AGRICULTURAL IMPACT ANALYSIS METHODOLOGY

SANTA ROSA SUBREGIONAL LONG-TERM WASTEWATER PROJECT

Prepared for

City of Santa Rosa
and
U.S. Army Corps of Engineers

MAY 1996

Prepared by

ECONOMIC & PLANNING SYSTEMS, INC.

For

HARLAND BARTHOLOMEW & ASSOCIATES, INC.

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INTRODUCTION

In the context of this study the impact is defined as a net change in agricultural production and gross income resulting from the availability of reclaimed water for agricultural irrigation. In this instance the impacts being described are all positive impacts that result in increased agricultural production and sales. The following sections describe the methodology used to measure production and income related impacts on the Sonoma and Marin agricultural economy and present the major findings and conclusions. The effects of purchases of production supplies and services on the local economy are not described in this document.

In order to test the economic viability of project irrigation alternatives, a set of "cropping scenarios" were developed for the one, five and ten percent Russian River discharge alternatives (Technical Memorandum *"Cropping Scenarios for the West County and South County Reclamation Alternatives"* dated January 10, 1996). The cropping scenarios reflect soil capabilities, soil limitations, and cropping restrictions as defined in the *Irrigation Suitability Technical Report* and the *Irrigation Management Plan* (**Tables A-1, A-2** and **A-3**). Five levels of farming intensity were considered:

- vineyards and orchards;
- berry crops such as strawberries, blueberries, and raspberries;
- vegetable crops such as cool season vegetables (onions, Swiss chard, lettuce, broccoli, green beans);
- forage, hay, or silage crops (irrigated hay, Sudan grass, field corn); and
- improved irrigated permanent pasture (with cross fencing for rotational management).

The cropping scenarios represent progressive levels of farming intensity. In general, the higher the farming intensity the more inputs of labor and management are required and the commodity grown can generate higher potential income per acre. The more intensively farmed crops require higher capability soils and/or greater attention to soil management and erosion control. Three cropping scenarios were developed which arrayed the available irrigable acreage among the five technical levels of farming intensity. The cropping scenarios are designed to test composite area-wide farming intensities with different degrees of investment (management and labor) and potential income generation.

The purpose of this assessment is to determine whether agricultural irrigation is a long-term viable option for the project. The economic viability will depend on the potential benefits to farmers of using reclaimed water and on the long-term prospects for the agricultural industry in Sonoma County. The project needs to have a guaranteed method of disposing reclaimed water. Also, because the costs of water storage facilities are high, there must be some certainty that there will be a long-term and stable demand for the reclaimed water along with a potential for cost recovery and cost justification.

Table A-1
Cropping Scenarios by Alternative for the 1% Discharge
Santa Rosa Subregional Long-Term Wastewater Project

Alternative/Crop Type	Low Tech Scenario Acres	Medium Tech Scenario Acres	High Tech Scenario Acres
West County Reclamation			
Berry Crops	0	450	2,000
Vegetable Crops	200	600	1,500
Forage/Hay/Silage	900	2,750	2,300
Irrigated Pasture	4,500	2,400	1,000
Total	5,600	6,200	6,800
West County with Sebastopol			
Apples (1)	1,600	1,600	1,600
Vineyards (1)	600	600	600
Berry Crops	0	300	1,350
Vegetable Crops	100	450	1,200
Forage/Hay/Silage	950	2,000	1,300
Irrigated Pasture	2,850	1,550	750
Total	6,100	6,500	6,800
South County Reclamation			
Vineyards	0	300	1,300
Berry Crops	0	250	900
Vegetable Crops	200	800	900
Forage/Hay/Silage	800	1,300	800
Irrigated Pasture	2,400	1,150	300
Total	3,400	3,800	4,200
South County with Sebastopol			
Apples (1)	1,600	1,600	1,600
Vineyards (1)	600	600	600
Vineyards	0	250	600
Berry Crops	0	200	600
Vegetable Crops	200	600	1,100
Forage/Hay/Silage	600	1,100	400
Irrigated Pasture	1,500	450	200
Total	4,500	4,800	5,100

(1) Existing irrigated vineyards and orchards in Sebastopol.

