.09	0.79	0.00	0.79	3.55
07	Mower-Flail 8'	133	5.12	0.19	0.26	4.58	0.00	4.58	10.15
07	Orchard/Vine Sprayer 500 gal	400	5.96	0.15	0.21	3.67	0.00	3.67	9.99
07	Pickup Truck 1/2 T	286	8.46	0.29	0.41	2.04	14.76	16.80	25.96
07	Sprayer ATV 20 gal	148	0.19	0.01	0.01	0.09	0.00	0.09	0.30
07	Truck Flatbed (10 ton)	200	20.65	0.78	1.09	5.30	2.64	7.94	30.46
07	Weed Sprayer 3 PT 100 gal	199	1.59	0.05	0.07	0.68	0.00	0.68	2.39

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Table 8. OPERATIONS WITH EQUIPMENT for TABLE GRAPES – Thompson Seedless

SAN JOAQUIN VALLEY - SOUTH 2007

Operation	Operation Month	Tractor	Implement	Material	Broadcast Rate/acre	Unit
Weed: Winter Strip	March	60HP 4WD	Weed Sprayer	Surflan	2.40	pt
				Roundup	0.60	pt
Weed: Mow Middles	March	60HP 4WD	Mower Flail 8'			
	May	60HP 4WD	Mower Flail 8'			
	July	60HP 4WD	Mower Flail 8'			
Weed: Spot Spray	June	ATV 4WD	ATV Sprayer	Roundup	0.50	pt
Fertilize: N through drip	April			UN 32	50.00	lb N
Irrigation	April			Water	1.00	acin
	May			Water	4.00	acin
	June			Water	7.00	acin
	July			Water	9.00	acin
	August			Water	8.00	acin
	September			Water	6.00	acin
	October			Water	1.00	acin
Disease: Phomopsis/Mildew	March	60HP 4WD	Air Blast Sprayer	Abound	12.00	floz
				Microthiol	1.00	lb
Vertebrate: Squirrels, Gophers, Coyotes, Birds	Mar – Oct			Various methods	15.00	acre
Disease: Mildew 3X	April	60HP 4WD	Duster	Dusting Sulfur	10.00	lb
	June	60HP 4WD	Duster	Dusting Sulfur	10.00	lb
	July	60HP 4WD	Duster	Dusting Sulfur	10.00	lb
Disease: Mildew. **Fertilize**: Foliar Zinc	April	60HP 4WD	Air Blast Sprayer	Microthiol (Mildew)	2.00	lb
				Rally (Mildew)	4.00	oz
				Neutral Zinc	5.00	lb
***FM**: Bloom Thin. **Disease**: Mildew	May	60HP 4WD	Air Blast Sprayer	GA (Thin)	12.00	floz
				Microthiol (Mildew)	2.00	lb
				Flint (Mildew)	2.00	oz
FM: Bloom Thin. **Disease**: Mildew. **Insect**: Skeletonizer	May	60HP 4WD	Air Blast Sprayer	GA (Thin)	12.00	floz
				Microthiol (Mildew)	2.00	lb
				Kryocide (Skeletonizer)	6.00	lb
FM: Berry Size. **Disease**: Mildew	June	60HP 4WD	Air Blast Sprayer	GA (Thin)	60.00	floz
				Microthiol (Mildew)	2.00	lb
				Rally (Mildew)	4.00	oz
FM: Berry Size. **Disease**: Mildew. **Insect**: Leafhopper	June	60HP 4WD	Air Blast Sprayer	GA (Thin)	60.00	floz
				Microthiol (Mildew)	2.00	lb
				Flint (Mildew)	2.00	oz
				Provado (Leafhopper)	1.00	oz
Insect: Mealybug	March	60HP 4WD	Air Blast Sprayer	Lorsban	4.00	pt
FM: Cluster Tipping & Thinning	June			Labor	50.00	hrs
FM: Girdle	June			Labor	12.00	hrs
Trellis: Repair	January			Labor	2.00	hrs
				Trellis Materials	10.00	acre
Vine: Layering Vines	January			Labor	1.00	hrs
Prune	January			Labor	35.00	hrs
Prune: Shred Brush	January	60HP 4WD	Brush Shredder 6'			
Sucker: Remove Trunk Suckers	April			Labor	2.00	hrs
CM: Tie Canes	February			Labor	7.00	hrs
				Materials	11.50	acre
CM: Shoot Positioning	May			Labor	6.00	hrs
	July			Labor	4.00	hrs
CM: Cane Cutting	June	60HP 4WD	Cane Cutter			
Pickup: Business Use	Annual	Pickup 1/2 ton				
ATV	Annual	ATV				
Harvest: Pick & Field Pack	August			Labor	200.00	hrs
Harvest: Swamp, Spread, Haul	August	Truck Flatbed		Labor	23.50	hrs
				Boxes	800.00	boxes
				Plastic Bags	7,200.00	bags

*CM = Canopy Management. FM = Fruit Management

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UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

2007

SAMPLE COSTS TO ESTABLISH AND PRODUCE TABLE GRAPES

CRIMSON SEEDLESS

SAN JOAQUIN VALLEY - SOUTH

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UC COOPERATIVE EXTENSION

SAMPLE COSTS TO ESTABLISH AND PRODUCE TABLE GRAPES

Crimson Seedless

San Joaquin Valley – South 2007

CONTENTS

INTRODUCTION

Sample costs to establish and produce Crimson Seedless table grapes are presented in this study. This study is intended as a guide only, and can be used to make production decisions, determine potential returns, prepare budgets and evaluate production loans. Practices described are considered typical for the crop and area, but these practices will not apply to every farming operation. The sample costs for labor, materials, equipment and custom services are based on current figures. A blank column, "*Your Costs*", in Tables 2 and 3 is provided for entering your farm costs.

The hypothetical farm operation, production practices, overhead, and calculations are described under the assumptions. For additional information or an explanation of the calculations used in the study call the Department of Agricultural and Resource Economics, University of California, Davis, (530) 752-3589 or your local UC Cooperative Extension office.

Sample Cost of Production Studies for many commodities can be downloaded at http://coststudies.ucdavis.edu, requested through the Department of Agricultural and Resource Economics, UC Davis, (530) 752-1517 or obtained from the local county UC Cooperative Extension offices. Some archived studies are also available on the website.

ASSUMPTIONS

The assumptions refer to Tables 1 to 8 and pertain to sample costs to establish the vineyard and produce Crimson Seedless table grapes in the San Joaquin Valley. The cultural practices described represent production operations and materials considered typical on a well-managed vineyard in the region. Costs, materials, and practices in this study will not apply to all farms. Timing of and types of establishment and cultural practices will vary among growers within the region and from season to season due to variables such as weather, soil, and insect and disease pressure. **The use of trade names and cultural practices in this report does not constitute an endorsement or recommendation by the University of California nor is any criticism implied by omission of other similar products or cultural practices.**

Farm. The hypothetical farm consists of 120 contiguous acres. Crimson Seedless vineyard establishment and table grape production is on 40 acres. Other table grape varieties are on 75 acres; roads, irrigation systems, and farmstead occupy five acres. The farm is owned and managed by the grower.

Establishment Cultural Practices & Material Inputs
(Table 1)

Site Preparation. This vineyard is established on ground previously planted to vineyards or orchards. Land coming from vines or trees should be fallowed for two years except for a possible grain crop. The land is assumed to be fairly level. A custom operator chisels the ground (subsoils) twice to a depth of 4-5 feet. The grower floats the land to smooth and level the surface. Afterwards the ground is disced twice to apply and incorporate preplant herbicide. Nematode samples should be taken from land formerly in vines or trees and fumigated if necessary. Most operations that prepare the vineyard for planting are done in the year prior to planting, but costs are shown in the first year.

Plant. Planting the vineyard starts by laying out and marking vine sites in early spring. Holes are dug and vines planted and a two-inch by two-inch cardboard carton placed around the vine. In the second year, 2% or 10 vines per acre are replaced.

Vines. The Crimson Seedless plants are dormant, bench-grafted rootstock vines purchased from a commercial nursery. The grapevines are planted during the spring on a 7-foot x 12-foot spacing (vine x row) with 518 vines per acre. Vines are trained during the first and second years. The grapevines are expected to begin yielding fruit in the third year and then be productive for an additional 22 years.

Trellis System. A commercial company installs the trellis system in the second year. The trellis system will be removed when the vineyard is removed; therefore it is considered part of the vineyard and included in the establishment costs. Materials for the open gable trellis are as follows: (1) Stakes with V structure are placed every 24-feet down the row. Metal stakes (2 lbs/ft strength) are 8.5-feet long and placed in the ground 3-feet. The open gable is 72-inches wide from tip to tip. (2) End assemblies consist of 9.5-foot metal post (4 lb/ft) with a V that matches those within the row and with 10-inch helix anchor. (3) Eight wires, 12.5 gauge high tensile, are used for fruit and canopy support; three wires, 14 gauge high tensile, are used for movable catch wires and drip hose support. For growers planting and training vines in the first year with the intention to harvest in the second year, trellis installation should be completed in the first year and the cost shown accordingly.

Train/Prune. Vines are pruned to one two bud spur in the first dormant season (December to February, January in this study).

Train. The following spring (second year), a single shoot is selected and trained up the stake to form the permanent structure of the vine. Training consists of tying the shoot, removing lateral shoots from the base and tipping the shoot when it reaches desired head height. Most of the training costs occur during the second summer. The third summer is devoted to training missing vines or vines delayed in growth.

Prune. In the third year (January), vines are pruned much like an established vine. The exception being the number of canes retained: 2-3 canes on young vines and 5-8 canes on mature vines. Prunings are placed in the row middles and shredded. Selecting and tying canes to fruiting wires is required each year for the life of the vineyard. Suckers from vine trunks are removed in April, a practice that continues each year but diminishes as the vineyard matures. It should be noted that Crimson Seedless is often trained to quadrilateral cordons and spur pruned, but in this study, vines are head trained and cane pruned.

Irrigate. Water pumping costs plus labor constitute the irrigation cost. In this study, water is calculated to cost $4.59 per acre-inch or $55.08 per acre-foot. The pumping cost is based on a 40 horsepower (HP) motor to pump from 130 feet deep. The vineyard is irrigated during the growing season from April through October during the establishment years. Price per acre-foot of water will vary by grower in this region depending on quantity used, water district, power cost, various well characteristics, and other irrigation factors. The amount of water applied to the vineyard varies through the establishment years and is shown in Table A.

Table A. Irrigation Water Applied

Year	AcIn/Year
1	8
2	18
3+	36

Fertilize. Liquid nitrogen fertilizer, UN32, is applied through the irrigation system in April of the first year at five pounds of N per acre. A single application is made in April of the second year. The amount of nitrogen applied each year increases as the vineyard matures and is shown in Table B. It is important to identify sources of nitrogen in order to properly manage the nitrogen budget. For example, sources of nitrogen such as irrigation well water should be calculated to determine future irrigation and fertilizer needs.

Table B. Applied Nitrogen (N) Per Acre

Year	Lbs of N
1	5
2	25
3+	50

Pest Management. For pest identification, monitoring, management and pesticide information, visit the UC IPM website at www.imp.ucdavis.edu. Written recommendations are required for many commercially applied pesticides, and are available from licensed pest control advisers (PCAs). For information on pesticide use permits, contact the local county Agricultural Commissioner's office. **Pesticides mentioned in this study are used to calculate rates and costs. Although the pesticides mentioned are commonly used by growers, many other pesticides are available. Check with your PCA and/or the UC IPM website for current recommendations.**

Weeds (Vineyard Floor Management). In October of the year prior to planting, Treflan is applied to the vineyard floor and incorporated by discing. After planting, weeds in the vine rows and middles are managed with discing, mowing, and/or herbicides. From March through July of the first year, the row middles are disced twice and mowed twice. The vine rows are hand weeded in April. The row middles are mowed three to four times during the growing season starting the second year. The vine rows are sprayed (strip spray) in January of the second year with Roundup and Surflan. The strip spray is applied to 30% of the acreage. Also in the second year, spot sprays using Roundup are applied to the vine row in April, June, and July. The spot sprays (weedy spots or areas) are applied using an all terrain vehicle (ATV) with a sprayer attached.

Insects. Beginning in the second year, western grapeleaf skeletonizer (*Harrisina brillians*) is controlled in April with an application of Kryocide insecticide (mixed with micronized sulfur sprays). Additionally insects such as mealybugs are monitored each year beginning in the spring and may increase production costs if found.

If mealybugs (*Pseudococcus sp.*) are found during vineyard establishment, the grower should consult with a PCA, farm advisor, and/or Ag commissioner to develop management strategies.

Diseases. Although many pathogens attack grapevines, phomopsis cane and leafspot (*Phomopsis viticola)* and powdery mildew (*Uncinula necator)* are the two diseases managed in this study. In April of the second and third years, Microthiol plus Abound (strobilurin) are applied for phomopsis and mildew control. Mildew is controlled with various fungicide applications at 7 to 21 day intervals in the third year, depending on the fungicide used. For this study, the grower applies Kocide (copper) and Rubigan (SI), and two Microthiol applications (one with Kryocide) in April; one Rubigan (SI) application and two dusting sulfur applications in May; one Rubigan (SI) application and two dusting sulfur applications in June. Growers have the option of using sulfur (dust, wettable, flowable or micronized), sterol inhibitors (SIs), or strobilurins, as well as other fungicides to control powdery mildew. Sterol inhibitors and strobilurins are two classes of fungicides with different modes of action than sulfur against powdery mildew. It is recommended that fungicides with different modes of action be used to avoid powdery mildew populations from developing fungicide resistance.

Vertebrate. Rabbits, gophers, squirrels and coyotes are pests that can cause damage to the vines and irrigation lines. Various forms of control such as baiting, trapping and/or building a rabbit fence are utilized as necessary throughout the year. For this study no specific control is used, but an estimated cost for one or two management practices are shown in March. Endangered Species: It is important to know if your vineyard is located in an area where endangered species reside (i.e. San Joaquin Kit Fox). Trapping and killing endangered species can result in fines. Contact your County Agricultural Commissioner for additional information.

Harvest/Yield/Returns. The table grapes in this study are first harvested in the third year and the yields are 50% to 75% of mature producing vines. An assumed yield of 600 nineteen pound boxes is used for calculating income. If the crop is harvested for wine, a labor contractor may be needed. Growers sometimes plant and train vines in the same year, which produces a harvestable Crimson Seedless table grape crop in the second year.

Mature Production Cultural Practices and Material Inputs
(Tables 2-8)

Prune/Sucker/Canopy Management (CM). The vines are cane-pruned during the winter months (December to early February) in January and the prunings are placed in the row middles and shredded. In mid February, the canes are tied by wrapping on the trellis wire and tying with twist-ties. Suckers are removed from the vine trunks in early April. Shoot positioning and removal are done in late April. The canes are mechanically cut in June to improve canopy microclimate, allowing for sunlight penetration and proper coverage of pesticides.

Fruit Management (FM). Gibberellic acid (GA), a plant growth regulator, is applied two times: one time in May for thinning during bloom at one gram per acre and a second time for berry sizing three to four weeks after full bloom (June) at eight grams per acre (disease and insect materials are included with these applications). Applying GA to Crimson Seedless for sizing increases berry weight less than 10%. GA applied at this time decreases fruit color. Tradeoffs should be considered before application. Vines are girdled to increase berry size two to three weeks after full bloom (June). Cluster tipping and hand thinning are done in late May to early June to loosen and adjust cluster length and crop load. Leaf removal for fruit exposure is done in June. Ethrel, a second plant growth regulator, is applied to the vineyard in August to enhance color development in the fruit. Some growers cover canopies late in the season with plastic to protect fruit from fall rains, but the value of the practice is open for debate.

Trellis/Vines. Trellis repairs are done annually (January in this study) and the cost is not taken from any specific data. Weak or missing vines are replaced by layering. One year-old canes from neighboring vines are buried (layered) in the soil next to the stake and allowed to root. After rooting the canes are cut and the plant trained on the trellis. Trellis repair and vine replacement increases with vineyard age.

Irrigate. The vineyard is drip irrigated during the growing season from April through October. Deficit irrigation (70% ET) is applied three to five weeks prior to harvest to slow shoot growth and promote fruit maturity. Deficit irrigation may not work well on weak or low vigor vineyards. If deficit irrigation is used, these vineyards should be monitored closely. Water pumping costs plus labor constitute the irrigation cost. In this study, water is calculated to cost $ $4.59 per acre-inch or $ $55.08 per acre-foot. The pumping cost is based on a 40 horsepower (HP) motor to pump from 130 feet depth and pressurized to 20 pounds per square inch (PSI). A total of 36 acre-inches is applied to the vineyard. Price per acre-foot of water will vary by grower in this region depending on quantity used, water district, power cost, various well characteristics, and other irrigation factors.

Fertilize. Nitrogen (N) at 50 pounds per acre as UN32 is applied through the irrigation drip system in April or post-harvest. Neutral zinc is applied to prevent zinc deficiencies and is combined with the late April mildew (Microthiol, Rally) application.

Pest Management. The pesticides and rates mentioned in this cost study are listed in *UC Integrated Pest Management Guidelines, Grapes.* For information on other pesticides available, pest identification, monitoring, and management visit the UC IPM website at www.ipm.ucdavis.edu. For information and pesticide use permits, contact the local county agricultural commissioner's office. **Pesticides mentioned in this study are used to calculate rates and costs. Although the pesticides mentioned are commonly used by growers, many other pesticides are available. Check with your PCA and/or the UC IPM website for current recommendations.** Adjuvants are recommended for use with many pesticides for effective control, but the adjuvants and their costs are not included in this study. Pesticide costs may vary by location, brand, and grower volume. Pesticide costs in this study are taken from a single dealer and shown as full retail.

Pest Control Adviser (PCA). Written recommendations are required for many commercially applied pesticides and are written by licensed pest control advisers. In addition the PCA will monitor the field for agronomic problems including pests, diseases, and nutritional status. Growers may hire private PCAs or receive the service as part of a service agreement with an agricultural chemical and fertilizer company. Costs for a PCA are not included in this study.

Weeds (Vineyard Floor Management). Vineyard middles are mowed three times each season: March, May, July. Surflan and Roundup herbicides are applied to the vine row/berm in February. Roundup, a contact herbicide, is applied as a spot spray to the vine row in June.

Insects. Mealybug (*Pseudococcus sp.*) is treated with Lorsban insecticide in early March (dormant vines). Western grapeleaf skeletonizer (*Harrisina brillians*) is treated with Kryocide (mixed with a GA and/or sulfur application) during the bloom thinning spray in May. Grape leafhoppers (*Erythroneura elegantula*) are controlled with Provado insecticide (mixed with GA, Microthiol, Rally) during the berry size spray in June. An effective alternative material for mealybugs is to apply Admire insecticide through the drip system, but at a higher cost than a Lorsban application. It may be necessary to use multiple insecticides to control some mealybug species.

Diseases. Diseases treated in this study are phomopsis cane and leafspot (*Phomopsis viticola)* and powdery mildew (*Ersiphe necator).* Phomopsis and powdery mildew are both treated in late March (shoot length averages 2-inches) with Abound and Microthiol (micronized sulfur). Mildew is controlled with various fungicide applications at 7 to 21 day intervals, depending on the fungicide used. In this study, Dusting Sulfur is applied three times – April, June, July. Microthiol and Rally, an SI, (with zinc) are applied in late April. Microthiol (with GA and Kryocide) is applied with the May bloom thin spray. Rally and Microthiol are applied in June. Microthiol and Rally (with GA and Provado) are applied with the berry size spray in June. Microthiol and Rally are applied in July. Dusting Sulfur is applied two times in September and two times in October to control powdery mildew on the stems. The mildew does not grow on the grapes at this stage of maturity. Vangard fungicide is applied in October to protect grapes from Botrytis Bunch Rot. Growers have the option of using sulfur (dust, wettable, flowable or micronized), sterol inhibitors (SIs), or strobilurins, as well as other fungicides to control powdery mildew. Sterol inhibitors and strobilurins are two classes of fungicides with different modes of action than sulfur against powdery mildew. It is recommended that fungicides with different modes of action be used to prevent powdery mildew populations from acquiring fungicide resistance.

Vertebrate. Gophers, squirrels coyotes and birds are pests that can cause damage to the vines and irrigation lines. Various forms of control such as baiting, trapping and shooting are utilized as necessary throughout the year. For this study no specific control is used, but per acre costs are shown from March through October and are an estimate not based on any specific data. Endangered Species: It is important to know if your vineyard is located in an area where endangered species reside (i.e. San Joaquin Kit Fox). Trapping and killing endangered species can result in fines. Contact your County Agricultural Commissioner for additional information.

Harvest. Beginning in the October, the grapes are harvested for table grapes and packed in the field. The field is picked two to three times. Harvesting crews work in teams of three or four. Depending on fruit quality, the team can pick 3 to 6 boxes per hour per individual. For this study, the picker picks four shipping boxes per hour per individual. Two or three pickers field pick and trim the grapes, and put them in a reusable field box. After the fruit is picked and trimmed, the field boxes are loaded on a harvest wheelbarrow and delivered to the packer who places the fruit in bags and places them in shipping boxes. The box holds 9 bags and weighs 19 pounds when filled. The empty boxes are stacked along row ends and when filled, they are loaded on a truck and hauled to storage. The swamp and haul cost includes the boxes, plastic bags and related labor. Pre cooling and palletization (P&P) costs may in some cases be a grower cost but are generally charged to the buyer. After 30 days of cold storage, the grower is charged approximately $0.35 per box per month ($0.25-0.45) until the fruit is sold. Brokerage fees are paid by the grower and range from 7 to 10% of the selling price. A figure of 9% of the selling price is used in this study.

Yields. This study uses an average yield of 1,000, 19-pound boxes over the productive life of the vineyard to calculate returns. Average yields for all table grape varieties are shown in Table C. The averages include all vineyards in production regardless of maturity.

Returns. Return prices for grapes at different yields and prices are shown in Table 5. Based on grower information, an estimated price of $14 per box for Crimson Seedless grapes is used in this study.

Table C. Table Grapes

Average Yields	
Year	Ton/Acre (boxes)
2002	8.13 (856)
2003	7.60 (800)
2004	7.76 (815)
2005	11.34 (1,194)
2006	9.66 (1,016)

Source: Fresno County Crop Reports, 2002-2006

Box = 19 lbs.

Assessments/Inspection. The California Table Grape Commission (CTGC) assesses $0.1156 per 19-pound box or $0.006087 per pound. Early in the season, growers often have the county Agricultural Commissioner inspect their fruit for maturity at a cost of $0.035 per box. Approximately one-third of the entire crop is inspected to determine that maturity requirements are met, which includes soluble solids:acid ratios (20:1) and color.

Pickup/ATV. It is assumed that the grower uses the pickup for business and personal use. Estimated business mileage for the ranch is 5,250 miles. The all terrain vehicle (ATV) is used for spot spraying weeds and is included in that cost. It is assumed that the ATV will be used another 800 miles on the ranch for checking the vineyards including the irrigation system.

Labor. Hourly wages for workers are $11.00 for machine operators and $8.50 per hour non-machine labor. Adding 33% for the employer's share of federal and state payroll taxes, workers compensation insurance for vine crops (0040) and other possible benefits gives the labor rates shown of $14.63 and $11.31 per hour for machine labor and non-machine labor, respectively. Workers' compensation costs will vary among growers, but for this study the cost is based upon the average industry final rate as of January 1, 2007 (personal email from California Department of Insurance, May 18, 2007, unreferenced). Labor for operations involving machinery are 20% higher than the operation time given in Table 2 to account for the extra labor involved in equipment set up, moving, maintenance, work breaks, and field repair.

Equipment Operating Costs. Repair costs are based on purchase price, annual hours of use, total hours of life, and repair coefficients formulated by the American Society of Agriculture Engineers (ASAE). Fuel and lubrication costs are also determined by ASAE equations based on maximum power takeoff (PTO) horsepower, and fuel type. Prices for on-farm delivery of diesel and gasoline are $2.30 and $2.80 per gallon, respectively. Fuel costs are derived from American Automobile Association (AAA) and Energy Information Administration 2006 monthly data. The cost includes a 2.25% sales tax (effective September 2001) on diesel fuel and 7.25% sales tax on gasoline. Gasoline also includes federal and state excise tax, which can be refunded for on-farm use when filing your income tax. The fuel, lube, and repair cost per acre for each operation in Table 2 is determined by multiplying the total hourly operating cost in Table 7 for each piece of equipment used for the selected operation by the hours per acre. Tractor time is 10% higher than implement time for a given operation to account for setup, travel and down time.

Interest on Operating Capital. Interest on operating capital is based on cash operating costs and is calculated monthly until harvest at a nominal rate of 10.00% per year. A nominal interest rate is the typical market cost of borrowed funds. The interest cost of post harvest operations is discounted back to the last harvest month using a negative interest charge. The rate will vary depending upon various factors, but the rate in this study is considered a typical lending rate by a farm lending agency as of January 2007.

Risk. The risks associated with crop production should not be minimized. While this study makes every effort to model a production system based on typical, real world practices, it cannot fully represent financial, agronomic and market risks, which affect profitability and economic viability. Growers may purchase Federal crop insurance to reduce the production risk associated with specific natural hazards. Insurance policies vary and range from a basic catastrophic loss policy to one that insures losses for up to 75% of a crop. Insurance costs will depend on the type and level of coverage.

Cash Overhead

Cash overhead consists of various cash expenses paid out during the year that are assigned to the whole farm and not to a particular operation. These costs include property taxes, interest on operating capital, office expense, liability and property insurance, sanitation services, equipment repairs, and management.

Property Taxes. Counties charge a base property tax rate of 1% on the assessed value of the property. In some counties special assessment districts exist and charge additional taxes on property including equipment, buildings, and improvements. For this study, county taxes are calculated as 1% of the average value of the property. Average value equals new cost plus salvage value divided by 2 on a per acre basis.

Insurance. Insurance for farm investments varies depending on the assets included and the amount of coverage. Property insurance provides coverage for property loss and is charged at 0. 714% of the average value of the assets over their useful life. Liability insurance covers accidents on the farm and costs $ 674 for the entire farm.

Office Expense. Office and business expenses are estimated at $80 per producing acre or $9,200 annually for the ranch. These expenses include office supplies, telephones, bookkeeping, accounting, legal fees, road maintenance, etc.

Sanitation Services. Sanitation services provide double portable toilets with washbasins for 10 months. The cost includes delivery and weekly cleaning service. The number of sanitation facilities will vary depending upon local regulations and size of labor force. In many cases labor contractors furnish the sanitation facilities for their crews and are included in the contractor's labor overhead.

Management/Supervisor Wages. Salary is not included. Returns above costs are considered a return to management

Investment Repairs. Annual maintenance is calculated as 2% of the purchase price.

Non-Cash Overhead Costs

Non-cash overhead is calculated as the capital recovery cost for equipment and other farm investments.

Capital Recovery Costs. Capital recovery cost is the annual depreciation and interest costs for a capital investment. It is the amount of money required each year to recover the difference between the purchase price and salvage value (unrecovered capital). It is equivalent to the annual payment on a loan for the investment with the down payment equal to the discounted salvage value. This is a more complex method of calculating ownership costs than straight-line depreciation and opportunity costs, but more accurately represents the annual costs of ownership because it takes the time value of money into account (Boehlje and Eidman). The formula for the calculation of the annual capital recovery costs is ((Purchase Price – Salvage Value) x Capital Recovery Factor) + (Salvage Value x Interest Rate).

Salvage Value. Salvage value is an estimate of the remaining value of an investment at the end of its useful life. For farm machinery (tractors and implements) the remaining value is a percentage of the new cost of the investment (Boehlje and Eidman). The percent remaining value is calculated from equations developed by the American Society of Agricultural Engineers (ASAE) based on equipment type and years of life. The life in years is estimated by dividing the wear out life, as given by ASAE by the annual hours of use in this operation. For other investments including irrigation systems, buildings, and miscellaneous equipment, the value at the end of its useful life is zero. The salvage value for land is the purchase price because land does not depreciate. The purchase price and salvage value for equipment and investments are shown in Table 6.

Capital Recovery Factor. Capital recovery factor is the amortization factor or annual payment whose present value at compound interest is 1. The amortization factor is a table value that corresponds to the interest rate used and the life of the machine.

Interest Rate. An interest rate of 7.25% is used to calculate capital recovery. The rate will vary depending upon loan amount and other lending agency conditions, but is the basic suggested rate by a farm lending agency as of January 2007.

Land. The land was formerly a vineyard, but has been out of production for two years. The open land was planted to grain crops. Land in the San Joaquin Valley with table grape production ranges from $6,000 to $13,400 per acre (depending on vineyard age, variety and location). Cropland with district or well water in the area ranges from $2,500 to $12,000. For this study, the land value was established based on 2007 real estate values (2007 Trends & Leases); therefore a cost of $7,000 per acre or $7,304 per producing acre is used.

Tools. This is an assumed value for shop, hand, and miscellaneous field tools and not based on any grower's tool inventory.

Fuel Tanks. Two 300-gallon fuel tanks using gravity feed are on metal stands. The tanks are setup in a cement containment pad that meets federal, state, and county regulations.

Drip Irrigation System. The drip lines, filters, booster pump and the labor to install the components are included in the irrigation system cost. The previous vineyard is assumed to have a pumping system that had been refurbished and therefore is not included as a cost. Water is delivered from a 130-foot depth using a 40-horsepower pump. The drip irrigation lines are laid directly on the ground prior to planting and the labor cost is included in the drip irrigation system cost.

Establishment Cost. The establishment cost is the sum of the costs for land preparation, trellis system, planting, vines, cash overhead and production expenses for growing the vines through the first year (third planted year in this study) that grapes are harvested. It is used to determine the non-cash overhead expense, (capital recovery cost) during the production years. The Total Accumulated Net Cash Cost on Table 1, in the third year represents the establishment costs. For this study the cost is $5,247 per acre or $209,880 for the 40 producing acres. The establishment cost is spread over the remaining 22 years of the 25 years the vineyard is in production.

Equipment. Farm equipment is purchased new or used, but the study shows the current purchase price for new equipment. The new purchase price is adjusted to 60% to indicate a mix of new and used equipment. Annual ownership costs for equipment and other investments are shown in Table 6. Equipment costs are composed of three parts: non-cash overhead, cash overhead, and operating costs. Both of the overhead factors have been discussed in previous sections. The operating costs consist of repairs, fuel, and lubrication and are discussed under operating costs.

Table Values. Due to rounding, the totals may be slightly different from the sum of the components.

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Table 1. COSTS PER ACRE TO ESTABLISH A CRIMSON TABLE GRAPE VINEYARD

SAN JOAQUIN VALLEY SOUTH - 2007

	Cost Per Acre		
Year:	1st	2nd	3rd
Boxes Per Acre:	0	0	600
Planting Costs:			
Site Prep: Subsoil 2X	400		
Site Prep: Float (Level)	12		
Site Prep: Disc/Apply Herbicide (Treflan)	17		
Site Prep: Disc/Incorporate Herbicide	12		
Plant: Survey & Layout Vineyard	70		
Plant: Plant, Wrap Vines	166	2	
Vines: 518 Per Acre (2% Replant In 2nd Year)	1,606	31	
Trellis: Trellis System (custom)		4,000	
TOTAL PLANTING COSTS	2,282	4,033	
Cultural Costs:			
Vertebrate: (Rabbit, Gopher, Squirrel)	40	15	15
Fertilize: Nitrogen (UN32)	3	12	23
Irrigate: Water/Labor	54	107	181
Weed: Disc Middles - 2X/Yr 1	16		
Weed: Mow Middles - 2X/Yr 1, 4X/Yr 2, 3X/Yr 3	16	31	24
Weed: Hand Hoe	34		
Prune: Dormant		73	90
Training: (Sucker, Tie)		271	136
Insect: Skeletonizer (Kryocide). **Disease**: Mildew (Microthiol)		36	36
Weed: Spot Spray (Roundup)		42	42
Weed: Winter Strip Spray (Roundup, Surflan)		53	53
Prune: Shred prunings			15
Disease: Phomopsis (Microthiol, Abound)			51
Disease: Mildew Control (Microthiol)			20
Insect: Leafhoppers 1X (Provado)			46
Disease: Mildew (Kocide, Rubigan)			50
Disease: Mildew 4X (Sulfur Dust)			39
Disease: Mildew 2X, (Rubigan)			56
Pickup: Business use	82	82	82
ATV: Field use	30	38	38
TOTAL CULTURAL COSTS	274	761	996
Harvest Costs:			
Pick & Field Pack (labor)			1,697
Spread/Stack boxes, Swamp, Haul (includes boxes, bags, labor)			1,372
Brokerage Fee			756
Assessment & Inspection Fees			77
TOTAL HARVEST COSTS			3,901
Interest On Operating Capital @ 10.00%	233	355	83
TOTAL OPERATING COSTS/ACRE	2,788	5,148	4,980
Cash Overhead Costs:			
Office Expense	80	80	80
Liability Insurance	6	6	6
Sanitation Service	19	19	19
Property Taxes	85	86	88
Property Insurance	9	9	11
Investment Repairs (non-cash overhead items)	42	42	42
TOTAL CASH OVERHEAD COSTS	242	242	246
TOTAL CASH COSTS/ACRE	3,030	5,390	5,227
INCOME/ACRE FROM PRODUCTION	0	0	8,400
NET CASH COSTS/ACRE FOR THE YEAR	3,030	5,390	0
PROFIT/ACRE ABOVE CASH COSTS	0	0	3,173
ACCUMULATED NET CASH COSTS/ACRE	3,030	8,420	**5,247**

UC COOPERATIVE EXTENSION

Table 1. continued

	Cost Per Acre		
Year:	1st	2nd	3rd
Boxes Per Acre:	0	0	600
Non-Cash Overhead Costs (Capital Recovery):			
Land	530	530	530
Irrigation System	110	110	110
Shop Building	57	57	57
Shop Tools	14	14	14
Fuel Tank & Pump	2	2	2
Equipment	37	41	95
TOTAL CAPITAL RECOVERY COST	750	755	809
TOTAL COST/ACRE FOR THE YEAR	3,780	6,145	6,035
INCOME/ACRE FROM PRODUCTION	0	0	8,400
TOTAL NET COST/ACRE FOR THE YEAR	3,780	6,145	0
NET PROFIT/ACRE ABOVE TOTAL COST	0	0	2,365
TOTAL ACCUMULATED NET COST/ACRE	3,780	9,925	7,560

UC COOPERATIVE EXTENSION

Table 2. COSTS PER ACRE TO PRODUCE CRIMSON TABLE GRAPES

SAN JOAQUIN VALLEY - 2007

Operation	Operation Time (Hrs/A)	Cash and Labor Cost per acre: Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
Cultural:							
Vine: Layering Missing Vines	1.00	11	0	0	0	11	
Prune: Vines	38.00	430	0	0	0	430	
Prune: Shred Prunings (Every Middle)	0.50	9	7	0	0	15	
Trellis: Repair	2.00	23	0	10	0	33	
***CM**: Tie Canes	8.00	90	0	14	0	104	
Weed: Winter Strip (Surflan, Roundup)	0.49	9	5	40	0	53	
Vertebrate: (gopher, squirrel, coyote, bird) various methods	0.00	0	0	15	0	15	
Disease: Phomopsis (Abound)/Mildew (Microthiol)	0.50	9	7	35	0	51	
Insect: Mealybug (Lorsban)	0.50	9	7	25	0	41	
Weed: Mow Middles 3X	0.74	13	11	0	0	24	
Disease: Mildew 3X (Dusting Sulfur)	0.84	15	9	6	0	30	
Sucker: Remove Trunk Suckers	2.00	23	0	0	0	23	
Disease: Mildew (Rally, Microthiol). **Fertilize**: (Neutral Zinc)	0.50	9	7	28	0	44	
Fertilize: N through drip (UN32)	0.00	0	0	23	0	23	
Irrigate: (Water)	2.55	29	0	165	0	194	
CM: Shoot Position & Removal	15.00	170	0	0	0	170	
FM: BloomThin (GA). **Disease**: Mildew (Microthiol). **Insect**: Skeletonizer (Kryocide)	0.50	9	7	22	0	37	
FM: Fruit Exposure/Leaf Removal	50.00	566	0	0	0	566	
Disease: Mildew (Rally, Sulfur)	0.50	9	7	23	0	38	
FM: Cluster Thinning	10.00	113	0	0	0	113	
FM: Girdle	12.00	136	0	0	0	136	
FM: Berry Size (GA). **Disease**: Mildew (Microthiol, Rally). **Insect**: Leafhopper (Provado)	0.50	9	7	80	0	96	
CM: Cane Cutting (Mechanical)	0.29	5	3	0	0	8	
Weed: Spot Spray (Roundup)	0.53	9	1	4	0	14	
Disease: Mildew (Rally, Microthiol)	0.50	9	7	23	0	38	
FM: Color Fruit (Ethrel)	0.50	9	7	8	0	24	
Disease: Mildew on Stem 4X (Dusting Sulfur)	1.12	20	12	9	0	40	
Disease: Botrytis (Vangard)	0.50	9	7	47	0	62	
Pickup Truck Use	2.39	42	40	0	0	82	
ATV	2.00	35	3	0	0	38	
TOTAL CULTURAL COSTS	153.95	1,825	151	576	0	2,552	
TOTAL CULTURAL COSTS/Box		1.82	0.15	0.58	0.00	2.55	
Harvest (1,000 boxes per acre):							
Pick and Field Pack	250.00	2,828	0	0	0	2,828	
Boxes, Spread/Stack, Swamp & Haul (includes boxes, bags)	2.00	363	16	1,915	0	2,294	
Brokerage Fee	0.00	0	0	0	1,260	1,260	
Assessment & Inspection Fees	0.00	0	0	128	0	128	
TOTAL HARVEST COSTS/ACRE	252.00	3,191	16	2,043	1,260	6,509	
TOTAL HARVEST COSTS/Box		3.19	0.02	2.04	1.26	6.51	
Interest on operating capital @ 10.00%						187	
TOTAL OPERATING COSTS/ACRE		5,015	167	2,618	1,260	9,248	
TOTAL OPERATING COSTS/Box		5.02	0.17	2.62	1.26	9.25	
CASH OVERHEAD:							
Office Expense						80	
Liability Insurance						6	
Sanitation Fees						19	
Property Taxes						116	
Property Insurance						31	
Investment Repairs						42	
TOTAL CASH OVERHEAD COSTS						294	
TOTAL CASH COSTS/ACRE						9,542	

UC COOPERATIVE EXTENSION

Table 2. continued

Operation	Operation Time (Hrs/A)	Labor Cost	Fuel,Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
		Cash and Labor Cost per acre					
NON-CASH OVERHEAD (Capital Recovery):		Per producing Acre		-- Annual Cost -- Capital Recovery			
Land		7,304		530		530	
Drip Irrigation System		1,250		110		110	
Building		696		57		57	
Tools-Shop/Field		130		14		14	
Fuel Tanks 2-300G		30		2		2	
Vineyard Establishment		5,247		484		484	
Equipment		968		129		129	
TOTAL NON-CASH OVERHEAD COSTS		15,626		1,326		1,326	
TOTAL COSTS/ACRE						10,868	
TOTAL COSTS/Box						10.87	

*CM = Canopy Management. FM = Fruit Management

To find cost per box divide by 1,000

UC COOPERATIVE EXTENSION

Table 3. MATERIAL & CUSTOM COSTS & NET RETURN PER ACRE FOR CRIMSON TABLE GRAPES

SAN JOAQUIN VALLEY - SOUTH 2007

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
GROSS RETURNS					
Crimson Table Grapes (19 lb box)	1,000.00	box	14.00	14,000	
OPERATING COSTS					
Trellis System:					
Miscellaneous Repair Materials	1.00	acre	10.00	10	
Vine Aids:					
Tying Materials (twist-ems) ($0.003 each)	4,540.00	each	0.00	14	
Herbicide:					
Surflan 4 AS	2.40	pint	14.52	35	
Roundup Ultra Max	1.10	pint	7.80	9	
Vertebrate Control:					
Shoot, Bait, Trap	1.00	acre	15.00	15	
Fungicide:					
Abound (Strobilurin)	12.00	floz	2.86	34	
Microthiol Disperss (micronized wettable sulfur)	11.00	lb	0.83	9	
Dusting Sulfur	70.00	lb	0.22	15	
Rally 40W (Sterol Inhibitor)	16.00	oz	5.23	84	
Vangard WG	10.00	oz	4.66	47	
Insecticide:					
Lorsban 4E	4.00	pint	6.35	25	
Kryocide	6.00	lb	3.08	18	
Provado 1.6 Solupak	1.00	oz	44.21	44	
Fertilizer:					
Neutral Zinc 50% (foliar)	5.00	lb	1.08	5	
UN 32	50.00	lb N	0.46	23	
Water:					
Water Pumped	36.00	acin	4.59	165	
Growth Regulator:					
ProGibb 4% (Gibberelic Acid)	9.00	gram	1.68	15	
Ethrel	1.00	pint	8.04	8	
Harvest Supplies:					
Box (19 lb)	1,000.00	box	[illegible]	1,600	
Plastic Bags (9/box)	9,000.00	each	0.04	315	
Contract:					
Commission (9% of selling price)	1,000.00	box	1.26	1,260	
Assessment:					
Table Grape Commission	1,000.00	box	0.12	116	
Quality Inspection (1/3 of yield)	333.00	box	0.04	12	
Labor (machine)	18.48	hrs	14.63	270	
Labor (non-machine)	419.55	hrs	11.31	4,745	
Fuel - Gas	11.78	gal	2.80	33	
Fuel - Diesel	29.50	gal	2.30	68	
Lube				15	
Machinery repair				51	
Interest on operating capital @ 10.00%				187	
TOTAL OPERATING COSTS/ACRE				9,248	
NET RETURNS ABOVE OPERATING COSTS				4,752	
CASH OVERHEAD COSTS:					
Office Expense				80	
Liability Insurance				6	
Sanitation				19	
Property Taxes				116	
Property Insurance				31	
Investment Repairs				42	
TOTAL CASH OVERHEAD COSTS/ACRE				294	
TOTAL CASH COSTS/ACRE				9,542	

UC COOPERATIVE EXTENSION

Table 3. continued

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
NON-CASH OVERHEAD COSTS (Capital Recovery)					
Land				530	
Drip Irrigation System				110	
Building				57	
Tools-Shop/Field				14	
Fuel Tanks 2-300G				2	
Establishment Costs				484	
Equipment				129	
TOTAL NON-CASH OVERHEAD COSTS/ACRE				1,326	
TOTAL COSTS/ACRE				10,868	
NET RETURNS ABOVE TOTAL COSTS				3,132	

UC COOPERATIVE EXTENSION

Table 4. MONTHLY CASH COSTS PER ACRE to PRODUCE CRIMSON TABLE GRAPES

SAN JOAQUIN VALLEY – SOUTH 2007

Beginning JAN 07 Ending DEC 07	JAN 07	FEB 07	MAR 07	APR 07	MAY 07	JUN 07	JUL 07	AUG 07	SEP 07	OCT 07	NOV 07	DEC 07	TOTAL
Cultural: **Bold** see section in assumptions													
Vine: Layering Missing Vines	11												11
Prune: Vines	430												430
Prune: Shred Prunings (all middles)	15												9
Trellis: Repair	33												33
***CM**: Tie Canes		104											104
Weed: Winter Strip (Surflan, Roundup)		53											53
Vertebrate: (gophers, squirrels, coyotes, birds)			2	2	2	2	2	2	2	2			15
Disease: Phomopsis (Abound)/Mildew (Microthiol)			51										51
Insect: Mealybug (Lorsban)			41										41
Weed: Mow Middles 3X			8		8		8						24
Disease: Mildew (Dusting Sulfur)				10		10	10						30
Sucker: Trunk				23									23
Disease: Mildew (Microthiol, Rally). **Fertilize**: (Zn)				44									44
Fertilize: (UN32) through drip				23									23
Irrigate: (Water/Labor)				6	22	37	48	44	31	6			194
***CM**: Shoot Position & Removal				170									170
***FM**: BloomThin (GA). **Disease**: Mildew (Microthiol). **Insect**: Skeletonizer (Kryocide)					37								37
FM: Fruit Exposure/Leaf Removal						566							566
Disease: Mildew (Rally, Microthiol)						38							38
FM: Cluster Thinning						113							113
FM: Girdle						136							136
FM: Berry Sizing (GA). **Disease**: Mildew (Microthiol, Rally). **Insect**: Leafhopper (Provado)						96							96
CM: Cane Cutting (Mechanical)						8							8
Weed: Spot Spray (Roundup)						14							14
Disease: Mildew (Rally, Microthiol)							38						38
FM: Color Fruit (Ethrel)								24					24
Disease: Mildew on stem 4X (Dusting Sulfur)									20	20			40
Disease: Botrytis (Vangard)										62			62
Pickup Truck Use	7	7	7	7	7	7	7	7	7	7	7	7	82
ATV	3	3	3	3	3	3	3	3	3	3	3	3	38
TOTAL CULTURAL COSTS	499	167	111	287	79	1,030	116	79	63	100	10	10	2,552
Harvest:													
Pick & Field Pack										2,828			2,828
Boxes, Spread, Swamp & Haul										2,294			2,294
Brokerage Fee										1,260			1,260
Assessment & Inspection Fees										128			128
**TOTAL HARVEST COSTS										6,509			6,509
Interest on operating capital @ 10.00%	4	6	6	9	10	18	19	20	20	75	0	0	187
TOTAL OPERATING COSTS/ACRE	503	173	118	296	88	1,048	135	99	83	6,685	10	10	9,248

UC COOPERATIVE EXTENSION

Table 4. continued

Beginning JAN 07 Ending DEC 07	JAN 07	FEB 07	MAR 07	APR 07	MAY 07	JUN 07	JUL 07	AUG 07	SEP 07	OCT 07	NOV 07	DEC 07	TOTAL
CASH OVERHEAD:													
Office Expense	7	7	7	7	7	7	7	7	7	7	7	7	80
Liability Insurance									6				6
Sanitation Fees	2	2	2	2	2	2	2	2	2	2			19
Property Taxes	58						58						116
Property Insurance	15						15						31
Investment Repairs	4	4	4	4	4	4	4	4	4	4	4	4	42
TOTAL CASH OVERHEAD COSTS	86	12	12	12	12	12	86	12	18	12	10	10	294
TOTAL CASH COSTS/ACRE	589	185	130	308	101	1,060	221	111	101	6,697	20	20	9,542

*CM = Canopy Management. FM = Fruit Management

** To find cost per box divide by 1,000

UC COOPERATIVE EXTENSION
Table 5. RANGING ANALYSIS
SAN JOAQUIN VALLEY – SOUTH 2007

COSTS PER ACRE AT VARYING YIELD TO PRODUCE CRIMSON TABLE GRAPES

	YIELD (19 lb box/acre)						
	600	700	800	900	1,000	1,100	1,200
OPERATING COSTS:							
Cultural Cost	2,552	2,552	2,552	2,552	2,552	2,552	2,552
Harvest Cost (pick, pack, haul)	3,073	3,585	4,097	4,609	5,121	5,634	6,146
Brokerage Fee	756	882	1008	1134	1260	1386	1512
Assessment/Inspection Cost	77	89	102	115	128	140	153
Interest on operating capital	165	171	176	181	187	192	198
TOTAL OPERATING COSTS/ACRE	6,623	7,279	7,935	8,591	9,248	9,904	10,561
Total Operating Costs/box	11.04	10.40	9.92	9.55	9.25	9.00	8.80
CASH OVERHEAD COSTS/ACRE	293	293	294	294	294	294	295
TOTAL CASH COSTS/ACRE	6,916	7,572	8,229	8,885	9,542	10,198	10,856
Total Cash Costs/box	11.53	10.82	10.29	9.87	9.54	9.27	9.05
NON-CASH OVERHEAD COSTS/ACRE	1,315	1,318	1,321	1,324	1,326	1,329	1,331
TOTAL COSTS/ACRE	8,231	8,890	9,550	10,209	10,868	11,527	12,187
Total Costs/box	13.72	12.70	11.94	11.34	10.87	10.48	10.16

NET RETURNS PER ACRE **ABOVE OPERATING COSTS**

PRICE	YIELD (19 lb box/acre)						
$/box	600	700	800	900	1,000	1,100	1,200
10.00	-623	-279	65	409	752	1,096	1,439
11.00	-23	421	865	1,309	1,752	2,196	2,639
12.00	577	1,121	1,665	2,209	2,752	3,296	3,839
13.00	1,177	1,821	2,465	3,109	3,752	4,396	5,039
14.00	1,777	2,521	3,265	4,009	4,752	5,496	6,239
15.00	2,377	3,221	4,065	4,909	5,752	6,596	7,439
16.00	2,977	3,921	4,865	5,809	6,752	7,696	8,639

NET RETURNS PER ACRE **ABOVE CASH COSTS**

PRICE	YIELD (19 lb box/acre)						
$/box	600	700	800	900	1,000	1,100	1,200
10.00	-916	-572	-229	115	458	802	1,144
11.00	-316	128	571	1,015	1,458	1,902	2,344
12.00	284	828	1,371	1,915	2,458	3,002	3,544
13.00	884	1,528	2,171	2,815	3,458	4,102	4,744
14.00	1,484	2,228	2,971	3,715	4,458	5,202	5,944
15.00	2,084	2,928	3,771	4,615	5,458	6,302	7,144
16.00	2,684	3,628	4,571	5,515	6,458	7,402	8,344

NET RETURNS PER ACRE **ABOVE TOTAL COSTS**

PRICE	YIELD (19 lb box/acre)						
$/box	600	700	800	900	1,000	1,100	1,200
10.00	-2,231	-1,890	-1,550	-1,209	-868	-527	-187
11.00	-1,631	-1,190	-750	-309	132	573	1,013
12.00	-1,031	-490	50	591	1,132	1,673	2,213
13.00	-431	210	850	1,491	2,132	2,773	3,413
14.00	169	910	1,650	2,391	3,132	3,873	4,613
15.00	769	1,610	2,450	3,291	4,132	4,973	5,813
16.00	1,369	2,310	3,250	4,191	5,132	6,073	7,013

UC COOPERATIVE EXTENSION

Table 6. WHOLE FARM ANNUAL EQUIPMENT, INVESTMENT, & BUSINESS OVERHEAD

SAN JOAQUIN VALLEY – SOUTH 2007

ANNUAL EQUIPMENT COSTS

Yr	Description	Price	Yrs Life	Salvage Value	Capital Recovery	Cash Overhead Insur-ance	Cash Overhead Taxes	Total
07	60 HP 4WD Narrow Tractor	47,000	15	9,150	4,885	200	281	5,366
07	ATV 4WD	6,700	5	3,003	1,125	35	49	1,209
07	Brush Shredder 6'	8,000	15	768	862	31	44	937
07	Cane Cutter	3,500	20	182	333	13	18	364
07	Duster - 3 Pt 12'	5,500	5	1,792	1,040	26	36	1,103
07	Mower-Flail 8'	10,500	15	1,008	1,132	41	58	1,230
07	Orchard/Vine Sprayer 500 gal	21,000	5	6,840	3,973	99	139	4,211
07	Pickup Truck 1/2 T	28,000	7	10,621	4,023	138	193	4,354
07	Sprayer ATV 20 gal	350	10	62	46	1	2	50
07	Truck-Flatbed (10 ton)	56,000	10	16,542	6,882	259	363	7,504
07	Weed Sprayer 3 PT 100 gal	4,000	10	707	526	17	24	566
	TOTAL	190,550		50,675	24,827	861	1,206	26,894
	60% of New Cost *	114,330		30,405	14,896	517	724	16,136

* Used to reflect a mix of new and used equipment.

ANNUAL INVESTMENT COSTS

Description	Price	Yrs Life	Salvage Value	Capital Recovery	Cash Overhead Insur-ance	Cash Overhead Taxes	Cash Overhead Repairs	Total
Building 2,400 sqft	80,000	30		6,610	286	400	1,600	8,895
Drip Irrigation System 40 acres	50,000	25		4,388	179	250	1,000	5,816
Vineyard Establishment	209,880	22		19,369	749	1,049	0	21,168
Fuel Tanks 2-300 gal	3,500	30	350	286	14	19	70	389
Land	840,000	25	840,000	60,900	0	8,400	0	69,300
Tools-Shop/Field	15,000	15	1,500	1,614	59	83	300	2,056
TOTAL INVESTMENT	1,198,380		841,850	93,167	1,286	10,201	2,970	107,624

ANNUAL BUSINESS OVERHEAD COSTS

Description	Units/ Farm	Unit	Price/ Unit	Total Cost
Liability Insurance	115	acre	5.86	674
Office Expense	115	acre	80.00	9,200
Sanitation Fee	115	acre	19.35	2,225

UC COOPERATIVE EXTENSION

Table 7. HOURLY EQUIPMENT COSTS

SAN JOAQUIN VALLEY - 2007

Yr	Description	Actual Hours Used	Capital Recovery	Cash Overhead Insur-ance	Cash Overhead Taxes	Operating Repairs	Operating Fuel & Lube	Operating Total Opera.	Total Costs/Hr.
07	60 HP 4WD Narrow Tractor	1,066	2.75	0.11	0.16	1.11	7.79	8.90	11.92
07	ATV 4WD	400	1.69	0.05	0.07	0.49	1.07	1.56	3.37
07	Brush Shredder 6'	134	3.88	0.14	0.20	3.49	0.00	3.49	7.71
07	Cane Cutter	100	1.99	0.08	0.11	1.29	0.00	1.29	3.47
07	Duster - 3 Pt 12'	240	2.60	0.07	0.09	0.79	0.00	0.79	3.55
07	Mower-Flail 8'	133	5.12	0.19	0.26	4.58	0.00	4.58	10.15
07	Orchard/Vine Sprayer 500 gal	400	5.96	0.15	0.21	3.67	0.00	3.67	9.99
07	Pickup Truck 1/2 T	286	8.46	0.29	0.41	2.04	14.76	16.80	25.96
07	Sprayer ATV 20 gal	148	0.19	0.01	0.01	0.09	0.00	0.09	0.30
07	Truck – Flatbed (10 ton)	200	20.65	0.78	1.09	5.30	2.64	7.94	30.46
07	Weed Sprayer 3 PT 100 gal	199	1.59	0.05	0.07	0.68	0.00	0.68	2.39