Source: Technical Memorandum "Cropping Scenarios for the West County and South County Reclamation Alternatives", dated January 10, 1996 from Jeffrey Peters, Questa Engineering.

Table A-2
Existing Conditions by Reclamation Alternative for the 1% Discharge
Santa Rosa Subregional Long-Term Wastewater Project

Alternative/Crop Type	Existing Crop Production Acres
West County Reclamation	
Berry Crops	0
Vegetable Crops	150
Dry-farmed Hay/Silage	2,050
Native Pasture/Range	4,000
Total	6,200
West County with Sebastopol	
Apples (1)	1,600
Vineyards (1)	600
Berry Crops	0
Vegetable Crops	50
Dry-farmed Hay/Silage	1,300
Native Pasture/Range	2,950
Total	6,500
South County Reclamation	
Vineyards	200
Berry Crops	0
Vegetable Crops	150
Dry-farmed Hay/Silage	2,200
Native Pasture/Range	1,250
Total	3,800
South County with Sebastopol	
Apples (1)	1,600
Vineyards (1)	600
Vineyards	0
Berry Crops	0
Vegetable Crops	100
Dry-farmed Hay/Silage	1,600
Native Pasture/Range	900
Total	4,800

(1) Existing vineyards and orchards in Sebastopol.

Source: Technical Memorandum "Cropping Scenarios for the West County and South County Reclamation Alternatives", dated January 10, 1996 from Jeffrey Peters, Questa Engineering.

Table A-3
Net Adjusted Irrigated Acres by Alternative and Crop Type for the 1% Discharge Santa Rosa Subregional Long-Term Wastewater Project

Alternative/Crop Type/ Cropping Scenario	Low Tech Scenario Acres	Medium Tech Scenario Acres	High Tech Scenario Acres
West County Reclamation			
Berry Crops	0	450	2,000
Vegetable Crops	50	450	1,350
Forage/Hay/Silage (1)	900	2,750	2,300
Irrigated Pasture (2)	4,500	2,400	1,000
Total (5)	5,450	6,050	6,650
West County with Sebastopol			
Apples (3)	1,600	1,600	1,600
Vineyards (4)	0	0	0
Berry Crops	0	300	1,350
Vegetable Crops	50	400	1,150
Forage/Hay/Silage (1)	950	2,000	1,300
Irrigated Pasture (2)	2,850	1,550	750
Total (5)	5,450	5,850	6,150
South County Reclamation			
Vineyards	0	100	1,100
Berry Crops	0	250	900
Vegetable Crops	50	650	750
Forage/Hay/Silage (1)	800	1,300	800
Irrigated Pasture (2)	2,400	1,150	300
Total (5)	3,250	3,450	3,850
South County with Sebastopol			
Apples (3)	1,600	1,600	1,600
Vineyards (4)	0	0	0
Vineyards	0	250	600
Berry Crops	0	200	600
Vegetable Crops	100	500	1,000
Forage/Hay/Silage (1)	600	1,100	400
Irrigated Pasture (2)	1,500	450	200
Total (5)	3,800	4,100	4,400

(1) Irrigated pasture represents a new use so these acres are not subtracted from existing native pasture/rangeland.

(2) Irrigated forage/hay/silage represents a new use so these acres are not subtracted from existing dry-farmed hay/silage.

(3) Existing orchards in Sebastopol. These existing acres are included in order to estimate increased yields due to irrigation.

(4) No net increase in the number of vineyards in Sebastopol are assumed as a result of irrigation.

(5) Where there are existing similar uses in the project areas these acres are subtracted from the new irrigated acres except where noted above.

Source: Technical Memorandum "Cropping Scenarios for the West County and South County Reclamation Alternatives", dated January 10, 1996 from Jeffrey Peters, Questa Engineering.

The low technology scenario envisages a minimum level of labor and capital input and consequently the lowest return per acre on investment. In the low technology scenario, the majority of acreage would be used for irrigated pasture and a minimum amount of acreage would be used for higher value crops such as berry and vegetable crops. The medium technology cropping scenario envisages less irrigated pasture and more acres in forage crops such as oat hay and corn silage. The high technology cropping scenario envisages more acreage in berry and vegetable crops and less in irrigated pasture and forage crops (**Table A-3**). The acreage shown in **Table A-3** represents net adjusted acreages by cropping scenario and Alternative. Where appropriate, existing acreage under production was subtracted from the total irrigated acreage in order to estimate the net impact of the new agricultural production.