UC COOPERATIVE EXTENSION
Table 8. OPERATIONS WITH EQUIPMENT – CRIMSON TABLE GRAPES
SAN JOAQUIN VALLEY 2007

Operation	Operation Month	Tractor	Implement	Material	Broadcast Rate/acre	Unit
Weed: Winter Strip (Surflan, Roundup)	February	60HP 4WD	Weed Sprayer	Surflan	2.40	pt
				Roundup	.60	pt
Weed: Mow Middles 4X	March	60HP 4WD	Mower Flail 8'			
	May	60HP 4WD	Mower Flail 8'			
	July	60HP 4WD	Mower Flail 8'			
Weed: Spot Spray (Roundup)	June	ATV 4WD	Weed Sprayer	Roundup	0.50	pt
Irrigation: (Water)	April			Water	1.00	acin
	May			Water	4.00	acin
	June			Water	7.00	acin
	July			Water	9.00	acin
	August			Water	8.00	acin
	September			Water	6.00	acin
Irrigation: Post Harvest	October			Water	1.00	acin
Fertilize: N through Drip (UN32)	April			UN 32	50.00	lb N
Disease: Mildew/Fertilize: Zn	April	60HP 4WD	Air Blast Sprayer	Microthiol (mildew)	2.00	lb
				Rally (mildew)	4.00	oz
				Neutral Zinc	5.00	lb
Disease: Phomopsis/Mildew	March	60HP 4WD	Air Blast Sprayer	Abound (phom/mildew)	12.00	floz
				Microthiol(phom/mildew)	1.00	lb
Vertebrate: (gopher, squirrel, coyote, and/or birds)	Mar - Oct			Various as needed	15.00	acre
Disease: Mildew 3X (Dusting Sulfur)	April	60HP 4WD	Duster	Dusting Sulfur	10.00	lb
	June	60HP 4WD	Duster	Dusting Sulfur	10.00	lb
	July	60HP 4WD	Duster	Dusting Sulfur	10.00	lb
***FM**: Bloom Thin. **Disease**: Mildew. **Insect**: Skeletonizer	May	60HP 4WD	Air Blast Sprayer	GA(thin)	1.00	floz
				Microthiol (mildew)	2.00	lb
				Kryocide (skeletonizer)	6.00	lb
Disease: Mildew (Rally, Sulfur)	June	60HP 4WD	Air Blast Sprayer	Rally (mildew)	4.00	oz
				Microthiol (mildew)	2.00	lb
	July	60HP 4WD	Air Blast Sprayer	Rally (mildew)	4.00	oz
				Microthiol (mildew)	2.00	lb
Disease: Mildew on Stem 4X (Dusting Sulfur)	September	60HP 4WD	Duster	Dusting Sulfur	10.00	lb
	September	60HP 4WD	Duster	Dusting Sulfur	10.00	lb
	October	60HP 4WD	Duster	Dusting Sulfur	10.00	lb
	October	60HP 4WD	Duster	Dusting Sulfur	10.00	lb
Disease: Botrytis (Vangard)	October	60HP 4WD	Duster	Vangard	10.00	oz
FM: Berry Size/Disease: Mildew/ Insect: Leafhopper	June	60HP 4WD	Air Blast Sprayer	GA (size)	8.00	floz
				Microthiol (Mildew)	2.00	lb
				Rally (Mildew)	4.00	oz
				Provado (Leafhopper)	1.00	oz
Insect: Mealybug	March	60HP 4WD	Air Blast Sprayer	Lorsban	4.00	pt
Trellis: Repair	January			Labor	2.00	hrs
				Trellis Materials	10.00	acre
Vine: Layering Vines	January			Labor	1.00	hrs
Prune	January			Labor	38.00	hrs
Prune: Shred prunings	January	60HP 4WD	Brush Shredder			
CM; Tie Canes	February			Labor	8.00	hrs
				Materials	11.50	acre
CM: Shoot Positioning & Removal	April			Labor	15.00	hrs
Sucker: Remove Trunk Suckers	April			Labor	2.00	hrs
CM: Cane Cutting	June	60HP 4WD	Cane Cutter			
FM: Cluster Thinning	June			Labor	10.00	hrs
FM: Girdle	June			Labor	12.00	hrs
FM: Fruit Exposure/Leaf Removal	June			Labor	50.00	hrs
FM: Color Fruit	Aug	60HP 4WD	Air Blast Sprayer	Ethrel	1.00	pint
Pickup: Farm Use	Annual	Pickup 1/2 ton				
ATV: Farm Use	Annual	ATV				
Harvest: Pick & Pack	October			Labor	250.00	hrs
Harvest: Swamp, Spread, Haul	October	Truck-Flatbed		Labor	29.00	hrs

* CM = Canopy Management. FM = Fruit Management

Raisin Grapes

Raisin Grape

Winter		Associated Cost/acre
Pruning		$163.01
Tying		$67.00
Fertilizer Application		$60.00
Fix Stakes and wires		$32.00
Shred Prunings		$8.00
Spring		
Action		
Irrigation		$170.00
Weed Control/Cultivation		$160.00
Shoot Removal		$14.00
Fungicide/Pest Control	Spring/Summer	$217.00
Summer		
Mow Weeds/Cut Canes		$15.00
Cultivation		$24.00
Fall		
Harvest & Haul		$627.00
Trays, picking, rolling, pick-up, hauling, equipment		
Overhead Expenses		
Taxes, Insurance, Office, Electricity		$304.00
Non-Cash Overhead Expense		$1,131.00
Total Cost		**$3,281.00**
Total Income		**$1,903.82**
Tons/acre	2.132	
Ten Year Avg. Price	$892.98	
Net Return/acre		**($1,377.18)**

Source: Cost & Return Data, Agricultural Economics UC Davis (2006)

Income

Historical Pricing	Pricing/ton	Free Tonnage %	Grower Receives/ton	Avg. Ton/Acre	Gross Income
2000	$ 877.50	53%	$ 603.00	2.31	$ 1,392.93
2001	$ 880.00	63%	$ 651.00	2.1	$ 1,367.10
2002	$ 745.00	53%	$ 519.00	2.53	$ 1,313.07
2003	$ 810.00	70%	$ 567.00	1.94	$ 1,099.98
2004	$ 1,210.00	100%	$ 1,210.00	1.86	$ 2,250.60
2005	$ 1,210.00	83%	$ 998.00	2.12	$ 2,115.76
2006	$ 1,210.00	90%	$ 1,089.00	1.74	$ 1,894.86
2007	$ 1,210.00	85%	$ 1,028.50	2.09	$ 2,149.57
2008	$ 1,310.00	87%	$ 1,139.70	2.52	$ 2,872.04
2009 (est.)	$ 1,323.00	85%	$ 1,124.55	2.11	$ 2,372.80
Average:	**$ 1,078.55**	**77%**	**$ 892.98**	**2.132**	**$ 1,903.82**

Source: Raisin Bargaining Association

Pullout Costs

Chipping (1)	
	Cost/Acre
Remove Stakes & Stakes	$508.64
Labor - $259.20, Equipment - $250	
Cut Wire & Remove from Field	$212.00
(Labor and Equipment)	
Push and Pile Cost	$160.00
Chip Stacked Piles (2)	$200.00
20 acres/day (varies)	
Dust Control ~$400/day	$20.00
Remove and Dump Roots and Stumps after Chipping	
~4 tons/acre	
Deliver and dump container at Composter ($225/load)	$90.00
$25.00/ton Composting	$100.00
Tractor /labor to load roots into Container	$54.00
Total Cost of Chipping	***$1,344.64***

*Vineyard prunings are not burned, they are shredded in the vineyard.
(1) - Commercial grinders state that if they remove non-vegetative material cost = 1,000/acre+, which does not include root and stump removal
(2) - Cost may be as high as $400/acre depending on method of chipping (wind row vs. stacked piles)

Burning	
	Cost/Acre
Cut Wire	$2.70
Push and Pile Cost	$160.00
Burn Permit Fee (1)	$26.00
Burn Control (supervise burn)	$11.82
Remove Roots and Stumps before Burn	
~4 tons/acre	
Tractor/trailer/labor to load roots into piles	$54.00
Remove Steel after Burn	$11.82
20 acres/8 hour	
Total Cost of Burning	***$266.34***

If steel is removed before burn, cost would increase

(1) - Flat fee per site

Raisin Grapes

Methodology: Cost Study data was collected based on the farming costs of an average raisin vineyard in the San Joaquin Valley. The cost study data is from 2006, though growers estimate that the farming costs have increased 10 to 15% since then. The main areas of cost increases have been in fuel, labor, and water. Costs are generally consistent across varieties.

The non-cash overhead costs are based on the repayment of the establishment and other long-term costs of the vineyard. Costs associated with non-cash overhead include: land purchase, tools, fuel tanks, irrigation system, establishment costs, and equipment. Land and establishment costs are based over the 25 years of assumed production of the vineyard. 25 years is the standard production lifetime for a vineyard; after 25 years, the production deteriorates. Many vineyards continue to be in production past the 25 year mark, because growers cannot afford the up-front costs of establishing a new vineyard. The cost study information makes note of the fact that their costs do not take into account the cost of paying the owner a salary. The owner is assumed to be paid on any positive return at the end of the year.

Pullout Costs were calculated based on conversations with growers, chippers, and farm labor contractors. The vineyard trellis system would have a combination of metal stakes and cross arms, as well as multiple support wires which would have to be removed before the vineyard can be chipped. The labor rate used was $8.00 per hour (the state minimum wage), plus 35% to take into account all state and federal taxes, social security deductions, and worker's compensation insurance. The labor rate may be higher depending on the labor conditions. Another issue with chipping is that chippers are not always able to do their work on the farmer's schedule. It can take weeks or even months to have a field chipped, at which point it may be too late to plant for the next season.

The stakes would be removed by three workers operating a loader in the field. Two workers would use chains to remove the stakes and one employee would operate the loader. These workers would be able to complete approximately one acre in an 8 hour workday. When burning, the stakes are piled with the vines, and removed after the burn.

Wire must also be removed from the vineyard before it can be chipped. Depending on the chipper's equipment, wire must be removed completely from the vineyard or must be present only in very short lengths. Raisin vineyards are pruned in such a way that the remaining canes are wrapped around the vineyard wire to support the crop. This wire has to be pulled out from every vine. Chippers reported this wire causing problems and getting wrapped around the moving parts of their machinery. It was also reported that the bio mass facilities prefer not to receive material with wire, because the wire causes havoc with their equipment.

Wire removal is based on the cutting and removal of the wire from the field. For the chipping calculation, the wire removal cost estimate is significantly higher than the wire removal from burning. When wire is removed from a chipped vineyard, the wire has to be cut at every point where it is exposed. An individual wire would be cut between 150 and 200 times (depending on the number of vines in a row) per quarter mile. When burning, the wire has to be cut only once every 4-6 vines. This is only 45-60 per wire per row. The other issue for chipping is the removal of the clips or dog ears that hold the wire in place. These have to be removed from every stake in order to pull out the wire. Additionally, loose wire must also be picked up before the equipment can come into the field. Growers and contractors relayed that the wire removal for a single wire (the main wire) would take approximately 20 man-hours, as well as the use of a tractor or ATV to drive around picking up buckets full of pieces of wire. Each additional wire in the trellis system would cost $180 per wire. A typical trellis system for raisin grapes would have between 1-4 wires. Growers who are able to burn do not have this issue, as the wire stays with the vine until burned, and can then be picked up with a loader or forklift from the piles. This wire is then loaded onto a truck and taken to a recycling center.

Root removal also differs with regards to chipping or burning. Roots and stumps must be removed from the field before it can be replanted. In a typical vineyard, there will be approximately 4 tons of roots and stumps remaining in the field when the vines are laid over and piled. These roots will have to be excavated using a chisel to get them out of the ground, and hand and machine labor to remove them from the field. When burning, the roots and stumps can be placed into the burn piles along with the above-ground material. When chipping, the roots must be hauled from the field to either a composter or dump. Chippers stated that they do not like to chip roots because of the amount of dirt that is associated. This volume of dirt negatively affects the machinery and causes wear and tear. The rates listed on the attached sheets are for the most cost-effective removal and disposal of the roots. The roots and stumps would be hauled by truck to the composter that charges $25 per ton for the material. This compares favorably to the $60 per ton that was quoted at the waste disposal site.

GR-SJ-06-1

UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

2006

SAMPLE COSTS TO ESTABLISH A VINEYARD AND PRODUCE GRAPES FOR

RAISINS

TRAY DRIED RAISINS

SAN JOAQUIN VALLEY

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UC COOPERATIVE EXTENSION

SAMPLE COST TO ESTABLISH A VINEYARD AND PRODUCE RAISINS
San Joaquin Valley - 2006

CONTENTS

INTRODUCTION

Sample costs to establish a vineyard to produce raisins are presented in this study. This study is intended as a guide only, and can be used to make production decisions, determine potential returns, prepare budgets and evaluate production loans. Practices described are based on production practices considered typical for the crop and area, but these same practices will not apply to every farming operation. The sample costs for labor, materials, equipment and custom services are based on current figures. A blank column, "*Your Costs*", in Tables 3 and 4 is provided for entering your costs.

The hypothetical farm operation, production practices, overhead, and calculations are described under the assumptions. For additional information or an explanation of the calculations used in the study call the Department of Agricultural and Resource Economics, University of California, Davis, (530) 752-3589 or your local UC Cooperative Extension office.

Sample Cost of Production Studies for many commodities are available and can be requested through the Department of Agricultural and Resource Economics, UC Davis, (530) 752-4424. Current studies can be downloaded from the department website at http://coststudies.ucdavis.edu or obtained from selected county UC Cooperative Extension offices.

ASSUMPTIONS

The assumptions refer to Tables 1 to 9 and pertain to sample costs to establish the vineyard and produce raisin grapes in the San Joaquin Valley. The cultural practices described represent production operations and materials considered typical on a well-managed vineyard in the region. Costs, materials, and practices in this study will not apply to all farms. Timing of and types of establishment and cultural practices will vary among growers within the region and from season to season due to variables such as weather, soil, and insect and disease pressure. The study does not represent a single farm and is intended as a guide only. **The use of trade names and cultural practices in this report does not constitute an endorsement or recommendation by the University of California nor is any criticism implied by omission of other similar products or cultural practices.**

Land. The 120 contiguous acre farm is owned and operated by the grower. Vines for raisin production are being established on 40 acres and 75 acres are mature vines for raisin or wine production. Roads, irrigation systems, and farmstead occupy the remaining five acres. The establishment and production costs in this study are based on the 40 acres.

Establishment Operating Costs

Land/Site Preparation. This vineyard is established on ground previously planted to vineyards or orchards. Land coming from trees or vines should be fallowed for two years except for a possible grain crop. The land is assumed to be fairly level. A custom operator chisels the ground twice to a depth of 2 to 3 feet. The grower floats the land to smooth and level the surface. Afterwards the ground is disked twice to apply and incorporate preplant herbicide. Nematode samples should be taken from land formerly in trees or vines and fumigated if necessary. Most operations that prepare the vineyard for planting are done in the year prior to planting, but costs are shown in the first year.

Vines. During the first spring following fall land preparation, Thompson Seedless vines are planted on 7 x 12-foot spacing with 519 vines per acre. Plants are dormant Thompson Seedless grafted onto a rootstock like Freedom or Harmony. Fiesta, Selma Pete and DOVine are early ripening cultivars– that can also be used for establishing a new raisin vineyard. Establishment and production costs for Thompson Seedless and the other cultivars are similar when tray drying. Thompson Seedless is used in this study because it is the primary cultivar used for tray dried raisins. Vines will be trained up the t-post during the second and third years. The grapevines are expected to begin yielding fruit in three years and then be productive for an additional 22 years.

Trellis System. The trellis cost is provided by a trellis company and is an approximate estimate for the described trellis system. The trellis system is a two-wire 24-inch crossarm design and is installed by a custom trellis company in the second year. Once the vineyard is laid out, an eight-foot wooden end post is placed at each end of the rows. In between the end posts, a six-foot steel stake is installed at each vine. Each stake has a single 24 inch crossarm attached to support the two 13 gauge fruiting wires. A third wire is added to the lower portion of the trellis to hold the drip lines. The trellis system is considered part of the vineyard since it would be removed at the time of vine removal and is shown in the vineyard establishment costs. Trellis and vine repairs of $1,332 or $33 per acre are shown in Table 7 (Annual Investment Costs) and included in Investment Repairs under Cash Overhead in the various tables. A 36-inch crossarm may increase raisin yields, but raisins need to be harvested prior to September 1 to successfully dry with the wider trellis. The larger crossarm may cause some shading in the drying row.

Planting. Planting starts by laying out and marking vine sites in late winter. In the spring, holes are dug and the vines are planted and protected with an open carton placed over the vine. In the second year 2% or 10 vines per acre are replanted for those lost in the first year.

Train/Prune. In the first year, the vines are allowed to grow without any training. During the second year (first dormant season), the vines are pruned back to two buds. In the spring, a shoot is selected and trained up the stake to form head trained vines. Additional training plus tying and suckering are done once in April and twice in May. Standard pruning begins in the third year (second dormant season) leaving three canes per vine. In January, the vines are pruned and in January or February, the canes are tied to the wires. The dormant season prunings are shredded beginning in the third year. Mechanical cane cutting or skirting begins and is done in June and August. In the fourth year, the vines are considered mature and pruned to four or more canes per vine. Besides training the selected canes, training also includes suckering and tying canes. Suckering is the removal of water sprouts from the trunk. Selecting and tying canes to the fruiting wires is required each year for the life of the vineyard. Vines that are replanted (replacement vines) show training costs in the third year.

Irrigation. The drip line is laid on the ground prior to planting. After the trellis is installed, the drip line is clipped to the bottom trellis wire. In this study, the pumped water is calculated to cost $5.67 per acre-inch or $68.00 per acre-foot. Water pumping costs plus labor constitute the irrigation cost. Price per acre-foot of water will vary, depending on quantity used, water district, power cost, well characteristics, and other irrigation factors. Water is applied immediately after planting and during the growing season from April through September. No assumption is made about effective rainfall or runoff. The amount of water applied to the vines each year is shown in Table A.

Table A. Applied Irrigation Water

Year	AcIn/Year
1	12
2	24
3+	28

Fertilize. Liquid nitrogen fertilizer, UN32, is applied through the irrigation system in April of the first year at five pounds of nitrogen (N) per acre. A single application is made in April of the second year and equally split applications in May and June of the third year. The amount of nitrogen applied each year increases as the vineyard matures and is shown in Table B. It is important to identify sources of nitrogen in order to properly manage the nitrogen budget. Sources of nitrogen such as irrigation well water should be calculated to determine the need to irrigate and fertilize.

Table B. Applied Nitrogen (N) Per Acre

Year	Lbs of N
1	5
2	20
3+	40

Pest Management. For pest identification, monitoring, management and pesticide information, visit the UC IPM website at www.ipm.ucdavis.edu. Written recommendations are required for many commercially applied pesticides, and are available from licensed pest control advisers (PCAs). For information on pesticide use permits, contact the local county Agricultural Commissioner's office. **Pesticides mentioned in this study are used to calculate rates and costs. Although the pesticides mentioned are commonly used by growers, many other pesticides are available. Check with your PCA and/or the UC IPM website for current recommendations.**

Table A. PESTICIDE PROGRAM– Establishment Years

MONTH	MILDEW	PHOMOP-SIS	LEAF HOPPER	SKELETON-IZER	MEALY BUG	OTHER	YEAR
April	Microthiol			Kryocide			2
March					Lorsban		3
March	Microthiol	Abound					3
April	Dusting Sulfur						3
April	Microthiol + Rally					Zinc	3
May	Microthiol + Flint			Kryocide			3
June	Microthiol + Rally						3
June			Provado				3
June	Dusting Sulfur						3
June	Dusting Sulfur						3

Insects. Western grapeleaf skeletonizer (*Harrisina brillians*) is controlled in April of the second and third years with an application of Kryocide insecticide (applied with Microthiol sulfur spray). In the third year, Lorsban is applied in early March to control mealybugs (*Pseudococcus and Planococcus spp.*) and Provado insecticide is applied in June to control the grape leafhoppers (*Erythroneura elegantula*).

Diseases. Although many pathogens attack grapevines, phomopsis cane and leafspot (*Phomopsis viticola)* and powdery mildew (*Uncinula necator)* are the two diseases managed in this study. In the second year, Microthiol (micronized sulfur) for mildew is applied (with Kryocide application) in April. In March of the third year, Microthiol plus Abound (strobilurin) are applied for phomopsis and mildew control. Mildew is controlled with various fungicide applications at 7 to 21 day intervals in the third year, depending on the fungicide used. For this study, the grower applies Microthiol and Rally (SI) (with zinc application) in April, Dusting Sulfur in April, Microthiol and Flint (with Kryocide application) in May. Microthiol and Rally in June and two applications of Dusting Sulfur in June. Growers have the option of using sulfur (dust, wettable, flowable or micronized), sterol inhibitors (SIs), or strobilurins, as well as other fungicides to control powdery mildew. Sterol inhibitors and strobilurins are two classes of fungicides with different modes of action than sulfur against powdery mildew. It is recommended that fungicides with different modes of action be used to avoid powdery mildew populations from acquiring fungicide resistance.

Weeds (Vineyard Floor Management). In October of the year prior to planting, Treflan is applied to the vineyard floor and incorporated by disking. After planting, weeds in the vine rows and middles are managed with disking, mowing, and/or herbicides. In the first year, the row middles are disked two times – July, September. The vine rows are hand weeded in May and August. The row middles are disked three times – March, June, September - in the second year and disked two times – March, May - in the third year. (See Terrace for additional disking.) The vine rows are sprayed (strip spray) beginning in January of the second year with Roundup and Surflan. The strip spray is applied to 30% of the acreage. Also beginning in the second year, spot sprays using Roundup are applied to the vine row in April, June, and July. The spot sprays (weedy spots or areas) are applied using an all terrain vehicle (ATV) with a sprayer attached.

Terrace. The middles are disked three times during August and September to form and remove the drying terrace. See related paragraph under Production section.

Harvest. Harvest begins the third year and the fruit is picked for raisins. See harvest in the production section for description

Yields. The vineyard yields approximately 1.5 tons of raisins per acre (equivalent to 6.75-tons of fresh grapes) in year three.

Returns. In this study, the raisins are sold for $1,150 per ton.

Production Operating Costs

Prune/Tie/Sucker. The vines are pruned during the winter months and the prunings, placed in row middles, are shredded and disked (see weeds). The vines are cane pruned with renewal spurs in January; canes are tied in February to the trellis wire(s) by twisting around the trellis wire and attaching with twist-ems. The canes are mechanically cut (skirted) in June and August to open the canopy and prevent canes from crossing rows.

Irrigation. The vineyard is drip irrigated using 28 acre-inches of applied water during the growing season from April through September. During June, July, and August, irrigations are applied frequently with no more than four days between irrigations. Daily irrigations during this period are preferable. Deficit irrigation (50% ET) is applied during the three week period in late August to mid September when fruit is drying on the trays. Drip irrigation may be withheld completely during this period if there is a risk of dripline hoses rupturing or water running on the trays. After raisins are removed from the field, irrigation resumes at full ET (Evapotranspiration) to replenish the soil profile. Irrigation amounts are based on vineyard ET and can vary from season to season. Water pumping costs plus labor, which includes checking the drip lines, constitute the irrigation cost. In this study, water is calculated to cost $5.67 per acre-inch or $68.00 per acre-foot. The pumping cost is based on using 40 horsepower motor to pump from 130 feet deep. Price per acre-foot of water will depend on quantity used, water district, power cost, various well characteristics, and other irrigation factors. No assumption is made about effective rainfall and runoff. In some years frost protection may be required and water applications may be necessary in March.

Fertilize. Nitrogen (N) at 40 pounds per acre as UN32 is applied through the irrigation drip system during April (or can be applied post harvest). Neutral zinc is foliar applied to prevent zinc deficiencies and is combined with the late April mildew (Microthiol, Rally) application.

Pest Management. The pesticides and rates mentioned in this cost study are listed in *UC Integrated Pest Management Guidelines, Grapes.* For information on other pesticides available, pest identification, monitoring, and management visit the UC IPM website at www.ipm.ucdavis.edu. For information and pesticide use permits, contact the local county agricultural commissioner's office. **Pesticides mentioned in this study are used to calculate rates and costs. Although the pesticides mentioned are commonly used by growers, many other pesticides are available. Check with your PCA and/or the UC IPM website for current recommendations.** Adjuvants are recommended for use with many pesticides for effective control, but the adjuvant and their costs are not included in this study. Pesticide costs may vary by location, brand, and grower volume. Pesticide costs in this study are taken from a single dealer and shown as full retail.

Pest Control Adviser (PCA). Written recommendations are required for many commercially applied pesticides and are written by licensed pest control advisers. In addition the PCA will monitor the field for agronomic problems including pests, diseases, and nutritional status. Growers may hire private PCAs or receive the service as part of a service agreement with an agricultural chemical and fertilizer company. Costs for a PCA are not included in this study.

Weeds (Vineyard Floor Management). Vineyard middles are disked two times each season: March and May. (See Terrace for additional disking) Surflan and Roundup herbicides are applied to the vine row in January or early February. Roundup, a contact herbicide, is applied as a spot spray to the vine row in April, June and July.

Insects. Mealybugs (*Pseudococcus and Planococcus spp.*) are treated at delayed dormant with Lorsban insecticide in early March (dormant vines). Western grapeleaf skeletonizer (*Harrisina brillians*) is treated with Kryocide (mixed with a GA and/or sulfur application) during the bloom spray in May. Grape leafhoppers (*Erythroneura elegantula*) are controlled with Provado

Table B. PESTICIDE PROGRAM– Production Years

MONTH	MILDEW	PHOMOP	LEAF HOPPER	SKELE-TONIZER	MEALY BUG	OTHER
March					Lorsban	
March	Microthiol	Abound				
April	Dusting Sulfur					
April	Microthiol + Rally					Zinc
May	Microthiol + Flint			Kryocide		ProGibb (GA)
June	Microthiol + Rally					
June			Provado			Ethrel
June	Dusting Sulfur					
June	Dusting Sulfur					

insecticide (mixed with Ethrel application) in late June or early July. An effective alternative material for mealybugs is to apply Admire insecticide through the drip system, but at a higher cost than a Lorsban application. It may be necessary to use multiple insecticides to control some mealybug species.

Diseases. Diseases treated in this study are phomopsis cane and leafspot (*Phomopsis viticola)* and powdery mildew (*Uncinula necator)*. Phomopsis and powdery mildew are both treated in late March (shoot length 2 inches) with Microthiol (micronized sulfur) and Abound (strobilurin). Mildew is controlled during the season with various fungicide applications at 7 to 21 day intervals, depending on the fungicide used. In this study, Microthiol and Rally, an SI (mixed with zinc application) are applied in late April. Microthiol and Flint (mixed with Kryocide and GA application) are applied with the spray in May. Microthiol and Rally, an SI are applied in June. Dusting Sulfur is applied once in early April and two times in June. Growers have the option of using sterol inhibitors (SI), quinolins, strobilurins, or sulfur (micronized, wettable, dust, flowable), as well as other fungicides to control powdery mildew. Materials that represent classes of fungicides with different modes of action should be incorporated into your powdery mildew program to avoid resistance problems.

Fruit Management (FM). Gibberellic acid (GA), a plant growth regulator, is applied one time in May during bloom for thinning. Ethrel is applied at veraison in late June or early July to accelerate grape maturity. GA is applied with the mildew/skeletonizer spray in May and Ethrel with the leafhopper spray in June.

Terrace. Terraces are formed to provide an angled area facing the sun to dry the grapes. After the last irrigation in July or August, the middles are disked twice. Four to five days prior to harvest, the south facing terraces are formed using a tractor with a rear blade. After the raisins are boxed, a pass is made with the blade reversed (terrace back) to remove the terrace, followed by one disking and an irrigation. Forming the terrace is considered a preharvest operation and some growers will consider the operation as a harvest cost.

Harvest. The grapes are typically picked from mid August through mid September. The grower contracts to have the crop custom hand harvested for raisins at a rate of $0.35 per tray. Based on a two ton raisin yield, one man can pick approximately one-third acre per 10-hour day or one raisin ton (4.5 tons fresh grapes) per 15 hours. For this study we are assuming a crew of 20. Harvest consists of hand picking the grapes into pans. Paper trays are placed by the picker on the upper one-half of the terrace and the grapes are spread evenly on the paper trays. On average, about 18 to 20 pounds of fresh fruit are placed on each tray. Once dry this will amount to 4.5 pounds of raisins. Raisins are rolled at 16-18% moisture, allowed to equilibrate and then boxed when moisture is 14% or less. The grower rents for two weeks, a tractor to pull the second bin trailer and a forklift for loading and unloading the bins. The crop is dumped into bins that hold 1,000 to 1,200 pounds of raisins, a process referred to as boxing. The bins are furnished free by the packer. At 2.00 tons of raisins per acre, approximately 4 bins per acre are needed. Labor costs include a tractor driver for pulling the bin trailer with 4 bins and one person who rides the bin trailer and removes the paper trays, and two persons to pickup the rolled raisins and throw them into the bins. Papers are burned at the end of the row when weather conditions permit. The forklift operator works in the staging area unloading/loading bins and transporting the loaded and empty bin trailers to and from the boxing crew. Before raisins are delivered to the packer, they are run across the grower owned shaker to remove sand, leaves, and other debris. This is not always required, but is shown as a cost in this study. Shaking operations consist of a forklift operator in the staging area that loads and unloads the bins on the shaker and two men removing debris from the raisins on the shaker. Costs also include renting the forklift for an additional week. Shaking takes about five minutes per bin. It is assumed that all drivers and operators work hour's equivalent to the harvest time. The filled bins are hauled to the packer by a contract trucker. The shaking and transport operations may not occur at the same time as harvest, but at a later date. Depending on the market each year, growers have the option to produce the grapes for raisins or wine.

Yields. Raisin vineyards reach maturity in the fourth year and over the remaining years the vineyard will average 2.00 dry tons per acre based on California Department of Food and Agriculture 1995 to 2004 data. The drying ratio of green fruit to raisins is 4.1 to 4.5:1. Two tons per acre is the industry average for Thompson Seedless; new vineyards planted to new cultivars may have higher yields.

Returns. The estimated return for this study based on current raisin markets gives a final return (free + reserve tonnage) of $1,150 per ton. The raisin grape market is regulated by a federal marketing order administered by the Raisin Administrative Committee (RAC). Each year, the RAC sets minimum crop standards. In addition, the RAC regulates, on a percentage basis, the amount of the harvested crop that is offered for immediate sale (free tonnage), and the amount of the harvested crop that is held in reserve for later sale (the reserve pool), to control the overall supply of raisin grapes on the market.

Assessments. The California Raisin Marketing Board assesses a $16.20 per ton fee to support and promote use of California grown raisins.

Packers. Packing costs are not included in this study. The United States Department of Agriculture (USDA) inspects the raisins for maturity, quality, and moisture. The Raisin Administrative Committee (RAC), the administrative arm of the federal marketing order for raisins, sets industry standards. Fees are associated with both the USDA inspections and RAC administrative responsibilities; the packer pays for tonnage fees. Growers receive payment for the free tonnage (commercial sales) portion of their crop from the packer. The reserve tonnage portion (export sales and government purchases) is paid by the RAC. In most cases, the packer retains control of the raisin crop for marketing purposes after inspection.

Pickup/ATV. The grower uses the pickup for business and personal use. The assumed business use is 5,200 miles per year for the ranch. In addition to spot spraying for weed control, the All Terrain Vehicle (ATV) is used on the ranch for checking the vineyard and irrigating.

Labor, Equipment, Interest and Risk

Labor. Hourly wages for workers are $9.50 for machine operators and $8.25 per hour non-machine labor. Adding 34% for the employer's share of federal and state payroll taxes, insurance, and other possible benefits gives the labor rates shown of $12.73 and $11.05 per hour for machine labor and non-machine labor, respectively. Labor for operations involving machinery are 20% higher than the operation time given in Table 3 to account for the extra labor involved in equipment set up, moving, maintenance, work breaks, and field repair.

Equipment Operating Costs. Repair costs are based on purchase price, annual hours of use, total hours of life, and repair coefficients formulated by ASAE. Fuel and lubrication costs are also determined by ASAE equations based on maximum PTO horsepower, and fuel type. Prices for on-farm delivery of red dye diesel and gasoline are $2.00 and $2.55 per gallon, respectively. The cost includes a 2% local sales tax on diesel fuel, but does not include excise taxes. Gasoline costs include an 8% sales tax plus federal and state excise tax. Some federal and excise tax can be refunded for on-farm use when filing your income tax. The costs are based on 2005 American Automobile Association (AAA) and Department of Energy (DOE) monthly data. The fuel, lube, and repair cost per acre for each operation in Table 3 is determined by multiplying the total hourly operating cost in Table 8 for each piece of equipment used for the selected operation by the hours per acre. Tractor time is 10% higher than implement time for a given operation to account for setup, travel and down time.

Interest on Operating Capital. Interest on operating capital is based on cash operating costs and is calculated monthly until harvest at a nominal rate of 9.25% per year. A nominal interest rate is the typical market cost of borrowed funds. Interest in years one and two are calculated for the entire year; beginning in the third year, interest is calculated through harvest. Interest in year one in this study begins with the first operation in the fall of the previous year – total accumulated interest is for 15 months. The interest cost of post harvest operations is discounted back to the last harvest month using a negative interest charge.

Risk. The risks associated with crop production should not be minimized. While this study makes every effort to model a production system based on typical, real world practices, it cannot fully represent financial, agronomic and market risks, which affect profitability and economic viability. Growers may purchase Federal crop insurance to reduce the production risk associated with specific natural hazards. For raisin growers, income loss from bad weather during field drying is a major risk.

Crop Insurance. Crop insurance is available, but not included in this study. Insurance policies vary and range from a basic catastrophic loss policy to one that insures losses for up to 75% of a crop. Insurance costs will depend on the type and level of coverage. Coverage levels range from 50% to 75%. According to one insurer, premium and fees at the 60% level for 80 acres in Fresno County are $16.87 per ton for a $660 per ton guarantee.

Cash Overhead Costs

Cash overhead consists of various cash expenses paid out during the year that are assigned to the whole farm and not to a particular operation. These costs include property taxes, interest on operating capital, office expense, liability and property insurance, sanitation services, equipment repairs, and management.

Property Taxes. Counties charge a base property tax rate of 1% on the assessed value of the property. In some counties special assessment districts exist and charge additional taxes on property including equipment, buildings, and improvements. For this study, county taxes are calculated as 1% of the average value of the property. Average value equals new cost plus salvage value divided by 2 on a per acre basis.

Insurance. Insurance for farm investments varies depending on the assets included and the amount of coverage. Property insurance provides coverage for property loss and is charged at 0.70% of the average value of the assets over their useful life. Liability insurance covers accidents on the farm and costs $661 for the entire farm.

Office Expense. Office and business expenses are estimated at $80 per acre. These expenses include office supplies, telephones, bookkeeping, accounting, legal fees, shop and office utilities, and miscellaneous administrative charges.

Sanitation Services. Sanitation services provide portable toilets for the vineyard and cost the farm $1,900 annually. The cost includes two double toilet units with washbasins, delivery and pickup, and five months of weekly servicing. Costs also include soap or other suitable cleansing agent, and single use towers. Separate potable water and single-use drinking cups are also supplied.

Management/Supervisor Wages. Salary is not included. Returns above costs are considered a return to management

Investment Repairs. Annual maintenance is calculated as 2% of the purchase price, except for the vineyard establishment which is calculated as 0.50% to cover vine and trellis repairs and/or replacement.

Non-Cash Overhead Costs

Non-cash overhead is calculated as the capital recovery cost for equipment and other farm investments.

Capital Recovery Costs. Capital recovery cost is the annual depreciation and interest costs for a capital investment. It is the amount of money required each year to recover the difference between the purchase prices and salvage value (unrecovered capital). It is equivalent to the annual payment on a loan for the investment with the down payment equal to the discounted salvage value. This is a more complex method of calculating ownership costs than straight-line depreciation and opportunity costs, but more accurately represents the annual costs of ownership because it takes the time value of money into account (Boehlje and Eidman). The formula for the calculation of the annual capital recovery costs is ((Purchase Price – Salvage Value) x Capital Recovery Factor) + (Salvage Value x Interest Rate).

Salvage Value. Salvage value is an estimate of the remaining value of an investment at the end of its useful life. For farm machinery (tractors and implements) the remaining value is a percentage of the new cost of the investment (Boehlje and Eidman). The percent remaining value is calculated from equations developed by the American Society of Agricultural Engineers (ASAE) based on equipment type and years of life. The life in years is estimated by dividing the wear out life, as given by ASAE by the annual hours of use in this operation. For other investments including irrigation systems, buildings, and miscellaneous equipment, the value at the end of its useful life is zero. The salvage value for land is the purchase price because land does not depreciate. The purchase price and salvage value for equipment and investments are shown in Table 7.

Capital Recovery Factor. Capital recovery factor is the amortization factor or annual payment whose present value at compound interest is 1. The amortization factor is a table value that corresponds to the interest rate used and the life of the machine.

Interest Rate. The interest rate of 6.25% used to calculate capital recovery cost is the effective long term interest rate in January 2006. The interest rate is provided by a local farm lending agency and will vary according to risk and amount of loan.

Establishment Cost. Costs to establish the vineyard are used to determine capital recovery expenses, depreciation, and interest on investment for the production years. Establishment cost is the sum of the costs for land preparation, trellis system, planting, vines, cash overhead and production expenses for growing the vines through the first year that grapes are harvested minus any returns from production. The Total Accumulated Net Cash Cost on Table 1, in the third year represents the establishment cost. For this study the cost is $6,746 per acre or $269,840 for the 40-acre vineyard. The establishment cost is spread over the remaining 22 years of the 25 years the vineyard is in production.

Irrigation System. The previous vineyard is assumed to have an irrigation system that has been refurbished. A new pump, motor, and filtration/injector station is being installed along with the drip irrigation system during planting. The filtration station, fertilizer injector system, drip lines and the labor to install the components are included in the irrigation system cost. Water is pumped from a 130-foot depth with a 40 horsepower pump and supplies water to the 40 established acres and to other acres on the ranch. Another 40 horsepower pump and irrigation set-up supplies the rest of the ranch, but is not included. The irrigation system is considered an improvement to the property and has a 25-year life. An alternative is to include the drip system in the establishment costs because it will be removed when the vineyard is removed.

Land. The land was formerly a vineyard, but has been out of production for two years. The open land was planted to grain crops. Land for raisin production is valued at $5,500 per acre. This study assumes the land was purchased. Because only 115 of the 120 acres are planted to grapes, land is valued at $5,739 per planted acre.

Building. The metal buildings are on a cement slab and comprise 2,400 square feet.

Tools. This includes shop tools, hand tools, and miscellaneous field tools such as pruning tools.

Fuel Tanks. Two 250-gallon fuel tanks using gravity feed are on metal stands. The tanks are setup in a cement containment pad that meets federal, state, and county regulations.

Shaker/Screener. The shaker is located in the harvest staging area on a cement slab and is used for removing debris from the raisins. The machine cost does not include a bin dumper.

Equipment. Farm equipment is purchased new or used, but the study shows the current purchase price for new equipment. The new purchase price is adjusted to 60% to indicate a mix of new and used equipment. Annual ownership costs for equipment and other investments are shown in Table 7. Equipment costs are composed of three parts: non-cash overhead, cash overhead, and operating costs. Both of the overhead factors have been discussed in previous sections. The operating costs consist of repairs, fuel, and lubrication and are discussed under operating costs.

Table Values. Due to rounding, the totals may be slightly different from the sum of the components.

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For information concerning the DANR publications contact UC DANR Communications Services at 1-800-994-8849, online at http://anrcatalog.ucdavis.edu or your local county UC Cooperative Extension office. For information on Sample Cost of Production studies, contact UC Department of Agricultural and Resource Economics at 530-752-3589, online at http://coststudies.ucdavis.edu.

UC COOPERATIVE EXTENSION

Table 1. SAMPLE COSTS PER ACRE TO ESTABLISH A RAISIN VINEYARD

SAN JOAQUIN VALLEY - 2006

	Cost Per Acre		
Year:	1st	2nd	3rd
Raisin Tons Per Acre:			1.5
Planting Costs:			
Land Preparation - Chisel 2X (Custom)	300		
Land Preparation - Float	10		
Land Preparation - Disk/Apply Herbicide (Treflan)	15		
Land Preparation - Disk (Incorporate Herbicide)	10		
Survey & Layout Vineyard	70		
Dig, Plant, Wrap Vines	156	2	
Vines: 519 Per Acre (2% Replant In 2nd Year)	1,479	28	
Install Trellis System		2,700	
TOTAL PLANTING COSTS	2,040	2,730	
Cultural Costs:			
Prune: Prune & Tie Dormant Period		55	141
Prune: Shred Prunings			7
Weed: Winter Strip (Roundup, Surflan)		58	58
Weed: Disk Middles (2X Yr 1 & 3. 3X Yr 2)	14	21	14
Insect: Mealybug (Lorsban)			41
Disease: Phomopsis/Mildew (Microthiol, Abound)			47
Disease: Mildew (Dusting Sulfur) 3X Alternate Rows			21
Irrigate: (water & labor)	96	191	214
Weed: - Spot Spray (Roundup)		40	40
Disease: Mildew (Rally, Microthiol). Fertilizer: (Zinc)			39
Prune: Training (Sucker, Tie & Train) Yr 2. Replacement Vines Yr 3		286	22
Disease: Mildew (Microthiol, Flint). Insect: Skeletonizer (Kryocide).		33	66
Fertilize: (UN32) through drip	3	8	16
Disease: Mildew (Rally, Microthiol)			35
Insect: Leafhopper (Provado).			44
Weed: Hand Hoe	66		
Prune: Skirt Canes (Mechanical)			14
Terrace: Disk Middles 3X			21
Terrace: Terrace Make & Terrace Back			21
ATV Use	26	34	34
Pickup Truck Use	73	73	73
TOTAL CULTURAL COSTS	278	799	968
Harvest Costs:			
Hand Pick			270
Roll Trays			34
Haul/Box			112
Shake			34
Haul to Processor			20
Assessments			24
TOTAL HARVEST COSTS	0	0	494
Interest On Operating Capital @ 9.25%*	186	302	43
TOTAL OPERATING COSTS/ACRE	2,504	3,831	1,505

UC COOPERATIVE EXTENSION

Table 1. continued

	Cost Per Acre		
Year:	1st	2nd	3rd
Raisin Tons Per Acre:			1.5
Cash Overhead Costs:			
Office Expense	80	80	80
Liability Insurance	6	6	6
Sanitation Services	17	17	17
Property Taxes	67	67	69
Property Insurance	7	7	8
Investment Repairs	33	33	33
TOTAL CASH OVERHEAD COSTS	209	210	213
TOTAL CASH COSTS/ACRE	2,712	4,041	1,718
INCOME/ACRE FROM PRODUCTION	0	0	1,725
NET CASH COSTS/ACRE FOR THE YEAR	2,712	4,041	0
PROFIT/ACRE ABOVE CASH COSTS	0	0	7
ACCUMULATED NET CASH COSTS/ACRE	2,712	6,753	**6,746**
Non-Cash Overhead (Capital Recovery Cost):			
Land	359	359	359
Drip Irrigation System	64	64	64
Shop Building	52	52	52
Shop Tools	11	11	11
Fuel Tank & Pump	2	2	2
Shaker/Screener			4
Equipment	29	33	68
TOTAL CAPITAL RECOVERY COST	516	521	560
TOTAL COST/ACRE FOR THE YEAR	3,229	4,562	2,277
INCOME/ACRE FROM PRODUCTION	0	0	1,725
TOTAL NET COST/ACRE FOR THE YEAR	3,229	4,562	552
NET PROFIT/ACRE ABOVE TOTAL COST	0	0	0
TOTAL ACCUMULATED NET COST/ACRE	3,229	7,791	8,343

*Interest calculated: Yr. 1 over 15 months, Yr 2 over 12 months, Yr 3 through harvest.

UC COOPERATIVE EXTENSION

Table 2. MATERIAL COSTS TO ESTABLISH RAISIN GRAPES

SAN JOAQUIN VALLEY 2006

			YEAR 1		YEAR 2		YEAR 3	
MATERIAL	COST	UNIT	RATE	COST	RATE	COST	RATE	COST
Herbicide:								
Treflan HFP	4.74	pint	1.00	5				
Suflan 4AS	16.96	pint			2.40	41	2.40	41
Roundup Ultra Max	8.56	pint			2.10	18	2.10	18
Insecticide:								
Kryocide	3.00	lb			6.00	18	6.00	18
Lorsban 4E	6.86	pint					4.00	27
Provado 1.6 Solupak	43.96	lb					0.70	31
Fungicides:								
Microthiol Special	0.80	lb			2.00	2	7.00	6
Abound	2.70	floz					12.00	32
Dusting Sulfur	0.18	lb					15.00	3
Rally 40W	4.89	oz					8.00	39
Flint	16.49	oz					2.00	33
Fertilizer:								
UN32	0.41	lb N	5.00	2	20.00	8	40.00	16
Neutral Zinc 50%	0.92	lb					5.00	5
Water:								
Water Pumped	5.67	acin	12.00	68	24.00	136	28.00	159
Vine:								
Dormant Bench	2.85	each	519.00	1,479	10.00	29		
Vine Aids:								
Wraps	0.12	each	519.00	62				
Twist-ems	0.00	each			5,100.00	20	2,000.00	8
Trellis System	2,700.00	acre			1.00	2,700		
Trays 20 lb	0.05	each					675.00	34
Rentals:								
Forklift	850.00	week					0.08	68
Tractor	640.00	week					0.05	32
Assesments:								
CA Raisin Marketing Board	16.20	ton					1.50	24
Custom:								
Rip/Subsoil	150.00	acre	2.00	300				
Mark/Stake	0.14	each	519.00	70				
Plant Vines	0.18	each	519.00	93	10.00	2		
Pick Raisin (Hand)	0.35	tray					675.00	236
Roll Raisin (Hand)	0.05	tray					675.00	34
Haul to Processor	13.00	ton					1.50	20
Labor-Machine	12.76	hr	6.91	88	9.37	120	16.68	213
Labor-Non Machine	11.05	hr	8.55	94	34.00	376	21.95	243
Fuel-Gas	2.55	gal	11.41	29	12.08	31	12.08	31
Fuel-Diesel	2.00	gal	5.90	12	5.99	12	25.71	51
Lube				6		6		12
Machinery Repair				9		11		30
Interest				186		302		43
TOTAL COSTS				2,504		3,830		1,505

UC COOPERATIVE EXTENSION

Table 3. COSTS PER ACRE TO PRODUCE TRAY DRIED RAISINS

SAN JOAQUIN VALLEY - 2006

Operation	Operation Time (Hrs/A)	Cash and Labor Cost per acre Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
Cultural:							
Prune: Vines	24.00	265	0	0	0	265	
Prune: Brush Disposal (Every Middle)	0.26	4	3	0	0	7	
Prune: Tie Canes	4.50	50	0	8	0	58	
Weed: Winter Strip (Surflan, Roundup)	0.49	8	4	46	0	58	
Insect: Mealybugs (Lorsban)	0.50	8	6	27	0	41	
Disease: Phomopsis (Abound)/Mildew (Sulfur)	0.50	8	6	33	0	47	
Weed: Disk Middles 2X	0.57	9	5	0	0	14	
Disease: Mildew (Dusting Sulfur) 3X (alternate rows)	0.75	11	7	3	0	21	
Disease: Mildew (Rally, Sulfur). Fertilize: Foliar Zinc (Neutral Zinc)	0.50	8	6	26	0	39	
Fertilize: N through drip system (UN32)	0.00	0	0	16	0	16	
Irrigate: (Water)	5.50	61	0	159	0	220	
Weed: Spot Spray (Roundup)	1.59	24	3	13	0	40	
Disease: Mildew (Sulfur, Flint). Insect: Skeletonizer (Kryocide). Bloom Thin (GA)	0.50	8	6	63	0	76	
Disease: Mildew (Rally, Sulfur)	0.50	8	6	21	0	35	
Prune: Skirt Canes (Mechanical) 2X	0.57	9	5	0	0	14	
Insect: Leafhopper (Provado). FM*: Fruit Set (Ethrel)	0.50	8	6	51	0	65	
Terrace**: Disk Middles	0.86	13	8	0	0	21	
Terrace**: Build Terrace & Terrace Back	0.88	13	8	0	0	21	
Pickup: Business Use	2.39	36	37	0	0	73	
ATV Use	2.00	31	3	0	0	34	
TOTAL CULTURAL COSTS/ACRE	47.36	580	120	466	0	1,165	
Harvest							
Pick Grapes (contract) (includes trays)	0.00	0	0	45	315	360	
Roll Raisins (contract)	0.00	0	0	0	45	45	
Box Raisins	0.75	45	7	0	75	126	
Shake Raisins (includes forklift rental)	1.00	11	0	0	26	37	
Haul Raisins (contract)	0.00	0	0	0	26	26	
Assessment	0.00	0	0	32	0	32	
TOTAL HARVEST COSTS/ACRE	1.75	56	7	77	486	626	
Interest on operating capital @ 9.25%						56	
TOTAL OPERATING COSTS/ACRE		635	126	543	486	1,846	
CASH OVERHEAD:							
Office Expense						80	
Liability Insurance						6	
Sanitation Fees						17	
Property Taxes						103	
Property Insurance						32	
Investment Repairs						67	
TOTAL CASH OVERHEAD COSTS						304	
TOTAL CASH COSTS/ACRE						2,150	

UC COOPERATIVE EXTENSION

Table 3. continued

SAN JOAQUIN VALLEY - 2006

Operation	Operation Time (Hrs/A)	Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
		Cash and Labor Cost per acre					
NON-CASH OVERHEAD:		Per producing Acre		Annual Cost Capital Recovery			
Land		5,739		359		359	
Drip Irrigation System		800		64		64	
Building		696		52		52	
Tools-Shop/Field		104		11		11	
Fuel Tanks 2-300G		30		2		2	
Vineyard Establishment Costs		6,746		572		572	
Shaker/Screener		43		4		4	
Equipment		516		67		67	
TOTAL NON-CASH OVERHEAD COSTS		14,675		1,131		1,131	
TOTAL COSTS/ACRE						3,281	

* FM = fruit management.

**May be considered a harvest cost by some growers.

UC COOPERATIVE EXTENSION

Table 4. COSTS AND RETURNS to PRODUCE TRAY DRIED RAISINS

SAN JOAQUIN VALLEY - 2006

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
GROSS RETURNS					
Raisins	2.00	ton	1,150.00	2,300	
OPERATING COSTS					
Vine Aids:					
Twist-ems	2,000.00	each	0.00	8	
Herbicide:					
Surflan 4 AS	2.40	pint	16.96	41	
Roundup Ultra Max	2.10	pint	8.56	18	
Fungicide:					
Abound (Strobilurin)	12.00	floz	2.70	32	
Microthiol Disperss (micronized wettable sulfur)	7.00	lb	0.80	6	
Dusting Sulfur	15.00	lb	0.18	3	
Rally 40W (Sterol Inhibitor)	8.00	oz	4.89	39	
Flint (Strobilurin)	2.00	oz	16.49	33	
Insecticide:					
Lorsban 4E	4.00	pint	6.86	27	
Kryocide	6.00	lb	3.00	18	
Provado 1.6 Solupak	1.00	oz	43.96	44	
Fertilizer:					
Neutral Zinc 50% (foliar)	5.00	lb	0.92	5	
UN 32	40.00	lb N	0.41	16	
Water:					
Water Pumped SJV	28.00	acin	5.67	159	
Growth Regulator:					
Pro-Gibb 4% (Gibberelic Acid) 1oz=1g	6.00	floz	1.67	10	
Ethrel	1.00	Pint	7.00	7	
Rent:					
Tractor	0.05	week	640.00	32	
Forklift (2 wks @ harvest + 1 wk @ shaking)	0.08	week	850.00	68	
Harvest Aids:					
Trays 20 lb	900.00	tray	0.05	45	
Assessment:					
California Raisin Marketing Board	2.00	ton	16.20	32	
Custom/Contract:					
Pick Grapes (hand)	900.00	tray	0.35	315	
Roll Grapes (hand)	900.00	tray	0.05	45	
Haul Raisins to Processor	2.00	ton	13.00	26	
Labor (machine)	16.93	hrs	12.73	216	
Labor (non-machine)	38.00	hrs	11.05	420	
Fuel - Gas	12.14	gal	2.55	31	
Fuel - Diesel	26.35	gal	2.00	53	
Lube				13	
Machinery repair				30	
Interest on operating capital @ 9.25%				56	
TOTAL OPERATING COSTS/ACRE				1,846	
NET RETURNS ABOVE OPERATING COSTS				454	

UC COOPERATIVE EXTENSION
Table 4. continued
SAN JOAQUIN VALLEY - 2006

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
CASH OVERHEAD COSTS:					
Office Expense				80	
Liability Insurance				6	
Sanitation Fees				17	
Property Taxes				103	
Property Insurance				32	
Investment Repairs				67	
TOTAL CASH OVERHEAD COSTS/ACRE				304	
TOTAL CASH COSTS/ACRE				2,150	
NON-CASH OVERHEAD COSTS (Capital Recovery)					
Land				359	
Drip Irrigation System				64	
Building				52	
Tools-Shop/Field				11	
Fuel Tanks 2-300G				2	
Vineyard Establishment Costs				572	
Shaker/Screener				4	
Equipment				67	
TOTAL NON-CASH OVERHEAD COSTS/ACRE				1,131	
TOTAL COSTS/ACRE				3,281	
NET RETURNS ABOVE TOTAL COSTS				-981	

UC COOPERATIVE EXTENSION

Table 5. MONTHLY CASH to PRODUCE TRAY DRIED RAISINS

SAN JOAQUIN VALLEY - 2006

Beginning JAN 06 Ending DEC 06	JAN 06	FEB 06	MAR 06	APR 06	MAY 06	JUN 06	JUL 06	AUG 06	SEP 06	OCT 06	NOV 06	DEC 06	TOTAL
Cultural:													
Prune: Vines	265												265
Prune: Brush Disposal (Every Middle)	7												7
Prune: Tie Canes		58											58
Weed: Winter Strip (Surflan, Roundup)		58											58
Insect: Mealybug (Lorsban)			41										41
Disease: Phomopsis (Abound)/Mildew (Sulfur)			47										47
Weed: Disk Middles 2X			7		7								14
Disease: Mildew (Dusting Sulfur) 3X (alternate rows)				7		14							21
Disease: Mildew (Rally, Sulfur). Fertilize: Foliar Zinc (Neutral Zinc)				39									39
Fertilize: N through drip system (UN32)				16									16
Irrigate: (Water)				15	29	43	51	41	40				220
Weed: Spot Spray (Roundup)				13		13	13						40
Disease: Mildew (Sulfur, Flint). Insect: Skeleton (Kryocide). Thin (GA)					76								76
Disease: Mildew (Rally, Sulfur)						35							35
Prune: Skirt Canes (Mechanical)						7		7					14
Insect: Leafhopper (Provado). FM: at Veraison (Ethrel)						65							65
Terrace: Disk Middles								14	7				21
Terrace: Build Terrace & Terrace Back								11	11				21
Pickup: Business Use	6	6	6	6	6	6	6	6	6	6	6	6	73
ATV Use	3	3	3	3	3	3	3	3	3	3	3	3	33
TOTAL CULTURAL COSTS	281	124	104	100	121	186	73	82	67	9	9	9	1,165
Harvest:													
Pick Grapes (contract) (includes trays)									360				360
Roll Raisins (contract)									45				45
Box Raisins									126				126
Shake Raisins (includes forklift rental)									37				37
Haul Raisins (contract)									26				26
Assessment									32				32
TOTAL HARVEST COSTS.									626				626
Interest on operating capital @ 9.25%	2	3	4	5	6	7	8	8	14	0	0	0	56
TOTAL OPERATING COSTS/ACRE	283	128	108	104	127	193	81	90	706	9	9	9	1,846

UC COOPERATIVE EXTENSION
Table 5. continued
SAN JOAQUIN VALLEY - 2006

Beginning JAN 06 Ending DEC 06	JAN 06	FEB 06	MAR 06	APR 06	MAY 06	JUN 06	JUL 06	AUG 06	SEP 06	OCT 06	NOV 06	DEC 06	TOTAL
OVERHEAD:													
Office Expense	7	7	7	7	7	7	7	7	7	7	7	7	80
Liability Insurance									6				6
Sanitation Fees	2	2	2	2	2	2	2	2	2				16
Property Taxes	51						51						103
Property Insurance	16						16						32
Investment Repairs	6	6	6	6	6	6	6	6	6	6	6	6	67
TOTAL CASH OVERHEAD COSTS	81	14	14	14	14	14	81	14	20	12	12	12	304
TOTAL CASH COSTS/ACRE	365	142	122	119	141	207	162	104	726	21	21	21	2,150

UC COOPERATIVE EXTENSION
Table 6. RANGING ANALYSIS
SAN JOAQUIN VALLEY - 2006

COSTS PER ACRE AT VARYING YIELD TO PRODUCE TRAY DRIED RAISINS

	YIELD (tons/acre)						
	1.50	1.75	2.00	2.25	2.50	2.75	3.00
OPERATING COSTS:							
Cultural Cost	1,165	1,165	1,165	1,165	1,165	1,165	1,165
Harvest (pick, roll, box, shake, haul)	464	529	593	658	723	787	852
Assessment	24	28	32	36	41	45	49
Interest on operating capital @ 9.25%	55	55	56	56	57	57	58
TOTAL OPERATING COSTS/ACRE	1,708	1,777	1,846	1,915	1,986	2,054	2,124
Total Operating Costs/ton	1,139	1,015	923	851	794	747	708
CASH OVERHEAD COSTS/ACRE	304	304	304	304	304	304	304
TOTAL CASH COSTS/ACRE	2,012	2,081	2,150	2,219	2,290	2,358	2,428
Total Cash Costs/ton	1,341	1,189	1,075	986	916	857	809
NON-CASH OVERHEAD COSTS/ACRE	1,130	1,130	1,130	1,130	1,130	1,130	1,130
TOTAL COSTS/ACRE	3,142	3,211	3,280	3,349	3,420	3,488	3,558
Total Costs/ton	2,095	1,835	1,640	1,488	1,368	1,268	1,186

NET RETURNS PER ACRE ABOVE OPERATING COSTS

PRICE	YIELD (tons/acre)						
$/ton	1.50	1.75	2.00	2.25	2.50	2.75	3.00
850	-433	-289	-146	-2	139	284	426
950	-283	-114	54	223	389	559	726
1,050	-133	61	254	448	639	834	1,026
1,150	17	236	454	673	889	1,109	1,326
1,250	167	411	654	898	1,139	1,384	1,626
1,350	317	586	854	1,123	1,389	1,659	1,926
1,450	467	761	1,054	1,348	1,639	1,934	2,226

NET RETURN PER ACRE ABOVE CASH COST

PRICE	YIELD (tons/acre)						
$/ton	1.50	1.75	2.00	2.25	2.50	2.75	3.00
850	-737	-593	-450	-306	-165	-20	122
950	-587	-418	-250	-81	85	255	422
1,050	-437	-243	-50	144	335	530	722
1,150	-287	-68	150	369	585	805	1,022
1,250	-137	107	350	594	835	1,080	1,322
1,350	13	282	550	819	1,085	1,355	1,622
1,450	163	457	750	1,044	1,335	1,630	1,922

NET RETURNS PER ACRE ABOVE TOTAL COST

PRICE	YIELD (tons/acre)						
$/ton	1.50	1.75	2.00	2.25	2.50	2.75	3.00
850	-1,867	-1,723	-1,580	-1,436	-1,295	-1,150	-1,008
950	-1,717	-1,548	-1,380	-1,211	-1,045	-875	-708
1,050	-1,567	-1,373	-1,180	-986	-795	-600	-408
1,150	-1,417	-1,198	-980	-761	-545	-325	-108
1,250	-1,267	-1,023	-780	-536	-295	-50	192
1,350	-1,117	-848	-580	-311	-45	225	492
1,450	-967	-673	-380	-86	205	500	792

UC COOPERATIVE EXTENSION

Table 7. WHOLE FARM ANNUAL EQUIPMENT, INVESTMENT,

SAN JOAQUIN VALLEY - 2006

ANNUAL EQUIPMENT COSTS

						Cash Overhead		
Yr	Description	Price	Yrs Life	Salvage Value	Capital Recovery	Insur-ance	Taxes	Total
06	60 HP 4WD Narrow Tractor	36,000	15	7,009	3,472	151	215	3,838
06	ATV 4WD	6,700	5	3,003	1,071	34	49	1,154
06	Bin Trailer	2,100	10	371	261	9	12	282
06	Bin Trailer	2,100	10	371	261	9	12	282
06	Cane Cutter 12'	2,500	20	130	219	9	13	241
06	Disk - Tandem 8'	6,800	10	1,203	845	28	40	913
06	Duster - 3 Pt 12'	5,000	5	1,629	908	23	33	964
06	Mower-Flail 8'	9,600	15	922	966	37	53	1,056
06	Orchard/Vine Sprayer 500 gal	20,378	5	6,638	3,699	95	135	3,928
06	Pickup Truck 1/2 T	26,000	7	9,863	3,533	126	179	3,837
06	Rear Blade 8'	3,000	20	156	263	11	16	290
06	Sprayer ATV 20 gal	350	10	62	43	1	2	47
06	Weed Sprayer 3 PT 100 gal	3,500	10	619	435	14	21	470
	TOTAL	124,028		31,976	15,975	546	780	17,302
	60% of New Cost *	74,417		19,186	9,585	328	468	10,381

* Used to reflect a mix of new and used equipment.