The analysis was completed only for the one percent (largest irrigation acreage) project alternative. Since production is directly related to acreages, and the five percent and ten percent alternatives have acreages about 48.5 percent and 64.5 percent respectively of the one percent alternative, the economic benefits will roughly be in the same proportion. The following section describes how the net new acres were estimated for each crop type.

APPLES

All existing apple orchard acres in the Sebastopol area were included in order to estimate the potential increase in yields due to the availability of reclaimed water for irrigation. The gross value per apple orchard acre was adjusted to reflect the net increase in value that could occur over and above the value of the existing dry-farmed apple yields in the Sebastopol area.

WINE GRAPES, BERRY AND VEGETABLE CROPS

Where the project areas have existing irrigated uses such as fruit and vegetable crops and/or vineyards, these existing acres were subtracted from the total acreage proposed under each cropping scenario so as to capture the net impact of the proposed water use on the agricultural economy.

FORAGE CROPS

In the case of dry-farmed oat hay, it was assumed that in most cases farmers would continue to raise a winter crop of oat hay and, with the availability of reclaimed water for irrigation, would add a summer crop of Sudan grass or corn. Therefore, land in the project areas currently used for dry-farmed oat hay was not subtracted from the total acreage proposed for irrigated forage under each cropping scenario. In practice farmers may choose to grow two irrigated crops per year. However for the sake of simplicity it was assumed that the net impact would be equivalent to adding one summer crop of forage while maintaining an existing winter crop of dry-farmed oat hay.

IRRIGATED PASTURE

Land in the project areas that is currently used for dry native pasture or rangeland was not subtracted from the total acreage proposed for irrigated pasture under each cropping scenario. The capacity of pasture to support animal units can improve between three and four fold when dry-pasture is irrigated. The gross value of the new pasture was reduced to account for the current value of native pasture. The Sonoma County Agricultural Commissioner's Office estimates that the value of native pasture is equal to about $100 per acre (*Agricultural Crop Report Sonoma County 1994*). In order to estimate the net increase in value of irrigated pasture, which is a permanent year round use, the value of the new irrigated pasture was reduced by $100 per acre to account for the existing value of the native pasture. In reality some of the land that could be irrigated in the project areas, may currently be under-utilized or fallow, in which case 100 percent of the new value created by irrigation would be captured by the local economy.

Average irrigated crop yields and gross crop values per ton were estimated for each crop by cropping scenario and Alternative so as to measure the potential net new benefit to the local agricultural economy. The following section describes how the reclaimed water for irrigation could increase production and how the market might respond to these changes. Estimates of the value of the increased crop production are described by crop type.

INCOME PROJECTION AND MARKET RESPONSE BY CROP

DAIRY FORAGE AND PASTURE SUPPLY

Dairy Forage Crops

In order to estimate the potential increased production in forage crops, a prototypical distribution of forage crops was used to estimate yields and crop values for the additional irrigated forage acreage under each cropping scenario and Alternative. It was assumed that on average farmers in the project areas would grow approximately 25 percent oat hay; 35 percent oat silage; 30 percent corn silage or Sudan grass; and 10 percent green chop. Based on this prototypical forage crop distribution weighted average yields per acre, dry weight equivalents, and gross values per ton were estimated (**Table A-4**). For the purposes of this analysis it was assumed that the West County project area crop yields would be on average 85 percent of countywide crop yields due to the cooler climate and shorter growing season (**Table A-5**). As the South County has a more moderate climate and warmer temperatures, Countywide average crop yields were applied in the South County project area.

The new irrigated acres devoted to forage crops, as provided by Questa Engineering, were multiplied by the weighted average yields of 11.7 and 13.7 tons per acre to estimate total forage production for the West Country and South County Alternatives respectively by cropping scenario (**Table A-6**). Total tons of forage produced were multiplied by 46 percent to estimate the dry weight equivalent of the forage mix (assumes that 54 percent of every ton of forage mix is water content). The dry weight equivalent for forage was then added to the new irrigated pasture dry weight equivalent to estimate the total increase in local dairy feed available as a result of irrigation.