ANNUAL INVESTMENT COSTS

					Cash Overhead			
Description	Price	Yrs Life	Salvage Value	Capital Recovery	Insur-ance	Taxes	Repairs	Total
Building 2400 sqft	80,000	20		5,968	280	400	1,600	8,248
Drip Irrigation System 115 acres	92,000	25		7,369	322	460	1,840	9,991
Vineyard Establishment	269,840	22		22,899	944	1,349	1,350	26,542
Fuel Tanks 2-300 gal	3,500	30	350	257	13	19	70	360
Land	660,000	25	660,000	41,250	0	6,600	0	47,850
Shaker/Screener	5,000	20	0	445	18	25	100	587
Tools-Shop/Field	12,000	15	1,133	1,208	46	66	240	1,560
TOTAL INVESTMENT	1,122,340		661,483	79,395	1,623	8,919	5,200	95,138

ANNUAL BUSINESS OVERHEAD COSTS

Description	Units/ Farm	Unit	Price/ Unit	Total Cost
Liability Insurance	115	acre	5.75	661
Office Expense	115	acre	80.00	9,200
Sanitation Fees	115	acre	16.51	1,899

UC COOPERATIVE EXTENSION

Table 8. HOURLY EQUIPMENT COSTS

SAN JOAQUIN VALLEY - 2006

			COSTS PER HOUR						
		Actual		Cash Overhead		Operating			
		Hours	Capital	Insur-			Fuel &	Total	Total
Yr	Description	Used	Recovery	ance	Taxes	Repairs	Lube	Oper.	Costs/Hr.
06	60 HP 4WD Narrow Tractor	1,068	1.95	0.08	0.12	0.88	6.78	7.66	9.81
06	ATV 4WD	401	1.61	0.05	0.07	0.50	0.98	1.48	3.21
06	Bin Trailer	300	0.52	0.02	0.02	0.32	0.00	0.32	0.88
06	Bin Trailer	300	0.52	0.02	0.02	0.32	0.00	0.32	0.88
06	Cane Cutter 12'	98	1.32	0.06	0.08	0.95	0.00	0.95	2.41
06	Disk - Tandem 8'	200	2.55	0.08	0.12	1.10	0.00	1.10	3.85
06	Duster - 3 Pt 12'	240	2.26	0.06	0.08	0.73	0.00	0.73	3.13
06	Mower-Flail 8'	133	4.35	0.17	0.24	4.30	0.00	4.30	9.06
06	Orchard/Vine Sprayer 500 gal	400	5.55	0.14	0.20	3.58	0.00	3.58	9.47
06	Pickup Truck 1/2 T	286	7.43	0.26	0.38	1.91	13.44	15.35	23.42
06	Rear Blade 8'	100	1.57	0.07	0.09	0.44	0.00	0.44	2.17
06	Sprayer ATV 20 gal	151	0.17	0.01	0.01	0.10	0.00	0.10	0.29
06	Weed Sprayer 3 PT 100 gal	200	1.31	0.04	0.06	0.61	0.00	0.61	2.02

UC COOPERATIVE EXTENSION

Table 9. OPERATIONS PRODUCTION YEAR FOR TRAY DRIED RAISINS

SAN JOAQUIN VALLEY 2006

MONTH	OPERATION	TRACTOR	IMPLEMENT	OPERATION Minutes/acre	LABOR Hrs/acre	MATERIAL	RATE/ ACRE	UNIT
Jan	Prune				24.00			
Jan	Brush Disposal/Shred	60 HP	Shredder 6'	15.48				
Feb	Tie Canes				4.50	Twist-ems	2,000.00	each
Feb	Weed: Winter Strip	60 HP	Sprayer	29.46		Surflan	2.40	pt
						Roundup	0.60	pt
March	Insect: Mealybug	60 HP	Vine Sprayer	30.00		Lorsban	4.00	pt
March	Disease: Mildew/Phomopsis	60 HP	Vine Sprayer	30.00		Abound	12.00	floz
						Microthhiol	1.00	lb
March	Disk Middles	60 HP	Disk 8'	17.16				
April	Disease: Mildew Alternate Rows	60 HP	Duster	15.00		Dusting Sulfur	5.00	lb
April	Disease: Mildew. Fert: Zinc	60 HP	Vine Sprayer	30.00		Microthhiol	2.00	lb
						Rally	4.00	oz
						Neutral Zinc	5.00	lb
April	Fertilize					UN32	40.00	lb N
April	Irrigate				0.50	Water	1.67	acin
April	Spot Spray	ATV	ATV Sprayer	31.74		Roundup	0.50	pt
May	Disk Middles	60 HP	Disk 8'	17.16				
May	Disease: Mildew. Insect: Skeletonizer. FM: Thin	60 HP	Vine Sprayer	30.00		Microthhiol	2.00	lb
						Flint	2.00	oz
						Kryocide	6.00	lb
						ProGibb	6.00	grams
May	Irrigate				1.00	Water	3.11	acin
June	Mildew	60 HP	Vine Sprayer	30.00		Rally	4.00	oz
						Microthiol	2.00	lb
June	Skirt Canes	60 HP	Cane Cutter	17.16				
June	Insect: Leafhopper. FM: Maturity	60 HP	Vine Sprayer	30.00		Ethrel	1.00	pt
						Provado	1.00	oz
June	Irrigate				1.00	Water	5.70	acin
June	Spot Spray	ATV	ATV Sprayer	31.74		Roundup	0.50	pt
June	Disease: Mildew Alternate Rows	60 HP	Duster	15.00		Dusting Sulfur	10.00	lb
June	Disease: Mildew Alternate Rows	60 HP	Duster	15.00		Dusting Sulfur	10.00	lb
July	Spot Spray	ATV	ATV Sprayer	31.74		Roundup	0.50	pt
July	Irrigate				1.00	Water	7.11	acin
Aug	Irrigate				1.00	Water	5.29	acin
Aug	Skirt Canes	60 HP	Cane Cutter	17.16				
Aug	Terrace: Disk Middles	60 HP	Disk 8'	17.16				
Aug	Terrace: Disk Middles	60 HP	Disk 8'	17.16				
Aug	Terrace: Make Terrace	60 HP	Blade	26.46				
Sept	Harvest Pick	Custom				Trays	900.00	trays
Sept	Roll Trays	Custom						
Sept	Box Raisins	60 HP	Bin Trailer	45	3.00	Forklift Rent	0.05	wk
			Bin Trailer			Rented Tractor	0.05	wk
Sept	Shake Raisins	Shaker			1.00	Forklift Rent	0.03	week
Sept	Haul	Custom				Haul @ $13	2.00	ton
Sept	Terrace Back	60 HP	Blade	26.46				
Sept	Terrace: Disk Middles	60 HP	Disk 8'	17.16				
Sept	Irrigate				1.00	Water	5.12	acin

Citrus

CALIFORNIA ORANGES
ECONOMIC DATA 1999 - 2009

Year	Cartons	Utilization	Cartons	Packinghouse Door-Return[1]	Net on Tree[2]	Gross per Acre	Minus Pick & Hauling Fee[1]	Gross per Acre	Minus Cultural Cost[3]	Sub-Net per Acre	Minus Cash/Non-Cash Overhead Cost[3]	Net per Acre
1999-2000	600	75%	450	$2.70		$1,215	$600	$615	$1,357	-$742	$1,766	-$2,508
2000-2001	600	75%	450	$4.72		$2,124	$600	$1,524	$1,357	$167	$1,766	-$1,599
2001-2002	600	75%	450	$5.55		$2,498	$600	$1,898	$1,357	$541	$1,766	-$1,225
2002-2003	600	82%	492		$2.74			$1,348	$1,549	-$201	$1,582	-$1,783
2003-2004	621	81%	503		$3.86			$1,941	$1,549	$392	$1,582	-$1,190
2004-2005	683	71%	484		$4.64			$2,245	$1,549	$696	$1,582	-$886
2005-2006	719	67%	481		$3.74			$1,798	$1,761	$37	$1,724	-$1,687
2006-2007	*FREEZE YEAR*[4]		0		$0			$0	$0	$0	$0	$0
2007-2008	728	70%	509		$3.75			$1,909	$1,961	-$52	$2,080	-$2,132
2008-2009	518	80%	414		$4.65			$1,925	$2,065	-$140	$1,790	-$1,930

Sub-Net Average per acre $78

NET Average per acre -$1,660

USDA AGRICULTURAL STATISTICS BOARD, NATIONAL AGRICULTURAL STATISTICS SERVICE

USDA prices are based on a 75 pound carton. (Refer to Marketing Season and Net Weight per Box attachment.) The California citrus industry uses a 37.5 pound carton. Returns are adjusted accordingly for this data submission.

[1] Packinghouse Door-Return includes sorting, grading, packing, cooling and marketing fees. It does NOT include pick and haul (P&H) charges. For years 1999-2002 the P&H charge was $1.00 per carton equivalent.

[2] Net on Tree return includes pick/haul and all packinghouse door charges.

[3] Cultural Costs and Cash/Non-Cash Overhead costs are derived from the University of California Cooperative Extension Service studies. See attached summaries. Complete studies available upon request. In general, UCCE updates the economic data biennially.

[4] Did not use data from the 2006-2007 crop year due to the freeze.

Pullout Costs

Chipping	
	Cost/Acre
Push and Pile Cost	$250.00
Chip Stacked Piles	$310.00
10 acres/day (varies)	
$5,000 Move-in charge	
Dust Control ~$400/day	$20.00
Remove and Dump Roots and Stumps after Chipping	
~1 tons/acre	
Deliver and dump container at Composter ($225/load)	$22.50
$25.00/ton Composting	$25.00
Tractor /labor to load roots into Container	$27.00
Loader to compress roots into container (Cost open)	
Total Cost of Chipping	***$654.50***

Burning

	Cost/Acre
Remove Roots and Stumps before Burn	
~1 tons/acre	
Tractor/trailer/labor to load roots into piles	$27.00
Push and Pile Cost	$250.00
Burn Permit Fee (1)	$26.00
Burn Control (supervise burn)	$11.82
Total Cost of Burning	***$314.82***

(1) - Flat fee per site

Oranges: Price and Value by State and Crop, 2000-02

State, Crop and Season	Price per Box [1] [2]			Value of Production		
	Fresh	Processed	All	Fresh	Processed	Total
	Dollars	*Dollars*	*Dollars*	*1,000 Dollars*	*1,000 Dollars*	*1,000 Dollars*
AZ						
Navel and Misc.						
1999-00	9.58	-0.08	6.89	4,148	-13	4,135
2000-01	10.14	-0.14	6.54	3,164	-24	3,140
2001-02	16.50	-0.15	12.74	3,449	-9	3,440
Valencia						
1999-00	3.19	-0.13	2.35	1,190	-17	1,173
2000-01	5.06	-0.18	5.04	2,115	0	2,115
2001-02	3.42		3.42	855		855
All						
1999-00	6.62	-0.10	4.83	5,338	-30	5,308
2000-01	7.23	-0.14	5.84	5,279	-24	5,255
2001-02	9.38	-0.15	8.26	4,304	-9	4,295
CA						
Navel and Misc.						
1999-00	8.48	-0.08	6.55	262,880	-720	262,160
2000-01	11.64	-0.14	9.98	355,020	-700	354,320
2001-02	14.80	-0.15	12.89	438,820	-653	438,167
Valencia						
1999-00	6.69	-0.13	3.48	84,963	-1,469	83,494
2000-01	10.16	0.76	8.43	157,480	2,660	160,140
2001-02	10.02	0.74	8.37	181,362	2,886	184,248
All						
1999-00	7.96	-0.11	5.40	347,843	-2,189	345,654
2000-01	11.14	0.23	9.44	512,500	1,960	514,460
2001-02	12.99	0.27	11.11	620,182	2,233	622,415
FL						
Early, Midseason						
1999-00	7.60	4.97	5.10	49,438	633,650	683,088
2000-01	6.10	4.48	4.56	37,973	545,552	583,525
2001-02	6.50	4.41	4.51	41,756	536,150	577,906
Valencia						
1999-00	7.00	6.26	6.28	20,216	601,661	621,877
2000-01	6.90	5.99	6.02	23,991	550,020	574,011
2001-02	7.10	6.06	6.09	22,010	599,334	621,344
All						
1999-00	7.42	5.52	5.60	69,654	1,235,311	1,304,965
2000-01	6.39	5.13	5.18	61,964	1,095,572	1,157,536
2001-02	6.70	5.15	5.21	63,766	1,135,484	1,199,250

[1] Equivalent packinghouse-door returns.
[2] See page 17 for price per box calculations.

Marketing Year Average Prices and Value of Production

State level marketing year average (MYA), or price per box, for fresh and processed sales are the weighted average of monthly sales that occur during a crop's marketing season, adjusted to the packinghouse-door level. The "all" sales MYA price is derived by dividing the "all" sales value by the "all" sales boxes. MYA prices at the U.S. level for commodities with different State box weights are computed as follows:

$$\text{Fresh Market MYAP} = \frac{\text{(State Fresh Value * State Box Weight)}}{\text{(State Fresh Boxes * State Box Weight)}}$$

$$\text{Process Market MYAP} = \frac{\text{(State Process Value * State Box Weight)}}{\text{(State Process Boxes * State Box Weight)}}$$

$$\text{"All" Sales MYAP} = \frac{\text{(State All Value * State Box Weight)}}{\text{(State All Boxes * State Box Weight)}}$$

For commodities with the same box weights across all states, the U.S. MYA's are derived by dividing the sum of State's values by the sum of States' boxes.

U.S. value of production for a given commodity is the sum of the State's values for that commodity. The State level value of production for each commodity is computed as follows:

Fresh Market Value = Fresh Market MYAP * Fresh Market Boxes

Process Market Value = Process Market MYAP * Process Market Boxes

"All" Sales Value = Fresh Market Value + Process Market Value

Citrus prices are based on weighted average f.o.b. packed prices received for fresh fruit and weighted average prices received at the processing plant door for processing fruit. Equivalent returns for fresh and processed fruit are calculated at the packinghouse-door level by deducting sorting, grading, packing, cooling, marketing, and other costs from the two base prices. In some cases, this results in negative returns.

Marketing Seasons and Net Weight per Box

Oranges:		
Arizona	November 1 to August 31	75 pounds
California Navels	November 1 to June 15	75 pounds
California Valencias	March 15 to December 20	75 pounds
Florida Early and Midseason	October 1 to April 15	90 pounds
Florida Valencia	February 1 to July 31	90 pounds
Texas	September 25 to May 15	85 pounds
Grapefruit:		
Arizona	November 1 to July 31	67 pounds
California (Desert)	November 15 to July 15	67 pounds
California (Other Areas)	March 20 - October 30	67 pounds
Florida	September 10 to July 31	85 pounds
Texas	October 1 to May 30	80 pounds
K-Early Citrus Fruit:		
Florida	October 1 to November 30	90 pounds
Lemons:		
Arizona	August 15 to March 1	76 pounds
California	August 1 to July 31	76 pounds
Limes:		
Florida	April 1 to March 31	88 pounds
Tangelos:		
Florida	October 15 to April 15	90 pounds
Tangerines:		
Arizona	November 1 to February 1	75 pounds
California	November 1 to May 15	75 pounds
Florida	October 1 to April 1	95 pounds
Temples:		
Florida	December 1 to May 1	90 pounds

Oranges: Average Prices and Equivalent Returns, California
September 2002 - August 2005

State, Month, and Year	F.O.B. Packed	Equiv. P.H.D. All	Equiv. P.H.D. Fresh	Equiv. P.H.D. Proc.	Equiv. On-Tree All	Equiv. On-Tree Fresh	Equiv. On-Tree Proc.
CA	All Oranges						
	Dollars per box	Dollars per box	Dollars per box	Dollars per box	Dollars per box	Dollars per box	Dollars per box
Sep 2002	15.50	7.72	8.72	0.74	5.33	6.33	-1.65
Oct	15.80	7.78	9.02	0.74	5.39	6.63	-1.65
Nov	20.70	11.95	13.46	0.40	9.54	11.05	-2.01
Dec	17.90	9.84	10.66	0.40	7.43	8.25	-2.01
Jan 2003	15.30	6.95	8.06	0.40	4.54	5.65	-2.01
Feb	13.90	5.52	6.67	0.40	3.11	4.26	-2.01
Mar	16.10	7.02	8.86	0.40	4.61	6.45	-2.01
Apr	18.00	8.72	10.83	0.40	6.30	8.41	-2.02
May	18.20	9.04	11.07	0.39	6.62	8.65	-2.03
Jun	16.50	7.97	9.52	0.37	5.53	7.09	-2.06
Jul	14.70	6.22	7.80	0.35	3.78	5.36	-2.09
Aug	15.00	6.15	8.08	0.34	3.71	5.64	-2.10
Sep	14.30	5.44	7.38	0.34	3.00	4.94	-2.10
Oct	14.20	4.27	7.28	0.34	1.83	4.84	-2.10
Nov	22.00	12.91	14.62	0.39	10.45	12.16	-2.07
Dec	19.80	11.59	12.42	0.39	9.13	9.96	-2.07
Jan 2004	18.30	9.93	10.92	0.39	7.47	8.46	-2.07
Feb	18.40	9.88	10.99	0.39	7.42	8.53	-2.07
Mar	19.90	10.97	12.58	0.38	8.50	10.11	-2.08
Apr	19.60	9.90	12.23	0.39	7.43	9.77	-2.08
May	19.90	10.54	12.63	0.38	8.08	10.16	-2.08
Jun	21.10	12.51	13.97	0.34	10.03	11.49	-2.14
Jul	19.60	11.18	12.54	0.32	8.69	10.05	-2.17
Aug	21.00	13.14	13.94	0.32	10.65	11.45	-2.17
Sep	25.40	18.34	18.34		15.85	15.85	
Oct	31.20	23.94	23.94		21.44	21.44	
Nov	23.00	13.48	15.47	0.38	10.97	12.96	-2.13
Dec	20.40	11.09	12.87	0.38	8.58	10.36	-2.13
Jan 2005	19.50	9.91	11.97	0.38	7.40	9.46	-2.13
Feb	19.00	9.27	11.45	0.38	6.76	8.94	-2.13
Mar	19.40	9.19	11.97	0.37	6.69	9.47	-2.13
Apr	20.50	9.09	13.08	0.37	6.59	10.58	-2.13
May	20.60	10.19	13.27	0.37	7.69	10.77	-2.14
Jun	19.10	10.43	12.06	0.33	7.94	9.57	-2.16
Jul	17.50	9.04	10.44	0.32	6.55	7.95	-2.17
Aug	16.80	7.39	9.74	0.32	4.90	7.25	-2.17

Oranges: Average Prices and Equivalent Returns, California
September 2006 - August 2009

State, Month, and Year	F.O.B. Packed	Equiv. P.H.D. All	Equiv. P.H.D. Fresh	Equiv. P.H.D. Proc.	Equiv. On-Tree All	Equiv. On-Tree Fresh	Equiv. On-Tree Proc.
CA	All Oranges						
	Dollars per Box	*Dollars per Box*	*Dollars per Box*	*Dollars per Box*	*Dollars per Box*	*Dollars per Box*	*Dollars per Box*
Sep 2006	32.40	20.45	24.53	1.41	17.96	22.04	-1.08
Oct	24.90	13.66	16.99	1.46	11.16	14.49	-1.04
Nov	19.90	10.82	11.99	1.48	8.32	9.49	-1.02
Dec	22.80	13.18	14.89	1.48	10.68	12.39	-1.02
Jan 2007	22.80	13.12	14.89	1.48	10.62	12.39	-1.02
Feb	35.10	6.91	27.18	1.48	4.41	24.68	-1.02
Mar	33.10	13.53	25.21	1.48	11.03	22.71	-1.02
Apr	33.20	12.18	25.24	1.49	9.68	22.74	-1.01
May	32.50	8.84	24.51	1.52	6.32	21.98	-0.99
Jun	28.60	12.16	20.57	1.64	9.62	18.03	-0.90
Jul	27.40	11.10	19.37	1.64	8.56	16.83	-0.90
Aug	25.20	11.52	17.17	1.64	8.98	14.63	-0.90
Sep	23.40	10.38	15.37	1.64	7.84	12.83	-0.90
Oct	25.30	12.95	17.28	1.60	10.41	14.74	-0.95
Nov	25.90	15.21	17.82	1.48	12.66	15.27	-1.07
Dec	21.60	11.84	13.53	1.46	9.29	10.98	-1.09
Jan 2008	20.10	10.60	12.03	1.46	8.05	9.48	-1.09
Feb	18.90	8.87	10.83	1.46	6.32	8.28	-1.09
Mar	19.00	8.73	10.96	1.47	6.18	8.40	-1.08
Apr	18.30	7.89	10.16	1.47	5.34	7.61	-1.08
May	20.00	9.17	11.84	1.49	6.61	9.28	-1.07
Jun	21.70	10.11	13.59	1.56	7.53	11.01	-1.02
Jul	18.50	8.14	10.31	1.62	5.55	7.72	-0.97
Aug	18.50	6.91	10.31	1.62	4.32	7.72	-0.97
Sep	21.00	8.51	12.81	1.62	5.92	10.22	-0.97
Oct	20.90	6.55	12.71	1.62	3.96	10.12	-0.97
Nov	27.00	16.07	18.80	1.50	13.47	16.20	-1.10
Dec	24.20	13.99	15.97	1.44	11.39	13.37	-1.16
Jan 2009	25.20	15.10	16.97	1.44	12.50	14.37	-1.16
Feb	23.90	14.09	15.64	1.44	11.49	13.04	-1.16
Mar	23.60	13.22	15.39	1.64	10.62	12.79	-0.97
Apr	21.10	10.89	12.86	1.54	8.28	10.25	-1.07
May	22.30	11.60	14.03	1.05	8.98	11.41	-1.56
Jun	23.20	11.58	14.86	0.65	8.95	12.23	-1.98
Jul	21.50	10.11	13.15	([1])	7.47	10.51	([1])
Aug	21.60	11.22	13.25	([1])	8.58	10.61	([1])

[1] Price not published to avoid disclosure of individual firms.

Marketing Seasons and Net Weight per Box

Oranges:		
Arizona navel and miscellaneous	November 1 to March 31	75 pounds
Arizona Valencia	February 1 to June 30	75 pounds
California navel and miscellaneous	November 1 to June 15	75 pounds
California Valencia	March 15 to December 20	75 pounds
Florida early, midseason, and navel [1/]	October 1 to April 1	90 pounds
Florida Valencia	January 1 to July 31	90 pounds
Texas early and midseason	September 25 to February 15	85 pounds
Texas Valencia	January 15 to May 15	85 pounds
Grapefruit:		
Arizona	November 1 to June 30	67 pounds
California	November 1 to October 31	67 pounds
Florida	September 10 to July 1	85 pounds
Texas	October 1 to May 30	80 pounds
Lemons:		
Arizona	September 1 to March 31	76 pounds
California	August 1 to July 31	76 pounds
Tangelos:		
Florida	October 15 to March 1	90 pounds
Tangerines and Mandarins:		
Arizona	November 1 to April 30	75 pounds
California	November 1 to May 15	75 pounds
Florida	October 1 to May 1	95 pounds

[1/] Including Temples

UC COOPERATIVE EXTENSION
Table 3. COSTS PER ACRE TO PRODUCE ORANGES
SAN JOAQUIN VALLEY - SOUTH 2009

Operation	Operation Time (Hrs/A)	Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
		Cash and Labor Costs per acre					
Cultural:							
Frost Protection (water & wind machine)	2.19	24	0	324	0	348	
Fertilize: N (UN32 through drip line)	0.30	3	0	37	0	40	
Weed: Pre-emergent (Princep, Karmex) 2X	0.50	9	1	49	0	59	
Insect/Fertilizer: Orangeworm (Dipel)/N Mn Zn	0.00	0	0	27	35	62	
Prune: Top Trees, Stack & Shred Prunings 1X/4 Yr	0.00	0	0	0	25	25	
Prune: Hedge Alt. Rows, Shred Prunings 2X/4Yr	0.00	0	0	0	24	24	
Prune: Hand Prune & Stack, Shred Prunings 1X/4 Yr	0.00	0	0	0	75	75	
Irrigate: (water & labor)	5.55	61	0	323	0	384	
Soil Amendment: (Soluble Gypsum) w/irrigation	8.75	97	0	133	0	230	
Weed: Spot Spray (Roundup) 3X	0.75	13	2	3	0	18	
Insect/Fertilizer: Thrips, Katydid (Success, Oil) /N	0.00	0	0	50	35	85	
Insect: Thrips (Success, Oil)	0.00	0	0	36	35	71	
Insect: Scale (Esteem)	0.00	0	0	145	85	230	
Leaf Analysis (1 sample/10 acres)	0.05	1	0	0	7	7	
Disease: Brown Rot (Lime, Kocide)	0.00	0	0	38	35	73	
Growth Regulator: (Fruit Fix) [Navel Only]	0.00	0	0	11	53	64	
Growth Regulator: (GibGro or GA) [Navel Only]	0.00	0	0	24	53	77	
Pickup Truck Use	3.33	58	40	0	0	98	
ATV Use	3.33	58	5	0	0	63	
PCA/Consultant Services	0.00	0	0	0	35	35	
TOTAL CULTURAL COSTS	24.75	324	47	1,199	496	2,065	
Harvest:							
Pick & Haul Fruit	0.00	0	0	0	926	926	
Pack Fruit	0.00	0	0	0	2,668	2,668	
Assessments	0.00	0	0	42	0	42	
TOTAL HARVEST COSTS	0.00	0	0	42	3,594	3,635	
Interest on operating capital @ 5.75%						160	
TOTAL OPERATING COSTS/ACRE		324	47	1,240	4,089	5,860	
Cash Overhead:							
Office Expense						125	
Liability Insurance						10	
Property Taxes						147	
Property Insurance						54	
Investment Repairs						149	
TOTAL CASH OVERHEAD COSTS						485	
TOTAL CASH COSTS/ACRE						6,346	

Non-Cash Overhead:	Per producing Acre	Annual Cost Capital Recovery	
Buildings 1800 sqft	1,050	66	66
Fuel Tanks 2-250g	58	3	3
Shop Tools	250	24	24
Land	8,125	386	386
Gypsum Machine (1)	600	138	138
Orchard Establishment	6,509	381	381
Drip Irrigation	1,550	87	87
Wind Machine (6)	2,340	177	177
Equipment	405	44	44
TOTAL NON-CASH OVERHEAD COSTS	20,887	1,305	1,305
TOTAL COSTS/ACRE			7,651

UC COOPERATIVE EXTENSION
Table 3. COSTS PER ACRE TO PRODUCE ORANGES
SAN JOAQUIN VALLEY - SOUTH 2007

Operation	Operation Time (Hrs/A)	Cash and Labor Costs per acre: Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
Cultural:							
Frost Protection (water & wind machine)	2.19	24	0	379	0	403	
Fertilize: N (UN32 through drip line)	0.30	3	0	37	0	40	
Weed: Pre-emergent (Princep, Karmex) 2X	0.50	8	1	38	0	47	
Insect/Fertilizer: Worm (Dipel)/N Mn Zn	0.00	0	0	26	30	56	
Prune: Top Trees, Stack & Shred Prunings 1X/4 Yr	0.00	0	0	0	28	28	
Prune: Hedge Alt. Rows, Shred Prunings 2X/4Yr	0.00	0	0	0	23	23	
Prune: Hand Prune & Stack, Shred Prunings 1X/4 Yr	0.00	0	0	0	98	98	
Irrigate: (water & labor)	5.55	61	0	257	0	319	
Soil Amendment:(Soluble Gypsum) w/irrigation	8.75	97	0	106	0	203	
Weed: Spot Spray (Roundup) 3X	0.75	12	1	3	0	16	
Insect/Fertilizer: Thrips, Katydid (Success, Oil) /N	0.00	0	0	51	30	81	
Insect: Thrips (Success, Oil)	0.00	0	0	38	30	68	
Insect: Scale (Esteem)	0.00	0	0	98	80	178	
Leaf Analysis (1 sample/10 acres)	0.05	1	0	0	6	6	
Disease: Brown Rot (Lime, Kocide)	0.00	0	0	29	35	64	
Growth Regulator: (Hivol) [Navel Only]	0.00	0	0	11	53	64	
Growth Regulators (GibGro or GA) [Navel Only]	0.00	0	0	28	53	81	
Pickup Truck Use	3.33	55	34	0	0	89	
ATV Use	3.33	55	4	0	0	59	
PCA/Consultant Services	0.00	0	0	0	40	40	
TOTAL CULTURAL COSTS	24.75	317	40	1,100	504	1,961	
Harvest:							
Pick & Haul Fruit	0.00	0	0	0	940	940	
Pack Fruit	0.00	0	0	0	2,338	2,338	
Assessments	0.00	0	0	24		24	
TOTAL HARVEST COSTS	0.00	0	0	24	3,277	3,302	
Interest on operating capital *						203	
TOTAL OPERATING COSTS/ACRE		317	40	1,125	3,781	5,466	
Cash Overhead:							
Office Expense						120	
Liability Insurance						9	
Property Taxes						136	
Property Insurance						43	
Investment Repairs						137	
TOTAL CASH OVERHEAD COSTS						446	
TOTAL CASH COSTS/ACRE						5,912	

Non-Cash Overhead:	Per producing Acre	Annual Cost Capital Recovery	Total Cost	Your Cost
Buildings 1800 sqft	1,000	83	83	
Fuel Tanks 2-250g	58	4	4	
Shop Tools	215	23	23	
Land	7,583	550	550	
Gypsum Machine (1)	600	147	147	
Orchard Establishment	6,075	479	479	
Drip Irrigation	1,400	108	108	
Wind Machine (6)	2,070	194	194	
Equipment	356	45	45	
TOTAL NON-CASH OVERHEAD COSTS	19,357	1,634	1,634	
TOTAL COSTS/ACRE			7,546	

*Interest based on May 06 through April 07 Crop Year

UC COOPERATIVE EXTENSION

Table 3. COSTS PER ACRE TO PRODUCE ORANGES

SAN JOAQUIN VALLEY - SOUTH 2005

Operation	Operation Time (Hrs/A)	Cash and Labor Costs per acre: Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
Cultural:							
Frost Protection (water & wind machine)	2.19	21	0	309	0	330	
Fertilize: N (through drip line)	0.30	3	0	35	0	38	
Weed: Pre-emergent (Princep, Karmex) 2X	0.50	9	1	36	0	45	
Insect/Fertilizer: Worm (Dipel)/N Mn Zn	0.00	0	0	20	25	45	
Prune: Top Trees, Stack & Shred Prunings 1X/4 Yr	0.00	0	0	0	26	26	
Prune: Hedge Alt. Rows, Shred Prunings 2X/4Yr	0.00	0	0	0	20	20	
Prune: Hand Prune & Stack, Shred Prunings 1X/4 Yr	0.00	0	0	0	89	89	
Irrigate: (water & labor)	5.55	54	0	225	0	279	
Soil Amendment:(Soluble Gypsum) w/irrigation	8.75	84	0	120	0	204	
Weed: Spot Spray (Roundup) 3X	0.75	13	1	3	0	17	
Insect/Fertilizer: Thrips Katydid (Success, Oil) /N	0.00	0	0	44	25	69	
Insect: Thrips (Success, Oil)	0.00	0	0	37	25	62	
Insect: Scale (Esteem)	0.00	0	0	98	75	173	
Leaf Analysis (1 sample/10 acres)	0.05	0	0	0	3	4	
Disease: Brown Rot (Lime, Kocide)	0.00	0	0	21	30	51	
Growth Regulator: (Hivol) [Navel Only]	0.00	0	0	11	45	56	
Growth Regulators (GibGro or GA) [Navel Only]	0.00	0	0	28	45	73	
Pickup Truck Use	3.33	57	28	0	0	86	
ATV Use	3.33	57	3	0	0	61	
PCA/Consultant Services	0.00	0	0	0	35	35	
TOTAL CULTURAL COSTS	24.64	298	34	987	443	1,761	
Harvest:							
Pick & Haul Fruit	0.00	0	0	0	720	720	
Pack Fruit	0.00	0	0	0	2,200	2,200	
Assessments	0.00	0	0	23		23	
TOTAL HARVEST COSTS	0.00	0	0	23	2,920	2,943	
Interest on operating capital *						140	
TOTAL OPERATING COSTS/ACRE		298	34	1,010	3,363	4,845	
Cash Overhead:							
Office Expense						120	
Liability Insurance						9	
Property Taxes						122	
Property Insurance						39	
Investment Repairs						131	
TOTAL CASH OVERHEAD COSTS						421	
TOTAL CASH COSTS/ACRE						5,266	
Non-Cash Overhead:		Per producing Acre		Annual Cost Capital Recovery			
Buildings 1800 sqft		1,000		73		73	
Fuel Tanks 2-250g		58		4		4	
Shop Tools		215		21		21	
Land		6,500		391		391	
Gypsum Machine (1)		550		131		131	
Orchard Establishment		5,612		384		384	
Drip Irrigation		1,250		83		83	
Wind Machine (6)		2,070		175		175	
Equipment		350		41		41	
TOTAL NON-CASH OVERHEAD COSTS		17,605		1,303		1,303	
TOTAL COSTS/ACRE						6,569	

*Interest based on May 04 through April 05 Crop Year

UC COOPERATIVE EXTENSION

Table 2. COSTS PER ACRE TO PRODUCE ORANGES

SAN JOAQUIN VALLEY - SOUTH 2002

Operation	Operation Time (Hrs/A)	Cash and Labor Costs per acre: Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
Cultural:							
Frost Protection	2.19	20	0	200	0	220	
Irrigate	5.44	49	0	200	0	249	
Weed - Pre-emergent	0.50	7	1	41	0	49	
Weed - Spot Spray	0.75	24	2	4	0	30	
Top Trees 1X/4 Yr	0.00	0	0	0	11	11	
Hedge Trees 1X/4 Yr	0.30	3	0	0	6	8	
Prune - Hand 1X/4 Yr	0.00	0	0	0	88	88	
Shred Brush	0.00	0	0	0	18	18	
Fertilize - Nitrogen	0.30	3	0	21	0	24	
Pest/Fertilizer:Worm/N Mn Zn	0.00	0	0	19	22	41	
Pest/Fertilizer:Thrips Katydid/N	0.00	0	0	41	22	62	
Pest - Thrips Katydid	0.00	0	0	36	22	57	
Pest - Scale	0.00	0	0	84	60	144	
Pest - Brown Rot	0.00	0	0	15	25	40	
Leaf Analysis	0.05	0	0	0	3	3	
Soil Amendment:Soluble Gypsum w/irrigation	8.75	79	0	95	0	174	
Soil Ammendments: Compost	0.00	0	0	80	0	80	
Growth Regulators	0.00	0	0	13	90	103	
Pickup Truck Use	3.33	45	19	0	0	64	
ATV Use	3.33	45	4	0	0	49	
PCA/Consultant Services	0.00	0	0	0	35	35	
TOTAL CULTURAL COSTS	24.95	275	26	849	399	1,549	
Harvest:							
Pick & Haul Fruit	0.00	0	0	0	755	755	
Pack & Assessment	0.00	0	0	0	2,090	2,090	
Assessments	0.00	0	0	21	0	21	
TOTAL HARVEST COSTS	0.00	0	0	21	2,845	2,866	
Interest on operating capital @ 7.40% [1]						77	
TOTAL OPERATING COSTS/ACRE		275	26	870	3,244	4,492	
CASH OVERHEAD:							
Office Expense						110	
Liability Insurance						8	
Property Taxes						111	
Property Insurance						33	
Investment Repairs						89	
TOTAL CASH OVERHEAD COSTS						351	
TOTAL CASH COSTS/ACRE						4,843	
Non-cash Overhead		Per producing Acre		Annual Cost Capital Recovery			
Buildings 30'X60'		800		61		61	
Fuel Tanks 2-250g		58		4		4	
Shop Tools		215		22		22	
Land		6,000		385		385	
Gypsum Machine		482		116		116	
Establishment Costs		4,937		354		354	
Drip Irrigation		1,200		84		84	
Wind Machine (6)		1,695		148		148	
Equipment		422		57		57	
TOTAL NON-CASH OVERHEAD COSTS		15,809		1,231		1,231	
TOTAL COSTS/ACRE						6,074	

Table 2.

U.C. COOPERATIVE EXTENSION
COSTS PER ACRE TO PRODUCE ORANGES
SAN JOAQUIN VALLEY – 1999

Operation	Operation Time (Hrs/A)	Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
		----- Cash and Labor Costs per Acre -----					
Cultural:							
Frost Protection	2.19	16	0	186	0	201	
Fertilize - Nitrogen	0.00	0	0	16	0	16	
Weed Control - Pre-emergent	0.50	6	1	54	0	61	
Pest Control - Worms & Urea	0.00	0	0	21	27	48	
Top Trees (1 In 5 Years)	0.00	0	0	0	8	8	
Hedge Trees (1 In 5 Years)	0.30	2	0	0	4	6	
Prune - Hand (1 In 5 Years)	0.00	0	0	0	56	56	
Shred Brush	0.00	0	0	0	15	15	
Irrigate	4.93	35	0	159	0	194	
Pest Control - Worms	0.00	0	0	9	27	36	
Weed Control - Spot Spray	0.50	13	1	4	0	18	
Pest Control - Thrips & Urea	0.00	0	0	45	27	72	
Apply Soil Amendments (1 in 3 Years)	0.00	0	0	73	0	73	
Pest Control - Thrips	0.00	0	0	28	27	55	
Pest Control - Scale	0.00	0	0	60	56	116	
Leaf Analysis	1.00	7	0	0	5	12	
Pest Control - Whitewash	0.00	0	0	18	28	46	
Apply Growth Regulators	0.00	0	0	52	114	166	
Pickup Truck Use	4.75	56	21	0	0	77	
ATV Use	4.75	56	5	0	0	61	
PCA/Consultant Services	0.00	0	0	0	21	21	
TOTAL CULTURAL COSTS	18.92	191	28	724	415	1,357	
Harvest:							
Pick & Haul Fruit	0.00	0	0	0	547	547	
Pack & Assessment	0.00	0	0	0	2,188	2,188	
TOTAL HARVEST COSTS	0.00	0	0	39	2,735	2,774	
Assessments:							
State Marketing Order	0.00	0	0	11	0	11	
Central California Tristeza Eradication Agency	0.00	0	0	28	0	28	
TOTAL ASSESSMENT COSTS	0.00	0	0	39	2,735	2,774	
Interest on operating capital @ 9.69% [1]						-126	
TOTAL OPERATING COSTS/ACRE		191	28	762	3,150	4,005	
CASH OVERHEAD:							
Office Expense						105	
Liability Insurance						6	
Property Taxes						118	
Property Insurance						84	
Investment Repairs						60	
TOTAL CASH OVERHEAD COSTS						373	
TOTAL CASH COSTS/ACRE						4,377	

NON-CASH OVERHEAD:

Investment	Per producing Acre	-- Annual Cost -- Capital Recovery	Total Cost
Buildings	654	57	57
Fuel Tanks & Pumps	230	22	22
Shop Tools	215	23	23
Land	6,000	444	444
Pruning Equipment	23	3	3
Frost Alarm	10	1	1
Establishment Cost	5,255	421	421
Drip Irrigation System	2,436	202	202
Wind Machine (5)	1,865	177	177
Equipment	292	42	42
TOTAL NON-CASH OVERHEAD COSTS	16,980	1,393	1,393
TOTAL COSTS/ACRE			5,770

[1] Postharvest operation costs are discounted back to the time of the first harvest

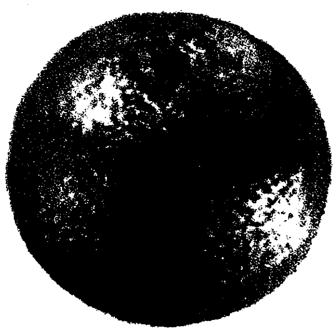
UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

2009

SAMPLE COSTS TO ESTABLISH AN ORANGE ORCHARD AND PRODUCE

ORANGES

Navels & Valencias



SAN JOAQUIN VALLEY - South

Low Volume Irrigation

Prepared by

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UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

SAMPLE COSTS TO ESTABLISH an ORANGE ORCHARD and PRODUCE ORANGES San Joaquin Valley South - 2009

CONTENTS

INTRODUCTION

Sample costs to establish an orange orchard and produce oranges under low volume irrigation in the Southern San Joaquin Valley are presented in this study. This study is intended as a guide only, and can be used to make production decisions, determine potential returns, prepare budgets and evaluate production loans. Practices described are based on production practices considered typical for the crop and area, but will not apply to every situation. Sample costs for labor, materials, equipment and custom services are based on current figures. A blank column, "Your Costs", in Tables 3 and 4 is provided to enter your costs.

The hypothetical farm operation, production practices, overhead, and calculations are described under the assumptions. For additional information or an explanation of the calculations used in the study call the Department of Agricultural and Resource Economics, University of California, Davis, (530) 752-3589 or your local UC Cooperative Extension office.

Sample Cost of Production Studies for all current and many archived commodities are available at http://coststudies.ucdavis.edu or can be requested from the Department of Agricultural and Resource Economics, UC Davis, (530) 752-1515 or obtained from selected county UC Cooperative Extension offices.

ASSUMPTIONS

The assumptions refer to Tables 1 to 9 and pertain to sample costs to establish an orange orchard and produce oranges in the southern San Joaquin Valley. The cultural practices shown represent production operations and materials considered typical of a well-managed orchard in the region. Costs, materials, and practices in this study will not apply to all farms. Timing of and types of cultural practices will vary among growers within the region and from season to season due to variables such as variety, weather, soil, and insect and disease pressure. **The use of trade names and cultural practices in this report does not constitute an endorsement or recommendation by the University of California nor is any criticism implied by omission of other similar products or cultural practices.**

Land. The hypothetical farm consists of 65 contiguous acres. Establishment and production costs are based on the ten acres being planted to oranges. Mature orange trees are on 50 acres and the remaining five acres are roads, equipment and shop area, and homestead. The grower owns and farms the orchards.

Establishment Operating Costs
Tables 1 & 2

Land Preparation. The orchard is established on ground previously planted to another tree crop. Land preparation begins by removing the old orchard. Orchard removal costs include pushing, stacking, and burning or shredding the trees, and a hand cleanup of the area. After removal, deep ripping of the soil profile 4 to 6 feet is done to break up stratified layers that affect root and water penetration. The ground is disced two times to break up large clods and then leveled (triplaned). All land preparation operations are contracted and done in the year prior to planting. Contracted or custom operation costs will vary depending upon acreage size. Small acres (10 in this case) may have a minimum fee or additional equipment delivery charges. Some of these costs are included.

Planting. Planting the orchard starts by marking tree sites (layout orchard). Holes are then dug and the trees planted in February. The trunks are wrapped with a foam wrap to shield them from sunburn and to reduce sucker development. Also, 2% of the trees or 2 trees per acre are assumed to be replaced in the second year.

Trees. The two major orange varieties grown in the San Joaquin Valley are Navels and Valencias. Navels are grouped into three types by harvest timing – early, mid and late season. Tree costs are for the standard varieties. A royalty fee is added to the cost on patented varieties, Most cultural and management practices for the two varieties are the same except where noted in pruning, growth regulators, and harvest. The trees are planted on 18 X 22-foot spacing, 110 trees per acre. Tree spacing and densities in orchards vary. Many new orchards are planted closer for earlier production, but historical data shows that the trees begin to crowd at 8 to 9 years with tree removal consideration warranted. Orange trees have a long production life if they are well maintained. The life of the orchard is assumed to be 40 years.

Pruning. Suckering is done during the first through the third year. Light pruning is done from the fourth year until mature. See Table A for estimated pruning/suckering times for the establishment years.

Table A. Sucker/Prune Operation Time Per Acre

Year	Operation	Hours
1	Sucker	2.71
2	Sucker	4.29
3	Sucker	5.00
4	Prune	3.14
5	Prune	6.00

Irrigation. Irrigation water is applied from April through October. District water is delivered via canal to the farm at a cost of $129 per acre-foot or $10.75 per acre-inch. Water costs are variable among districts with the cost shown being approximately mid-range between the high and low. Irrigation costs include the water and the labor for system operation and monitoring. No assumption is made about effective rainfall, runoff, and evaporation. The water applied for different aged trees is approximated and shown in Table B. Values are based on an irrigation system delivering water with a distribution uniformity of 85%.

Table B. Water applied

Year	Acre-Inches
1	2.0
2	4.5
3	7.0
4	10.5
5	14.0
Maturity	30.0

Frost Protection. This study assumes that only weed/cover crop management and 2.2 acre-inches of water are used for frost protection during the first three years. Frost protection is in effect from November to February. Wind machines are installed in the third year and begin operation in the fourth year. Water use remains constant for frost protection in all years. Table C illustrates this study's frost protection methods.

In this region three methods are used to protect fruit and trees from frost or freeze during late winter and early spring. (1) Orchard floors are kept free of vegetation (or if a cover crop is used it is maintained as low as possible during freezing weather by planting late in the fall). The low vegetation allows the soil to act as a reservoir for heat from solar radiation during the day. This heat is released at night which raises the air temperature (vegetation tends to reflect solar radiation during the day and consequently less heat is stored in the soil to be released at night). (2) Water is applied to the orchard floor. This also provides heat that is released to the trees as air temperature falls. (3) Wind machines are used to pull the warm air above the trees into the orchard and mix it with colder resident air resulting in a temperature increase. Wind machine installation is often delayed until significant fruit is produced, sometimes as late as the seventh or eighth establishment year. A single machine will cover about 10 acres.

Table C. Frost Protection Procedures

Year	water	acin	floor management	wind machine
1	Yes	2.2	Discing & contact herbicide	No
2	Yes	2.2	Residual & contact herbicide	No
3	Yes	2.2	Residual & contact herbicide	No
4	Yes	2.2	Residual & contact herbicide	100 hours
5+	Yes	2.2	Residual & contact herbicide	100 hours

Protection from yield losses due to freeze damage will help maintain an orchard's economic viability. Several protection strategies have been outlined above, but other options are available (e.g. crop insurance). Methods for determining the best frost protection strategy for individual orchards are discussed in the publication *Reducing Citrus Revenue Losses for Frost Damage: Wind Machines and Crop Insurance.*

Fertilization. Nitrogen (N) is the major nutrient required for proper tree growth and optimum yields. Beginning in the first year, UN32 is injected through the drip line and low biuret urea plus micronutrients - zinc sulfate and manganese (Tecmangam) - are applied in March as a foliage spray. Beginning in the fourth year, the micronutrients are applied as a foliar fertilizer with the March orangeworm spray. Additional urea is also applied with the May katydid/thrips spray. Nitrogen fertilizer rates from orchard establishment through maturity are shown in Table D. If groundwater is used for irrigation, water should be tested for nitrogen and the content taken into consideration in the fertilization program.

Table D. Applied N for Orange Orchards

Year	per tree	per acre	dripline	foliar
	Lbs. of N			
1	0.1	9.65	8.5	1.15
2	0.2	21.80	19.5	2.30
3	0.3	33.95	30.5	3.45
4	0.4	44.00	29.0	15.00
5	0.5	55.00	32.5	22.50
6	0.6	66.00	36.0	30.00
7+	0.8	110.00	80.0	30.00

Leaf/Tissue Sampling. Leaf samples are taken by the PCA sometime from August through October for nutrition analysis. For this study, one sample per 10 acres is taken.

Soil Amendments. Beginning in the fifth year, soluble gypsum is applied through the drip lines at each irrigation. A total of one-ton per acre per year is applied each season. Gypsum, calcium, or lime is applied for improving water infiltration and soil pH, and use should be based on soil and water tests. Although not included in this study, compost may be added to enhance soil organic matter.

Pest Management. The pesticides and rates mentioned in this cost study as well as other materials available are listed in *UC Integrated Pest Management Guidelines, Citrus*. Pesticides mentioned in the study are commonly used, but are not presented as a recommendation.

Weeds. Chemical weed control begins the first year with three spot sprays (April, June, August) in the tree row during the spring and summer using Roundup herbicide. In the first year a custom operator discs the floor middles three times (April, May, June). From the second year on residual/pre-emergent herbicides, Karmex and Princep, are applied to the orchard floor in the fall (October) and in the spring (March) using half of the maximum rate for each application. These materials are regulated under the Groundwater Protection Regulations and under some conditions may require a pesticide permit from the agricultural commissioner's office.

Insects. Insects treated in this study are citrus thrips (*Scirtothrips citri*), katydids (*Scudderia furcata),* and larvae of Lepidoptera species (orangeworms) such as citrus cutworm (*Xylomyges curialis*) and fruittree leafroller (*Archips argyrosphilus*). See UC IPM website http://ipm.ucdavis.edu/PMG/selectnewpest.citrus.html for full orangeworm list. Control for citrus thrips, orangeworms, and katydids begin in the fourth year. Orangeworms are controlled (control is generally required every other year) in March with one application of Dipel insecticide. Pesticides are applied at a lower volume per acre in the early years to account for the small tree size. In the fourth year 50% and in the fifth, 75% of the recommended spray volume is applied. Thrips and katydids are treated with Success insecticide plus oil in May at petal fall. Although a common industry practice is to apply multiple sprays on non-bearing trees for thrips, protection in this study begins in the fourth year for fruit protection rather than foliage protection. California red scale (*Aonidiella aurantii*) is not treated on young trees as it is only an economic problem when found on the fruit.

Fire ant (*Solenopsis xyloni*) control may be needed through the third year, especially if nests are still present. Clinch or Esteem ant bait is applied in late spring to early summer (May in this study) with the grower owned ATV and a bait applicator furnished by the chemical company. After careful monitoring, spot treatments with Lorsban may be needed, but are not included in this study.

Diseases. Beginning in October of the third year, brown rot (*Phytophthora spp.*) and septoria spot (*Septoria spp.*) are regulated with a Kocide (copper) and hydrated lime application. A custom applicator applies the insect and disease materials by ground with an air blast sprayer.

Nematodes and phytophthora. Nematodes (*Tylenchulus semipenetrans),* phytophthora root rot (*Phytophthora citrophthora and P. parasitica)* and phytophthora gummosis (*Phytophthora ssp)* can be severe problems. If the field was previously planted to citrus, phytophthora and nematode samples should be taken to detect the presence and population levels of the organisms prior to planting. Management strategies include resistant rootstocks, irrigation management, and chemical applications. All pest management strategies need to be tailored to meet specific orchard requirements and should be discussed with a certified pest control adviser or local farm advisor.

Harvest and Yields. Commercial yields normally begin in the third or fourth establishment year. New plantings with close spacing may have commercial yields in the second or third year. A custom operator harvests the field. Annual yields are shown in Table E.

Returns. See Returns in Production section.

Table E. Annual Orange Yields Per Acre

Year	Field Bins (900 lbs)	Field Boxes (55 lbs)	Total Crtns/bin (37.5 lbs)	Packed Cartons (37.5 lbs)
4	1.4	23	34	28
5	11.1	182	266	213
6	18.9	309	454	363
7	24.0	393	576	460
8	26.4	432	634	508
9	27.7	453	665	532
10+	28.6	468	686	550

Production Operating Costs

Table 3 to 9

Pruning. Pruning methods and frequencies vary widely on mature trees. In this study, pruning includes topping, hedging, hand pruning, and shredding. Pruning operations are done on a four-year cycle: (1) hedge alternate rows – each tree is hedged one side only, (2) top all trees, (3) hedge alternate rows - those not hedged previously, (4) hand prune. In this study, one-fourth of the costs are allocated to the orchard each year. Topping maintains tree height to augment adequate spray coverage and facilitate harvest operations. Hedging tree rows reduces fruit damage from orchard traffic and minimizes disruption of sprays applied to the orchard. Hand pruning of dead wood and suckering enhances spray deposition which is particularly important in the case of red scale. Hand pruning can also increase the amount of fruit inside the tree. Pruning is generally done after harvest. Because of increased risk from frost damage, pruning should be discontinued by mid-August to allow trees to enter the frost season in a reduced physiological state less susceptible to freezing. Pruning for Navels is normally done in the spring while Valencias are pruned in the summer. Pruning is done is April in this study. The prunings generally require shredding. The prunings from topping are stacked in alternate row middles by the custom shredder prior to shredding; the hand prunings are stacked by the pruners in alternate row middles and shredded by a custom shredder. The prunings from hedging fall in a manner that does not require hand stacking. Although, the custom operator shreds alternate rows, the charge is based on total acres.