Irrigated Pasture

Using factors of 5.1 and 6.0 tons of dry matter equivalent per acre for irrigated pasture yields, tons of animal feed production were estimated for the West and South County Alternatives respectively (**Table A-7)**. For the purposes of this study it was assumed that approximately 70 percent of the irrigated pasture would be used for dairy cattle and about 30 percent would be used for non-dairy animals such as beef cattle, sheep, and horses in the West County. In the South County, where there are fewer dairies and more beef cattle, sheep, and horses, it was assumed that 30 percent of the irrigated pasture would be used for dairy cattle and the remaining 70 percent would be used for non-dairy animals (**Table A-8**).

Table A-4
Forage Distribution - Gross Values per Ton, Yields, and Dry Weight Equivalents for South County
Santa Rosa Subregional Long-Term Wastewater Project

Item	Mix (1)	Gross Value Per Ton (2)	Weighted Average Gross Value Per Ton	Irrigated Yields Tons per Acre (3)	Weighted Average Tons per Acre	Dry Weight Percentage	Weighted Average Dry Weight Equivalent
Composition of Forage Grown							
Oat Hay	25%	$59.50	$14.87	5.00	1.25	90%	23%
Oat Silage (4)	35%	$36.14	$12.65	14.98	5.24	33%	12%
Corn/Sudan Grass Silage (4)	30%	$40.34	$12.10	19.77	5.93	33%	10%
Green Chop/Misc (4)	10%	$16.63	$1.66	12.98	1.30	20%	2%
Total Forage Distribution	100%		$41.29		13.72		46%

(1) Forage distribution is a representative mix of forage crops likely to be grown in Sonoma County throughout the irrigation areas.

(2) Crop values are based on a five year average from the Sonoma Agricultural Crop Reports 1990-1994 (See Table A-18).

(3) Crop yields assume one summer crop per year. Based on a five year average yield from the Sonoma Agricultural Crop Reports 1990-1994.

(4) Much of the green chop and silage is not sold but used on the farm. The value is determined by its feed equivalent of alfalfa hay after it is cut, loaded and ensiled (Sonoma Agricultural Crop Report, 1994)

Sources: Sonoma Agricultural Crop Reports 1990-1994; Economic & Planning Systems, Inc.

Table A-5
Forage Distribution - Gross Values per Ton, Yields, and Dry Weight Equivalents for West County
Santa Rosa Subregional Long-Term Wastewater Project

Item	Mix (1)	Gross Value Per Ton (2)	Weighted Average Gross Value Per Ton	Irrigated Yields Tons per Acre (3),(5)	Weighted Average Tons per Acre	Dry Weight Percentage	Weighted Average Dry Weight Equivalent
Composition of Forage Grown							
Oat Hay	25%	$59.50	$14.87	4.25	1.06	90%	23%
Oat Silage (4)	35%	$36.14	$12.65	12.73	4.46	33%	12%
Corn/Sudan Grass Silage (4)	30%	$40.34	$12.10	16.80	5.04	33%	10%
Green Chop/Misc (4)	10%	$16.63	$1.66	11.03	1.10	20%	2%
Total Forage Distribution	100%		$41.29		11.66		46%

(1) Forage distribution is a representative mix of forage crops likely to be grown in Sonoma County throughout the irrigation areas.

(2) Crop values are based on a five year average from the Sonoma Agricultural Crop Reports 1990-1994 (See Table A-19).

(3) Crop yields assume one crop per year.

(4) Much of the green chop and silage is not sold but used on the farm. The value is determined by its feed equivalent of alfalfa hay after it is cut, loaded and ensiled (Sonoma Agricultural Crop Report, 1994)

(4) West County forage crop yields are assumed to be 0.85 of average countywide crop yields due to the cooler climate.