Fertilization. Nitrogen (N) as UN-32 is applied through the irrigation system (not necessarily with an irrigation) in several applications during February, March, and April. Foliar applications of N as low biuret urea plus minor nutrients, zinc sulfate and manganese (Tecmangam), are mixed and sprayed with the March orangeworm treatment. A second low biuret urea application is made with the May thrips and katydid spray. The nutritional program should be based on leaf analysis.

Leaf/Tissue Sampling. Leaf samples are taken in the fall from spring flush, non-fruiting, 5-7 month old leaves. In this study, one sample is taken per 10 acres (0.10 samples per acre) by the PCA sometime from August through October. The cost shown is for lab analysis.

Soil Amendments. Each year from April through October, gypsum is injected through the irrigation system with each irrigation; this results in a total application of one-ton per acre for the season. The cost includes the gypsum and the labor to operate and fill the gypsum machine. The machine is listed as an investment under the Non-Cash Overhead section of the tables.

Irrigation. In this study, water is applied April through October. Thirty acre-inches of district water, delivered via canal, is applied to the orchard at a cost of $129 per acre-foot or $10.75 per acre-inch. Water costs are highly variable among districts and the cost shown is approximately mid-range. No assumption is made about effective rainfall, runoff, evaporation, winter water requirements or rainfall stored in the soil profile, tree size or tree health. The irrigation operation costs include the water and labor for irrigating, operating and monitoring the system.

Frost Protection. Protection is required from late winter to early spring (November through February) and is shown for November, December and January. In this study, chemical vegetation control on the orchard floor and 2.2 acre-inches of water are used for frost protection during the season. Also, wind machines are operated on nights with threatening minimum temperatures. See Table C. Each wind machine protects approximately 10 acres and uses 15 gallons of propane ($1.97 per gallon) per hour. The frost protection cost includes the fuel use and labor to operate the machines and to apply the water.

Pest Management. The pesticides and rates mentioned in this cost study are listed in *UC Integrated Pest Management Guidelines, Citrus* and *Reducing Insecticide Use and Energy Costs in Citrus Pest Management.* For more information on other pesticides available, pest identification, monitoring, and management visit the UC IPM website at www.ipm.ucdavis.edu. For information and pesticide use permits, contact the local county agricultural commissioner's office. **Growers with fruit destined for the export market, must use registered products that meet maximum residue limits (MRL) for that country.** Check the MRLs at www.calcitrusquality.org .

Pest Control Adviser (PCA). Written recommendations are required for many pesticides and are made by licensed pest control advisers. In addition the PCA can monitor the field for agronomic problems including pests and nutrition. Growers may hire private PCAs or receive the service as part of a service agreement with an agricultural chemical and fertilizer company. In this study, a private PCA monitors the crops for pest, disease, and nutrition.

Weeds. Pre-emergent herbicides (Karmex, Princep) are applied to the orchard floor (tree row and middles) in split applications, one in the fall (October) and one in the spring (March), using one-half the maximum rate per application. Surviving weeds are controlled with three spot sprays – April, June, August – with Roundup. Karmex and Princep are regulated under the Groundwater Protection Regulations. Check with your farm advisor or PCA prior to applying.

Insects. Orangeworms (Lepidoptera) are sprayed primarily in March with Dipel insecticide. Citrus thrips and katydids are treated in May and citrus thrips only in June. Success insecticide and oil are used in both applications. Urea and micronutrients are mixed with the orangeworm spray, and urea only, with the thrips and katydid spray. A spray is applied in July for California red scale and citricola scale alternating each year with Esteem (insect growth regulator) and Lorsban. Esteem controls red scale only and Lorsban controls both scales. All insect and disease treatments are applied by a commercial applicator. The custom application costs vary by pest, material applied, volume of water used, and sprayer speed. The grower should alternate materials in order to reduce the potential for the development of insect resistance to pesticides used.

Disease. Brown rot is the primary preharvest disease of fruit that occurs in this study and is controlled by spraying a Kocide (copper) and hydrated lime mixture during October or November. The same fungicide mixture also controls Septoria spot. Brown rot develops in the fall initially on fruit that is close to the ground. The pathogen is normally found in the soil and is splashed onto the low hanging fruit by rain. Symptoms usually appear during cool, wet periods on mature or nearly mature fruit.

Snails. Brown garden snails (*Helix aspera*) cause fruit damage. Control options for brown garden snails include predaceous snails, skirt pruning, trunk banding, and chemical baits. However, in this study snails are assumed not to be a problem.

Insect and Disease Management Options. There are two fundamental approaches to using synthetic pesticides in citrus production. (1) Several applications of broad-spectrum pesticides are made to prevent pest damage. While these pesticides control a wide range of insect and mite pests and persist to provide control for long periods of time, these attributes can also create additional pest problems. Long-term use has increased pest resistance to many of these pesticides, resulting in increased pesticide applications. Since broad-spectrum pesticides affect many species of insects and mites, those sprays decrease the levels of beneficial populations, that can assist in controlling many pests. Pest resurgence and secondary outbreaks can be the result of parasite and predator suppression by these pesticide applications. For example, treatment for orangeworms or citrus thrips can cause an increase of citrus red mite. (2) Use of selective pesticides and natural enemies (beneficial predators) as control measures. Selective pesticides are toxic to a narrow range of pests and are usually less harmful to the natural enemies. Their use requires careful monitoring of pests and more precise timing and application to be effective. Many selective pesticides do not persist for long-term control. Preserving beneficial predatory and parasitic populations can reduce the potential resurgence and secondary outbreaks of pests. However, some minor pests such as citricola scale may become economic pests once broad spectrum pesticides are not used. Pest management practices used in this study follow the first strategy described (currently this is the more typical pest management program used in this region).

Growth Regulators for Navels. Growth regulators are applied to mature Navel orange trees only. Gibberellic acid (Gib Gro) and 2, 4-D (Citrus Fix) treatments are made on mid-to-late harvested Navels. Gibberellic acid maintains a juvenile rind and 2,4-D applied in October/November minimizes pre-harvest fruit drop. In this study gibberellic acid (GA) is sprayed in October and 2,4-D in November. Growth regulators are applied to 70% of the orchard, because 30% of the orchard was picked earlier.

Harvest. Orange trees typically reach full production by the 10th or 11th year. In this cost study, the crop is hand picked and hauled by a contracted harvesting company.

Typically one-third of the orchard is picked in each of three harvests over the growing season. Navels are normally harvested from November to June while Valencias are harvested April through September. Oranges are hand picked and put into field bins that hold 900 pounds (24 carton equivalent) of fruit. The oranges are hauled from the field to a packinghouse where they washed, graded, sized, and packed. Picking, hauling, packing, and marketing costs from the field to the packinghouse are paid by the grower. Current rates for these services vary; picking and hauling costs are $1.35 per carton and the packinghouse cost are $4.85 per carton. Delivering outside the local area will increase hauling costs. The packing house cost includes costs for the carton, packing, marketing and some miscellaneous fees charged by the packer. The costs are based on typical costs as received from packinghouses and growers in the region.

Yields. Typical annual yields for the Navel and Valencia varieties are measured in 900-pound field bins per acre, but are typically sold by packed cartons weighing 37.5 pounds, although the industry often refers to them as 40-pound cartons. A 900-pound bin is calculated as either 23 or 24 cartons. Packed cartons represent 80% of the fruit picked. The remaining 20% may go to juices or a small percentage may be culls.

Returns. An estimated price based on past returns of $10 per carton, fob packinghouse, is used in this study. There is basically no income for juice products in Navels, but there may be a small amount in Valencias. Returns over a range of yields are shown in Table 6.

Assessments. Commercial orange producers pay two assessments.

State Marketing Order. Under a state marketing order, mandatory assessment fees are collected and administered by the grower-directed Citrus Research Board. This assessment, currently $0.07 per 55-pound field box, is used to fund industry research programs.

Central California Tristeza Eradication Agency. Tristeza disease can result in damage ranging from lower fruit quality to the death of the tree. The Central California Tristeza Eradication Agency (CCTEA) manages an eradication program to keep the Central Valley tristeza-free. The assessment varies by pest control district and not all districts participate. Although not all growers participate in this program and pay assessments, an average of $9.20 per acre is charged in this study. The charges are paid in the property assessment bill, but are shown as a line item cost in this study

Pickup/ATV. The grower uses the pickup for business and personal use. It is assumed that 5,000 miles are for business use. The all terrain vehicle (ATV) cost is for checking and monitoring the field, irrigating, and checking the irrigation system. The cost is estimated and not based on any specific data. The grower also uses the ATV for weed control and the operation cost is included in that cost.

Labor, Equipment and Interest

Labor. Labor rates of $14.49 per hour for machine operators and $11.04 for general labor includes payroll overhead of 38%. The basic hourly wages are $10.50 for machine operators and $8.00 for general labor. The overhead includes the employers' share of federal and California state payroll taxes, workers' compensation insurance for orchard/fruit crops (code 0016), and a percentage for other possible benefits. Workers' compensation costs will vary among growers, but for this study the cost is based upon the average industry final rate as of January 1, 2009 (personal email from California Department of Insurance, March 2009, unreferenced). Labor for operations involving machinery are 20% higher than the operation time given in Table 3 to account for the extra labor involved in equipment set up, moving, maintenance, work breaks, and field repair.

Wages for management are not included as a cash cost. Any return above total costs is considered a return to management and risk. However, growers wanting to account for management may wish to add a fee. The manager makes all production decisions including cultural practices, action to be taken on pest management recommendations, and labor.

Equipment Operating Costs. Repair costs are based on purchase price, annual hours of use, total hours of life, and repair coefficients formulated by American Society of Agricultural Engineers (ASAE). Fuel and lubrication costs are also determined by ASAE equations based on maximum Power Take Off (PTO) horsepower, and fuel type. Prices for on-farm delivery of red dye diesel and gasoline are $3.70 (excludes excise tax) and $3.56 per gallon, respectively. Fuel costs are derived from American Automobile Association (AAA) and Energy Information Administration 2008 July to December monthly data. The cost includes a 2% local sales tax on diesel fuel and 8% sales tax on gasoline. Gasoline also includes federal and state excise tax, which are refundable for on-farm use when filing your income tax. The fuel, lube, and repair cost per acre for each operation in Table 3 is determined by multiplying the total hourly operating cost in Table 7 for each piece of equipment used for the selected operation by the hours per acre. Tractor time is 10% higher than implement time for a given operation to account for setup, travel and down time.

Interest On Operating Capital. Interest on operating capital is based on cash operating costs and is calculated monthly until harvest at a nominal rate of 5.75% per year. A nominal interest rate is the typical market cost of borrowed funds. The interest cost of post harvest operations is discounted back to the last harvest month using a negative interest charge. The interest rate will vary depending upon various factors. The rate is this study is considered a typical lending rate by a farm lending agency as of January 2009.

Risk. The risks associated with crop production should not be minimized. While this study makes every effort to model a production system based on typical, real world practices, it cannot fully represent financial, agronomic and market risks, which affect profitability and economic viability. Crop insurance is a risk management tool available to growers.

Cash Overhead Costs

Cash overhead consists of various cash expenses paid out during the year that are assigned to the whole farm and not to a particular operation.

Property Taxes. Counties charge a base property tax rate of 1% on the assessed value of the property. In some counties special assessment districts exist and charge additional taxes on property including equipment, buildings, and improvements. For this study, county taxes are calculated as 1% of the average value of the property. Average value equals new cost plus salvage value divided by 2 on a per acre basis.

Insurance. Insurance for farm investments varies depending on the assets included and the amount of coverage. Property insurance provides coverage for property loss and is charged at 0.714% of the average value of the assets over their useful life. Liability insurance covers accidents on the farm and costs $539 for the entire farm.

Crop Insurance. Crop insurance is available to growers, but is not included as a cost in this study.

Office Expense. Office and business expenses are estimated at $125 per acre. These expenses include office supplies, telephones, bookkeeping, accounting, legal fees, shop and office utilities, miscellaneous administrative charges, and complying with environmental regulations.

Management/Supervisor Salaries. The grower farms the orchard, so no cash cost is allocated to management. Returns above costs are considered a return to management.

Investment Repairs. Annual maintenance is calculated as 2% of the purchase price, except orchard establishment is calculated at 0.50% to account for tree replacement and orchard repairs.

Non-Cash Overhead Costs

Non-cash overhead is calculated as the capital recovery cost for equipment and other farm investments.

Capital Recovery Costs. Capital recovery cost is the annual depreciation and interest costs for a capital investment. It is the amount of money required each year to recover the difference between the purchase price and salvage value (unrecovered capital). It is equivalent to the annual payment on a loan for the investment with the down payment equal to the discounted salvage value. This is a more complex method of calculating ownership costs than straight-line depreciation and opportunity costs, but more accurately represents the annual costs of ownership because it takes the time value of money into account (Boehlje and Eidman). The formula for the calculation of the annual capital recovery costs is ((Purchase Price – Salvage Value) x Capital Recovery Factor) + (Salvage Value x Interest Rate).

Salvage Value. Salvage value is an estimate of the remaining value of an investment at the end of its useful life. For farm machinery (tractors and implements) the remaining value is a percentage of the new cost of the investment (Boehlje and Eidman). The percent remaining value is calculated from equations developed by the American Society of Agricultural Engineers (ASAE) based on equipment type and years of life. The life in years is estimated by dividing the wear out life, as given by ASAE by the annual hours of use in this operation. For other investments including irrigation systems, buildings, and miscellaneous equipment, the value at the end of its useful life is zero. The salvage value for land is the purchase price because land does not depreciate.

Capital Recovery Factor. Capital recovery factor is the amortization factor or annual payment whose present value at compound interest is 1. The amortization factor is a table value that corresponds to the interest rate used and the life of the machine.

Interest Rate. An interest rate of 4.75% is used to calculate capital recovery. The rate will vary depending upon loan amount and other lending agency conditions, but is the basic suggested rate by a farm lending agency as of January 2009.

Establishment Cost. Costs to establish the orchard are used to determine capital recovery expenses, depreciation, and interest on investment for the production years. Establishment cost is the sum of the costs for land preparation, planting, trees, cash overhead and production expenses for growing the trees through the first year that oranges are harvested minus any returns from production. The Total Accumulated Net Cash Cost on Table 1, in the fourth year represents the establishment cost. For this study the cost is $6,509 per acre or $65,088 for the 10-acre orchard. The establishment cost is spread over the remaining 36 years of the 40 years the orchard is in production. Establishment costs in this study are based on typical basic operations, but can vary considerably, depending upon terrain, soil type, local regulations, and other factors. For example, development on marginal soils will require additional land preparation and soil amendments. Management/Development companies will have additional labor costs.

Irrigation System. Water is delivered under pressure to the orchard through a low-volume irrigation system. Low-volume emitters discharge 10 gallons per hour and are spaced at one per tree The cost for the low-volume irrigation system includes the cost of a pump, filtration system, hoses, emitters, and installation. The life of the irrigation system is estimated at 40 years. The above ground portion of the irrigation system will probably have to be replaced once per ten years, but is not separated out in this study.

Land. Land values for bare or row crop land range from $5,000 to $12,000 per acre (Trends & Leases), depending on available water. Land with citrus orchards ranges from $8,000 to $15,000 per acre. Current real estate listings for bare land values range from $5,500 to $9,500. The land on which the orchard is planted in this study is valued at $7,500 per acre.

Building. The shop building is a 1,800 square foot metal building or buildings on a cement slab.

Tools. This includes shop tools, hand tools, and miscellaneous field tools such as pruning tools. The value is estimated and not taken from any specific data.

Fuel Tanks. Two 250-gallon fuel tanks using gravity feed are on metal stands. The tanks are setup in a cement containment pad that meets federal, state, and county regulations.

Wind Machines. Each machine will cover approximately 10-acres. The cost includes six machines on the farm with one being in the new planting and five on the remaining acres. Cost includes installation of the propane-powered machines. The machines are assumed to use 15 gallons of propane per hour over 10 acres.

Gypsum Machine. The machine is used to inject the soluble gypsum into the irrigation system. The machine costs are allocated to the 10-acres of newly established oranges.

Equipment. Farm equipment is purchased new or used, but the study shows the current purchase price for new equipment. The new purchase price is adjusted to 60% to indicate a mix of new and used equipment. Equipment costs are composed of three parts: non-cash overhead, cash overhead, and operating costs. Both of the overhead factors have been discussed in previous sections. The operating costs consist of repairs, fuel, and lubrication and are discussed under operating costs.

Table Values. Due to rounding, the totals may be slightly different from the sum of the components.

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UC COOPERATIVE EXTENSION

Table 1. COSTS PER ACRE TO ESTABLISH AN ORANGE ORCHARD

SAN JOAQUIN VALLEY – SOUTH 2009

	Costs per Acre				
YEAR:	1st	2nd	3rd	4th	5th
PACKOUT YIELD (37.5 lb Cartons/Acre):				28	213
Planting Costs					
Land Preparation: Remove Old Orchard (Dig, Stack, Chip)	350				
Land Preparation: Subsoil	390				
Land Preparation: Disc 2X	110				
Land Preparation: Level (Triplane)	175				
Trees @ 110 per acre (Replant 2% of trees in 2nd Year)	1,155	21			
Plant: Layout, Plant, Stake & Wrap Trees (includes wrap costs)	149	3			
TOTAL PLANTING COSTS	2,329	24			
Cultural Costs:					
Sucker (Yr 1-3) Prune (Yr 4+)	30	47	55	35	66
Irrigate	66	93	119	173	211
Frost Protection (Yr 1-3, water. Yr 4+, water & wind machines)	27	40	40	330	337
Fertilizer: Foliar Spray N, Mn, Zn	37	38	39		
Fertilizer: N w/irrigation, (UN32)	4	9	14	13	15
Insect/Fertilizer: Thrips, Katydids (Success, Oil) /Foliar (N)				61	73
Insect/Fertilizer: Orangeworms (Dipel) / Foliar (N, Mn, Zn)				48	54
Insect: Ants (Clinch)	4	4	4		
Weed: Pre-emergent – orchard floor (Karmex, Princep)		59	59	59	59
Weed: Spot Spray (Roundup) 3X	18	18	18	18	18
Weed: Disc 3X (Custom)	165				
Disease: Brown Rot (Lime, Kocide)			54	63	73
Soil Amendments: Soluble Gypsum					145
Pickup Truck Use	98	98	98	98	98
ATV Use	63	63	63	63	63
Leaf Analysis (1 sample/10 acres)				7	7
PCA/Consultant Services	35	35	35	35	35
TOTAL CULTURAL COSTS	546	504	598	1,003	1,252
Harvesting Costs:					
Pick and Haul				46	359
Pack				136	1,033
Assessments				11	22
TOTAL HARVEST COSTS				193	1,414
Interest on operating capital @ 5.75%	173	17	18	20	32
TOTAL OPERATING COSTS PER ACRE	3,047	545	616	1,216	2,698
Cash Overhead Costs:					
Office Expense	125	125	125	125	125
Liability Insurance	10	10	10	10	10
Property Taxes	99	98	111	111	114
Property Insurance	14	14	25	25	27
Investment Repairs	58	58	105	105	117
TOTAL CASH OVERHEAD COSTS	307	306	376	376	394
TOTAL CASH COSTS	3,354	851	992	1,592	3,092
INCOME FROM PRODUCTION				280	2,130
NET CASH COSTS FOR THE YEAR	3,354	851	992	1,312	962
PROFIT ABOVE CASH COSTS					
TOTAL ACCUMULATED NET CASH COSTS	3,354	4,204	5,197	**6,509**	7,470

UC COOPERATIVE EXTENSION

Table 1. continued

SAN JOAQUIN VALLEY – SOUTH 2009

	Costs per Acre				
YEAR:	1st	2nd	3rd	4th	5th
Non-Cash Overhead Costs:					
Buildings	66	66	66	66	66
Drip Irrigation System	87	87	87	87	87
Shop Tools	24	24	24	24	24
Land	386	386	386	386	386
Fuel Tanks & Pumps	3	3	3	3	3
Gypsum Machine					138
Wind Machine			177	177	177
Equipment	45	42	42	42	42
TOTAL NON-CASH OVERHEAD COSTS	612	608	785	785	922
TOTAL COST FOR THE YEAR	3,966	1,459	1,778	2,377	4,014
INCOME FROM PRODUCTION				280	2,130
NET TOTAL COST FOR THE YEAR	3,966	1,459	1,778	2,097	1,884
NET PROFIT FOR THE YEAR					
ACCUMULATED NET TOTAL COST	3,966	5,424	7,202	9,298	11,182

UC COOPERATIVE EXTENSION

Table 2. MATERIALS AND CUSTOM WORK COSTS PER ACRE - ESTABLISHMENT YEARS

SAN JOAQUIN VALLEY – SOUTH 2009

			Year 1		Year 2		Year 3		Year 4		Year 5	
			Total Per Acre									
	Unit	$/Unit	units	$	units	$	units	$	units	$	units	$
OPERATING COSTS												
Custom:												
Orchard Removal & Chip	acre	350.00	1.00	350								
Slip Plow	acre	390.00	1.00	390								
Disc	acre	55.00	5.00	275								
Level - Triplane	acre	175.00	1.00	175								
Layout, Plant, Wrap	tree	0.77	110.00	85	2.00	2						
Ground Spray – Copper / Fertilizer	acre	35.00	1.00	35	1.00	35	2.00	70	1.00	35	1.00	35
Ground Spray – Orangeworm	acre	35.00							1.00	35	1.00	35
Ground Spray – Thrips	acre	35.00							1.00	35	1.00	35
Harvest: Pick & Haul	crtn	1.35							34.00	46	266.00	359
Harvest: Pack	crtn	4.85							28.00	136	213.00	1033
Leaf Analysis (Nutrients)	each	68.00							0.10	7	0.10	7
PCA	acre	35.00	1.00	35	1.00	35	1.00	35	1.00	35	1.00	35
Assessments:												
Citrus Research (55 lb lug)	lug	0.07							23.00	2	182.00	13
Tristeza Eradication	acre	9.20							1.00	9	1.00	9
Tree/Tree Aids:												
Orange Tree	tree	10.50	110.00	1,155	2.00	21						
Tree Wraps (foam type)	each	0.58	110.00	64	2.00	1						
Irrigation/Frost Protection:												
Wind Machine Operation	hr/ac	3.00							100.00	300	100.00	300
Water Frost Protection	acin	10.75	1.46	16	2.20	24	2.20	24	2.20	24	2.20	24
Water (growing season)	acin	10.75	2.00	22	4.50	48	7.00	75	10.50	113	14.00	151

UC COOPERATIVE EXTENSION

Table 2. continued

SAN JOAQUIN VALLEY – SOUTH 2009

			Year 1		Year 2		Year 3		Year 4		Year 5	
			Total Per Acre									
	Unit	$/Unit	units	$	units	$	units	$	units	$	units	$
Fertilizer:												
UN32 (32-0-0)	lb N	0.46	8.50	4	19.50	9	30.50	14	29.00	13	32.50	15
Urea Low Biuret (46-0-0)	lb N	0.91	1.15	1	2.30	2	3.45	3	15.00	14	22.50	20
Zinc Sulfate 36%	lb	0.64	0.50	0	0.50	0	0.50	0	0.50	0	0.50	0
Tecmangam (31% Mn)	lb	0.74	0.50	0	0.50	0	0.50	0	0.50	0	0.50	0
Soluble Gypsum (Soil Amendment)	ton	133.00									1.00	133
Herbicide:												
Roundup Original Max	pint	5.15	0.60	3	0.60	3	0.60	3	0.60	3	0.60	3
Princep 90S	lb	6.07			4.00	24	4.00	24	4.00	24	4.00	24
Karmex DF	lb	6.17			4.00	25	4.00	25	4.00	25	4.00	25
Insecticide:												
Clinch Ant Bait	lb	12.15	0.33	4	0.33	4	0.33	4				
Dipel ES	pint	5.10							1.00	5	1.50	8
Success	oz	5.66							3.00	17	4.50	25
Spray Oil 415	gal	4.43							0.50	2	0.50	2
Fungicide:												
Hydrated Lime	lb	0.25					5.00	1	7.50	2	10.00	3
Kocide 20/20	lb	3.53					5.00	18	7.50	26	10.00	35
Labor (machine)	hrs	14.49	8.93	129	9.53	138	9.53	138	9.50	138	9.50	138
Labor (non-machine)	hrs	11.04	7.71	85	9.80	108	10.50	116	9.26	102	13.77	152
Fuel - Gas	gal	3.36	9.17	31	9.26	31	9.26	31	9.25	31	9.25	31
Lube				5		5		5		5		5
Machinery repair				11		12		12		12		12
Operating Interest @ 5.75%				173		17		18		20		32
Total Operating Costs/Acre				3,048		545		616		1,216		2,698

UC COOPERATIVE EXTENSION

Table 3. COSTS PER ACRE TO PRODUCE ORANGES

SAN JOAQUIN VALLEY - SOUTH 2009

Operation	Operation Time (Hrs/A)	Cash and Labor Costs per acre: Labor Cost	Fuel, Lube & Repairs	Material Cost	Custom/ Rent	Total Cost	Your Cost
Cultural:							
Frost Protection (water & wind machine)	2.19	24	0	324	0	348	
Fertilize: N (UN32 through drip line)	0.30	3	0	37	0	40	
Weed: Pre-emergent (Princep, Karmex) 2X	0.50	9	1	49	0	59	
Insect/Fertilizer: Orangeworm (Dipel)/N Mn Zn	0.00	0	0	27	35	62	
Prune: Top Trees, Stack & Shred Prunings 1X/4 Yr	0.00	0	0	0	25	25	
Prune: Hedge Alt. Rows, Shred Prunings 2X/4Yr	0.00	0	0	0	24	24	
Prune: Hand Prune & Stack, Shred Prunings 1X/4 Yr	0.00	0	0	0	75	75	
Irrigate: (water & labor)	5.55	61	0	323	0	384	
Soil Amendment: (Soluble Gypsum) w/irrigation	8.75	97	0	133	0	230	
Weed: Spot Spray (Roundup) 3X	0.75	13	2	3	0	18	
Insect/Fertilizer: Thrips, Katydid (Success, Oil) /N	0.00	0	0	50	35	85	
Insect: Thrips (Success, Oil)	0.00	0	0	36	35	71	
Insect: Scale (Esteem)	0.00	0	0	145	85	230	
Leaf Analysis (1 sample/10 acres)	0.05	1	0	0	7	7	
Disease: Brown Rot (Lime, Kocide)	0.00	0	0	38	35	73	
Growth Regulator: (Fruit Fix) [Navel Only]	0.00	0	0	11	53	64	
Growth Regulator: (GibGro or GA) [Navel Only]	0.00	0	0	24	53	77	
Pickup Truck Use	3.33	58	40	0	0	98	
ATV Use	3.33	58	5	0	0	63	
PCA/Consultant Services	0.00	0	0	0	35	35	
TOTAL CULTURAL COSTS	24.75	324	47	1,199	496	2,065	
Harvest:							
Pick & Haul Fruit	0.00	0	0	0	926	926	
Pack Fruit	0.00	0	0	0	2,668	2,668	
Assessments	0.00	0	0	42	0	42	
TOTAL HARVEST COSTS	0.00	0	0	42	3,594	3,635	
Interest on operating capital @ 5.75%						160	
TOTAL OPERATING COSTS/ACRE		324	47	1,240	4,089	5,860	
Cash Overhead:							
Office Expense						125	
Liability Insurance						10	
Property Taxes						147	
Property Insurance						54	
Investment Repairs						149	
TOTAL CASH OVERHEAD COSTS						485	
TOTAL CASH COSTS/ACRE						6,346	
Non-Cash Overhead:		Per producing Acre		Annual Cost Capital Recovery			
Buildings 1800 sqft		1,050		66		66	
Fuel Tanks 2-250g		58		3		3	
Shop Tools		250		24		24	
Land		8,125		386		386	
Gypsum Machine (1)		600		138		138	
Orchard Establishment		6,509		381		381	
Drip Irrigation		1,550		87		87	
Wind Machine (6)		2,340		177		177	
Equipment		405		44		44	
TOTAL NON-CASH OVERHEAD COSTS		20,887		1,305		1,305	
TOTAL COSTS/ACRE						7,651	

UC COOPERATIVE EXTENSION

Table 4. COSTS AND RETURNS PER ACRE TO PRODUCE ORANGES

SAN JOAQUIN VALLEY - SOUTH 2009

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
GROSS RETURNS					
Oranges	550.00	*crtn	10.00	5,500	
OPERATING COSTS					
Frost Protection:					
Water	2.20	acin	10.75	24	
Wind Machine Operation (propane @ $1.97/gal)	100.00	hr/ac	3.00	300	
Fertilizer:					
UN 32 (32-0-0)	80.00	lb N	0.46	37	
Urea Low Biuret (46-0-0)	30.00	lb N	0.91	27	
Zinc Sulfate 36%	2.00	lb	0.64	1	
Tecmangam (31% Mn)	2.00	lb	0.74	1	
Soil Amendment:					
Gypsum Soluble	1.00	ton	133.00	133	
Herbicide:					
Princep 90S	4.00	lb	6.07	24	
Karmex	4.00	lb	6.17	25	
Roundup Original Max	0.60	pint	5.15	3	
Insecticide:					
Dipel ES	2.00	pint	5.10	10	
Success	12.00	oz	5.66	68	
Spray Oil 415	1.00	gal	4.43	4	
Esteem	17.00	floz	8.52	145	
Contract/Custom:					
Harvest - Pick & Haul	686.00	crtn	1.35	926	
Harvest - Pack	550.00	crtn	4.85	2,668	
Prune – by Hand & Stack (1X/4 Yr)	0.25	acre	270.00	68	
PCA Fees	1.00	acre	35.00	35	
Prune-Top (1X/4 Yr)	0.25	acre	35.00	35	
Prune-Hedge (2X/4 Yr, Alt. Rows = 1/2 field each time)	0.25	acre	35.00	9	
Shred Prunings (hand prunings1X/4 Yr & hedge prunings 2X/4 Yr)	0.75	acre	30.00	23	
Stack & Shred Prunings (top prunings) 1X/4 Yr	0.25	acre	65.00	16	
Spray Ground -Thrips	2.00	acre	35.00	70	
Spray Ground - Scale	1.00	acre	85.00	85	
Spray Ground - Orangeworm	1.00	acre	35.00	35	
Spray Ground - Copper or Fertilizer	1.00	acre	35.00	35	
Spray Ground - Growth Regulator	2.00	acre	52.50	105	
Leaf Analysis (1 per 10 acres)	0.10	each	68.00	7	
Irrigation:					
Water	30.00	acin	10.75	323	
Fungicide:					
Hydrated Lime	10.00	lb	0.25	3	
Kocide 20/20	10.00	lb	3.53	35	
Growth Regulator:					
Fruit Fix (2, 4-D) [Navel Only]	2.50	floz	4.56	11	
Gib Gro 4LS (gibberalic acid) [Navel Only}	40.00	gram	0.60	24	
Assessment:					
Citrus Research/55lb box	464.00	box	0.07	32	
Tristeza Eradication	1.00	acre	9.20	9	

UC COOPERATIVE EXTENSION
Table 4. continued
SAN JOAQUIN VALLEY - SOUTH 2009

	Quantity/ Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
Labor (machine)	9.50	hrs	14.49	138	
Labor (non-machine)	16.84	hrs	11.04	186	
Fuel - Gas	9.26	gal	3.36	31	
Lube				5	
Machinery repair				12	
Interest on operating capital @ 5.75%				160	
TOTAL OPERATING COSTS/ACRE				5,860	
NET RETURNS ABOVE OPERATING COSTS				-360	
CASH OVERHEAD COSTS:					
Office Expense				125	
Liability Insurance				10	
Property Taxes				147	
Property Insurance				54	
Investment Repairs				149	
TOTAL CASH OVERHEAD COSTS/ACRE				485	
TOTAL CASH COSTS/ACRE				6,346	
NON-CASH OVERHEAD COSTS					
Buildings 1800 sqft				66	
Fuel Tanks 2-250g				3	
Shop Tools				24	
Land				386	
Gypsum Machine				138	
Orchard Establishment				381	
Drip Irrigation				87	
Wind Machine (6)				177	
Equipment				44	
TOTAL NON-CASH OVERHEAD COSTS/ACRE				1,305	
TOTAL COSTS/ACRE				7,651	
NET RETURNS ABOVE TOTAL COSTS				-2,151	

*carton = 37.5 lbs

UC COOPERATIVE EXTENSION

Table 5. MONTHLY PER ACRE CASH COSTS - ORANGES

SAN JOAQUIN VALLEY - SOUTH 2009

Beginning JAN 09 Ending DEC 09	JAN 09	FEB 09	MAR 09	APR 09	MAY 09	JUN 09	JUL 09	AUG 09	SEP 09	OCT 09	NOV 09	DEC 09	TOTAL
Cultural:													
Frost Protection (water & wind machine)	115										118	115	348
Fertilize: N (through drip line)		13	13	13									40
Weed: Pre-emergent Orchard Floor (Princep, Karmex) 2X			29							29			59
Insect/Fertilizer: Orangeworm (Dipel)/N Mn Zn			62										62
Prune: Top Trees, Stack & Shred Prunings 1X/4 Yr				25									25
Prune: Hedge Alt. Rows, Shred Prunings 2X/4Yr				24									24
Prune: Hand Prune & Stack, Shred Prunings 1X/4 Yr				75									75
Irrigate: (water & labor)				43	52	65	82	65	52	25			384
Soil Amendment: (Soluble Gypsum) w/irrigation				28	32	36	42	36	32	22			230
Weed: Spot Spray (Roundup) 3X				6		6		6					18
Insect/Fertilizer: Thrips Katydid (Success, Oil) /N					85								85
Insect: Thrips (Success, Oil)						71							71
Insect: Scale (Esteem)							230						230
Leaf Analysis (1 sample/10 acres)									7				7
Disease: Brown Rot (Lime, Kocide)										73			73
Growth Regulator: (Fruit Fix) [Navel Only]										64			64
Growth Regulators (GibGro or GA) [Navel Only]											77		77
Pickup Truck Use	8	8	8	8	8	8	8	8	8	8	8	8	98
ATV Use	5	5	5	5	5	5	5	5	5	5	5	5	63
PCA/Consultant Services	3	3	3	3	3	3	3	3	3	3	3	3	35
TOTAL CULTURAL COSTS	131	30	121	231	185	195	370	123	108	229	211	131	2,065
Harvest:													
Pick & Haul Fruit		309		308							309		926
Pack Fruit		888		888							892		2,668
Assessments		14		14							14		42
TOTAL HARVEST COSTS		1,210		1,209							1,216		3,635
Interest on operating capital @ 5.75%	1	7	7	14	15	16	18	18	19	20	27	-1	160
TOTAL OPERATING COSTS/ACRE	132	1,247	128	1,454	200	210	388	142	127	249	1,453	131	5,860
OVERHEAD:													
Office Expense	10	10	10	10	10	10	10	10	10	10	10	10	125
Liability Insurance	10												10
Property Taxes	73						73						147
Property Insurance	27						27						54
Investment Repairs	12	12	12	12	12	12	12	12	12	12	12	12	150
TOTAL CASH OVERHEAD COSTS	134	23	23	23	23	23	123	23	23	23	23	23	486
TOTAL CASH COSTS/ACRE	265	1,269	151	1,477	223	233	511	165	150	272	1,476	154	6,346

UC COOPERATIVE EXTENSION
Table 6. RANGING ANALYSIS
SAN JOAQUIN VALLEY - SOUTH 2009

COSTS PER ACRE AT VARYING YIELDS TO PRODUCE ORANGES

	*YIELD (cartons/acre)						
	400	450	500	550	600	650	700
OPERATING COSTS/ACRE:							
Cultural Cost	2,065	2,065	2,065	2,065	2,065	2,065	2,065
Harvest Cost	2,646	2,976	3,306	3,635	3,965	4,295	4,624
Interest on operating capital	130	140	150	160	170	180	190
TOTAL OPERATING COSTS/ACRE	4,841	5,181	5,521	5,860	6,200	6,540	6,879
TOTAL OPERATING COSTS/CRTN	12.10	11.51	11.04	10.65	10.33	10.06	9.83
CASH OVERHEAD COSTS/ACRE	485	485	485	485	485	485	485
TOTAL CASH COSTS/ACRE	5,326	5,666	6,006	6,345	6,685	7,025	7,364
TOTAL CASH COSTS/CRTN	13.32	12.59	12.01	11.54	11.14	10.81	10.52
NON-CASH OVERHEAD COSTS/ACRE	1,305	1,305	1,305	1,305	1,305	1,305	1,305
TOTAL COSTS/ACRE	6,631	6,971	7,311	7,650	7,990	8,330	8,669
TOTAL COSTS/CRTN	16.58	15.49	14.62	13.91	13.32	12.82	12.38

*cartons = 37.5 pounds

NET RETURNS PER ACRE ABOVE OPERATING COSTS

PRICE	*YIELD (cartons/acre)						
$/carton	400	450	500	550	600	650	700
7.00	-2,041	-2,031	-2,021	-2,010	-2,000	-1,990	-1,979
8.00	-1,641	-1,581	-1,521	-1,460	-1,400	-1,340	-1,279
9.00	-1,241	-1,131	-1,021	-910	-800	-690	-579
10.00	-841	-681	-521	-360	-200	-40	121
11.00	-441	-231	-21	190	400	610	821
12.00	-41	219	479	740	1,000	1,260	1,521
13.00	359	669	979	1,290	1,600	1,910	2,221

NET RETURNS PER ACRE ABOVE CASH COSTS

PRICE	*YIELD (cartons/acre)						
$/carton	400	450	500	550	600	650	700
7.00	-2,526	-2,516	-2,506	-2,495	-2,485	-2,475	-2,464
8.00	-2,126	-2,066	-2,006	-1,945	-1,885	-1,825	-1,764
9.00	-1,726	-1,616	-1,506	-1,395	-1,285	-1,175	-1,064
10.00	-1,326	-1,166	-1,006	-845	-685	-525	-364
11.00	-926	-716	-506	-295	-85	125	336
12.00	-526	-266	-6	255	515	775	1,036
13.00	-126	184	494	805	1,115	1,425	1,736

NET RETURNS PER ACRE ABOVE TOTAL COSTS

PRICE	*YIELD (cartons/acre)						
$/carton	400	450	500	550	600	650	700
7.00	-3,831	-3,821	-3,811	-3,800	-3,790	-3,780	-3,769
8.00	-3,431	-3,371	-3,311	-3,250	-3,190	-3,130	-3,069
9.00	-3,031	-2,921	-2,811	-2,700	-2,590	-2,480	-2,369
10.00	-2,631	-2,471	-2,311	-2,150	-1,990	-1,830	-1,669
11.00	-2,231	-2,021	-1,811	-1,600	-1,390	-1,180	-969
12.00	-1,831	-1,571	-1,311	-1,050	-790	-530	-269
13.00	-637	-1,121	-811	-500	-190	120	431

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Table 7. WHOLE FARM ANNUAL EQUIPMENT, INVESTMENT, AND BUSINESS OVERHEAD COSTS

SAN JOAQUIN VALLEY - SOUTH 2009

ANNUAL EQUIPMENT COSTS

						Cash Overhead		
Yr	Description	Price	Yrs Life	Salvage Value	Capital Recovery	Insur-ance	Taxes	Total
09	ATV 4WD	6,700	15	1,304	573	33	40	646
09	Pickup Truck 1/2 Ton	32,000	7	12,139	3,978	181	221	4,380
09	Weed Sprayer-Pull, ATV 55 gal	2,500	20	130	192	11	13	216
TOTAL		41,200		13,573	4,743	225	274	5,242
	*60% of new cost	24,720		8,144	2,846	135	164	3,145

*Used to reflect a mix of new and used equipment

ANNUAL INVESTMENT COSTS

					Cash Overhead			
Description	Price	Yrs Life	Salvage Value	Capital Recovery	Insur-ance	Taxes	Repairs	Total
Buildings 1800 sqft	63,000	30		3,982	258	315	1,260	5,816
Drip Irrigation (10 acres)	15,500	40		873	64	78	310	1,324
Orchard Establishment (10 acres)	65,088	36		3,808	267	325	325	4,725
Fuel Tanks 2-250g	3,500	40	350	194	16	19	70	299
Gypsum Machine (1)	6,000	5		1,376	25	30	120	1,551
Land (65 acres)	487,500	40	487,500	23,156	0	4,875	0	28,031
Shop Tools	15,000	15		1,421	62	75	300	1,857
Wind Machine (6)	140,400	20	14,040	10,593	633	772	2,808	14,806
TOTAL INVESTMENT	795,988		501,890	45,403	1,324	6,489	5,193	58,409

ANNUAL BUSINESS OVERHEAD COSTS

Description	Units/ Farm	Unit	Price/ Unit	Total Cost
Liability Insurance	60	acre	10.35	621
Office Expense	60	acre	125.00	7,500

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Table 8. HOURLY EQUIPMENT COSTS

SAN JOAQUIN VALLEY - SOUTH 2009

			COSTS PER HOUR						
				Cash Overhead		Operating			
Yr	Description	Actual Hours Used	Capital Recovery	Insur-ance	Taxes	Repairs	Fuel & Lube	Total Oper.	Total Costs/Hr.
09	ATV 4WD	133	2.59	0.15	0.18	0.64	0.77	1.41	4.33
09	Pickup Truck 1/2 Ton	265	9.00	0.41	0.50	2.36	9.66	12.02	21.93
09	Weed Sprayer-Pull, ATV 55 gal	75	1.55	0.09	0.11	0.65	0.00	0.65	2.40

UC COOPERATIVE EXTENSION

Table 9. OPERATIONS WITH EQUIPMENT & MATERIALS

SAN JOAQUIN VALLEY - South 2009

Operation	Operation Month	Tractor	Implement	Field Labor Hr/Acre	Material	Broadcast Rate/Acre	Unit
Frost Protection (water & wind machine)	Jan			0.70	Water	0.73	acin
					Wind Machine	33.00	hr
	Nov			0.70	Water	0.73	acin
					Wind Machine	33.00	hr
	Dec				Water	0.74	acin
					Wind Machine	33.00	hr
Fertilize: N (through drip line)	Feb			0.10	UN32	26.60	lb N
	Mar			0.10	UN32	26.70	lb N
	Apr			0.10	UN32	26.70	lb N
Weed: Pre-emergent (Princep, Karmex) 2X	Mar	ATV	Weed Sprayer		Princep	2.00	lb
					Karmex	2.00	lb
	Oct	ATV	Weed Sprayer		Princep	2.00	lb
					Karmex	2.00	lb
Insect/Fertilizer: Orangeworm (Dipel)/ Foliar (N, Mn, Zn)	Mar	Custom			Dipel	2.00	pt
					Urea LB	15.00	lb N
					Zinc Sulfate	2.00	lb
					Tecmangam (Mn)	2.00	lb
Irrigate	Apr			0.50	Water	3.50	acin
	May			0.80	Water	4.00	acin
	June			1.00	Water	5.00	acin
	July			1.10	Water	6.50	acin
	Aug			1.00	Water	5.00	acin
	Sept			0.80	Water	4.00	acin
	Oct			0.30	Water	2.00	acin
Prune: Top Trees, Stack & Shred Prunings 1X/4 Yr	Apr	Custom					
Prune: Hedge Alt. Rows, Shred Prunings 2X/4Yr	Apr	Custom					
Prune: Hand Prune & Stack, Shred Prunings 1X/4 Yr	Apr	Custom					
Soil Amendment:(Soluble Gypsum) w/irrigation	Apr			1.30	Gypsum	0.11	ton
	May			1.30	Gypsum	0.14	ton
	June			1.30	Gypsum	0.17	ton
	July			1.30	Gypsum	0.21	ton
	Aug			1.30	Gypsum	0.17	ton
	Sept			1.30	Gypsum	0.14	ton
	Oct			1.30	Gypsum	0.06	ton
Weed: Spot Spray (Roundup) 3X	Apr	ATV	Weed Sprayer		Roundup	0.20	pt
	June	ATV	Weed Sprayer		Roundup	0.20	pt
	Aug	ATV	Weed Sprayer		Roundup	0.20	pt

UC COOPERATIVE EXTENSION

Table 9. continued

SAN JOAQUIN VALLEY - South 2009

Operation	Operation Month	Tractor	Implement	Field Labor Hr/Acre	Material	Broadcast Rate/acre	Unit
Insect/Fertilizer: Thrips, Katydid (Success, Oil) /N	May	Custom			Success	6.00	oz
					415 Oil	0.50	gal
					Urea LB	15.00	lb N
Insect: Thrips (Success, Oil)	June	Custom			Success	6.40	oz
					415 Oil	0.50	gal
Insect: Scale (Esteem)	July	Custom			Esteem	17.00	floz
Leaf Analysis (1 sample/10 acres)	July	Custom		0.10	Analysis	31.00	ea
Disease: Brown Rot (Lime, Kocide)	Oct	Custom			Lime	10.00	lb
					Kocide	10.00	lb
Growth Regulator: (Fruit Fix) [Navel Only]	Oct	Custom			Fruit Fix	2.50	floz
Growth Regulators: (GibGro or GA) [Navel Only]	Nov	Custom			Gib Gro	40.00	gram
Harvest: Pick & Haul	Feb	Custom				229.00	crtn
	Apr	Custom				228.00	crtn
	Nov	Custom				229.00	crtn
Harvest: Pack	Feb	Custom				183.00	crtn
	Apr	Custom				183.00	crtn
	Nov	Custom				184.00	crtn

Nut Crops

Impact of Almond Chips/Shreddings in the Orchard to an Almond Huller

In discussions with almond hullers, the impact of almond prunings or chips has been problematic. These chips are picked up with the almonds during the harvest process. These chips pass by the "detwiggers" which remove the larger sticks and branches that may get knocked down during the typical harvest process (shaking, sweeping and pick-up). Almond hullers/shellers separate the hull and shell from the almonds. The hull has significant feed value to dairies, and hulls with 15% fiber content or less are considered "prime hull" and receive the highest value. The next product is "hull and shell" which is limited to a fiber content of between 15% and 29%. And lastly, the shell or any product that has > 29% fiber content has little value and hardly any market. The almond hullers we spoke with estimate a 5% to 11% loss in prime hull revenue due to the presence of chips. Obviously, prices vary from year to year, but prime hull sells for significantly more than hull and shell.

For example, when we conducted the survey last year for the purposes of developing comments for this rule, prime hull was selling for $75 per ton, while hull and shell was selling for $45 to $50 per ton. Chips are high fiber content and when picked up with the hulls during the hulling process, they can significantly shift the fiber content. One huller estimated that he 4,000 tons out of 35,000 expected tons were shifted from "prime hull" to "hull and shell" due to the existence of chips. This was an 11.4% loss amounting to $120,000 in lost revenue. Another huller lost an estimated 5% of their "prime hull sales" due to the existence of the chips.

Impact of Walnut Prunings Being Shredded or Chipped in the Orchard

In discussions with walnut growers and walnut processors, the primary issue is plugging of the chips in the lines at the processor, especially under wet conditions. Walnuts are typically harvested from mid September through mid November. About half of the time, fall rains begin before the harvest can be completed. Since the prunings occur in the winter, it is impossible to get a chipper into the orchard until after the rains subside. The chips do not decompose in the 6 to 7 months between the pruning and the beginning of harvest. This is where the plugging occurs. The wet chips impede the ability to move the walnuts through the ductwork at a huller/dehydrator and processor, as the chips are picked up with the walnuts.

Walnut processors have also expressed concern with the chips being left in the orchard due to concerns over food safety. Since the chips are an organic material, they are subject to mold growth. If this mold is picked up during harvest, it can create a significant food safety issue in terms of the potential for aflatoxin. Food safety has become the number one issue of concern for the tree nut industry, and any issue that would confound food safety would be problematic.

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Diseased Crops

County of Fresno

DEPARTMENT OF AGRICULTURE
CAROL N. HAFNER
AGRICULTURAL COMMISSIONER/
SEALER OF WEIGHTS & MEASURES

Date: January 27, 2010

To: Manuel Cunha, Nisei Farmers League

From: Carol Hafner, Agricultural Commissioner/Sealer

Subject: Control Measures for Fireblight, *Erwinia amylovora*

Fireblight, *Erwinia amylovora*, is a bacterial disease that infects apples, pears, quince, raspberries and other plants in the Rosaceae family. This disease can destroy an entire orchard in a single season if left uncontrolled. The bacterium can be easily transmitted to susceptible tissue by contact. The unrestricted movement of infected tissue will cause the disease to spread rapidly and under certain environmental conditions (hot and wet). Containment of the infected tissue is an essential element for control. Options for controlling this disease that is becoming resistant to chemical means of control with Streptomycin are burning on site or disposal by placing infected plant material in double plastic bags for burial.

1730 S. Maple Avenue / Fresno, California 93702-4596 / (559) 456-7510
http://www.co.fresno.ca.us/fresnoag – fresnoag@co.fresno.ca.us

Raisin Trays

Raisin Tray Paper Volume History

Year

1990 – Raisin production 395,000 tons minus 5% mechanized (DOV)

375,000 tons produced on trays @ 4# tray =

188,000,000 million trays

2000 – Raisin production 432,000 tons minus 10% mechanized (DOV and continuous)

389,000 tons produced on trays @ 4#=

195,000,000 million trays

2009 – Raisin production 300,000 tons minus 40% mechanized (DOV and continuous)

180,000 tons produced on trays @ 4#=

90,000,000 million trays

2010 – Recommended practices for burning of raisin trays:

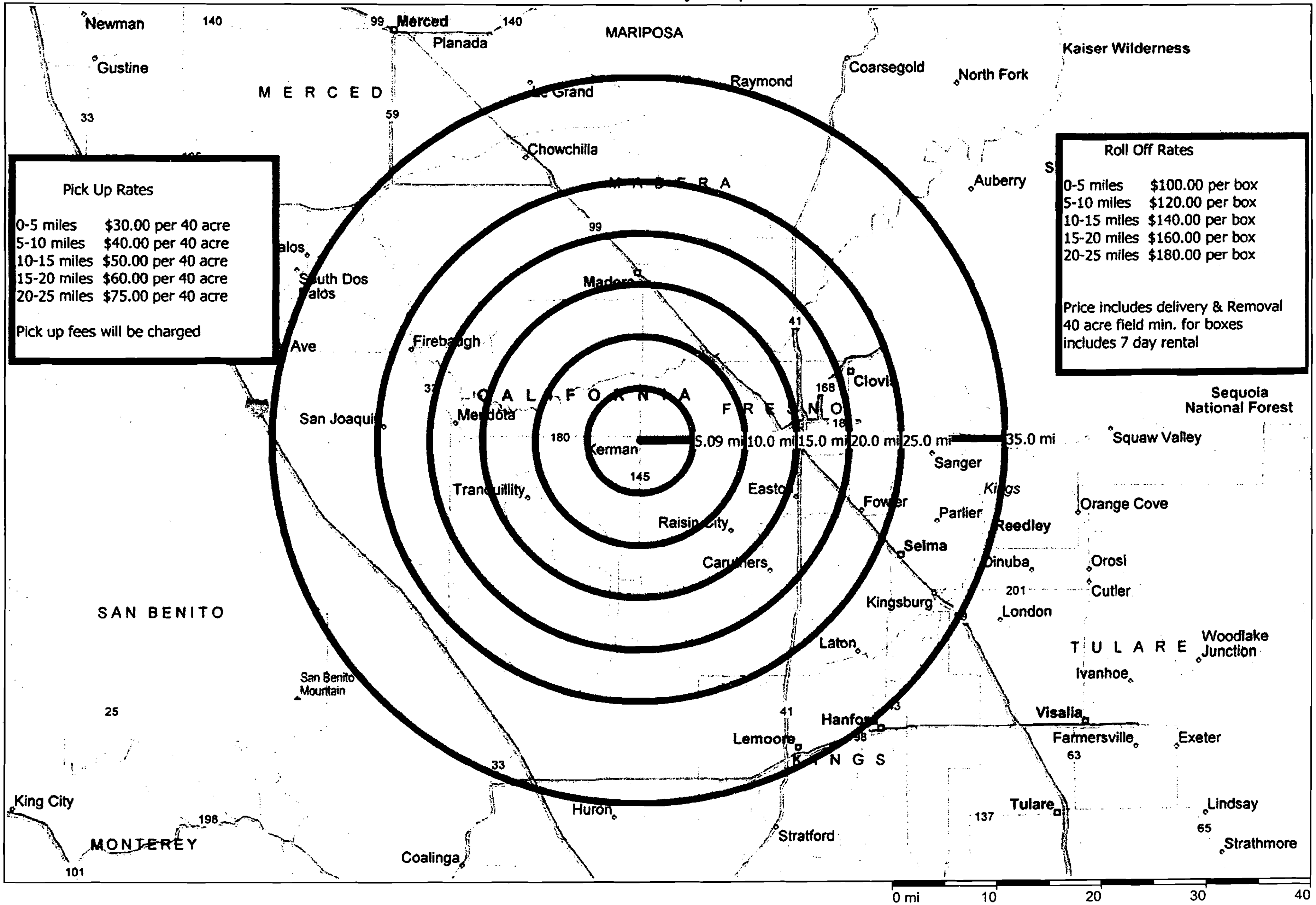
- **All burning locations must be attended at all times** when the paper raisin trays are burning, by able bodied adults with adequate tools or equipment to control a fire from escaping.
- **All burn locations must have adequate clearance to avoid escape**. The burn area should be a "fire safety zone" away from dry fields, homes, shops, garages, utility poles or utility supply lines, and other buildings or equipment. A rule to remember is to remove all combustible materials from 30 or more feet around the burn area.

- **Paper raisin trays must be burned in a container** to avoid escape of burning embers or ash, such as a wire cage. A wire cage may be constructed out of hardware cloth or chicken wire provided that the mesh is no larger than a ½ inch opening. The cage should never be filled beyond half and should be placed in a "fire safe zone". Using a burn barrel for burning anything is illegal.

- **Don't burn on windy days.**

- **Avoid burning near a highway or roadway**. Ashes or heavy smoke can create a very dangerous situation for drivers and winds caused by vehicles could cause the fire to escape from the fire safety zone.
- **Don't cause a smoke nuisance to your neighbors.**
- **Additional measures for further discussion**

Raisin Tray Map



Pick Up Rates

0-5 miles	$30.00 per 40 acre
5-10 miles	$40.00 per 40 acre
10-15 miles	$50.00 per 40 acre
15-20 miles	$60.00 per 40 acre
20-25 miles	$75.00 per 40 acre

Pick up fees will be charged

Roll Off Rates

0-5 miles	$100.00 per box
5-10 miles	$120.00 per box
10-15 miles	$140.00 per box
15-20 miles	$160.00 per box
20-25 miles	$180.00 per box

Price includes delivery & Removal
40 acre field min. for boxes
includes 7 day rental

STATE WATER RESOURCES CONTROL BOARD

PORTER-COLOGNE WATER QUALITY CONTROL ACT

WITH ADDITIONS AND AMENDMENTS EFFECTIVE JANUARY 1, 2010

Compiled by the Office of Chief Counsel
State Water Resources Control Board
Additions and amendments from the 2009 legislative session are underlined
deletions are in strikeout
An official copy of the current Water Code is available at
http://leginfo.ca.gov/calaw.html
Every effort has been made to ensure the accuracy of this document.
Please report errors to: Philip G. Wyels, Assistant Chief Counsel
pwyels@waterboards.ca.gov
(916) 341-5178

For an electronic copy of the State Water Resources Control Board Porter – Cologne Water Quality Control Act please refer to the SWRCB website at:

http://www.swrcb.ca.gov/laws_regulations/docs/portercologne.pdf