Table A-6
Potential New Irrigated Forage (TDME) Under the 1% Discharge Alternative by Cropping Scenario
Santa Rosa Subregional Long-Term Wastewater Project

Alternative/ Cropping Scenario	Acres of Irrigated Forage			Tons of Forage Produced (1),(2)			Tons of TDME Produced (3)		
	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech
West County	900	2,750	2,300	10,496	32,071	26,823	4,823	14,736	12,325
West County with Sebastopol	950	2,000	1,300	11,079	23,324	15,161	5,091	10,717	6,966
South County	800	1,300	800	10,976	17,836	10,976	5,043	8,196	5,043
South County with Sebastopol	600	1,100	400	8,232	15,092	5,488	3,783	6,935	2,522

(1) For West Co. assumes that 11.66 tons per acre. This repesents a weighted average for oay hay, oat silage, corn silage and green chop (See Table A-5).
(2) For South Co. assumes that 13.72 tons per acre. This repesents a weighted average for oay hay, oat silage, corn silage and green chop (See Table A-4).
(3) Assumes 46% dry weight. This represents a weighted average for oay hay, oat silage, corn silage and green chop (See Table A-4 and Table A-5).
TDME = Total Dry Matter Equivalent.

Sources: Sonoma Agricultural Crop Reports 1990-1994; Economic & Planning Systems, Inc.

Table A-7
Potential New Irrigated Pasture (TDME) under 1% Discharge Alternative by Cropping Scenario
Santa Rosa Subregional Long-Term Wastewater Project

Alternative/ Cropping Scenario	Acres of Irrigated Pasture			Tons of TDME of Feed Produced (1), (2)		
	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech
West County	4,500	2,400	1,000	22,950	12,240	5,100
West County with Sebastopol	2,850	1,550	750	14,535	7,905	3,825
South County	2,400	1,150	300	14,400	6,900	1,800
South County with Sebastopol	1,500	450	200	9,000	2,700	1,200

(1) Assumes 5.10 tons of dry matter equivalent per acre in the West County due to cooler climate.
(2) Assumes 6.00 tons of dry matter equivalent per acre in the South County.
TDME = Total Dry Matter Equivalent.
Sources: Rick Bennett, UC Cooperative Extension; Jeffrey Peters, Questa Engineering Corporation, and Economic & Planning Systems, Inc.

Table A-8
Potential New Irrigated Pasture (TDME) Produced for Dairy Cattle
Santa Rosa Subregional Long-Term Wastewater Project

Alternative/ Cropping Scenario	Tons of Dry Matter Equivalent (1), (2) Low Tech	Medium Tech	High Tech
West County	16,065	8,568	3,570
West County with Sebastopol	10,175	5,534	2,678
South County	4,320	2,070	540
South County with Sebastopol	2,700	810	360

(1) For West Co. assumes that 70% of all irrigated pasture produced will be used to feed dairy
(2) For South Co. assumes that 30% of all irrigated pasture produced will be used to feed dairy

Sources: Vern Marble, Ph.D., Agronomist, Jeffrey Peters, Questa Engineering Corporation, and Economic & Planning Systems, Inc.

Total New Dairy Feed

The total dry matter equivalent (TDME) of new irrigated forage crops and irrigated pasture was summed for each cropping scenario and Alternative. The West County Alternative was estimated to produce between 15,900 and 23,300 tons of dairy feed (TDME) per year depending on the cropping scenario (**Table A-9**). The South County Alternative was estimated to produce between approximately 5,600 and 10,300 tons of dairy feed (TDME) per year depending on the cropping scenario (**Table A-9**).

DAIRY FORAGE AND PASTURE DEMAND

In order to estimate the demand for dairy feed, all the milk cows in Sonoma and Marin Counties were considered to be part of the forage market area. It is generally considered to be economic to transport forage over a distance of about ten miles, whereas green chop and pasture would mainly be consumed on the farm. A ten mile radius was drawn from the perimeter of the project areas and it was determined that forage grown in the West County project area could reasonably be expected to be transported to all dairies in Sonoma County except for the four dairies in and near to the South County project area. Forage grown in the South County project area could reasonably be transported to all the dairies in Marin County in addition to the approximately four dairies in and close to the South County project area.

It is estimated that an average 1,400 pound milk cow requires 45 pounds of total dry matter equivalent (TDME) of which about 18 pounds of TDME per day must be from high protein concentrate.[1] It can be assumed therefore, that the remaining 27 pounds of TDME could be provided by a mixture of forage crops such as oat hay, silage, green chop and/or pasture. Based on these dairy feed factors it was estimated that the approximately 36,600 Sonoma County milk cows (less those in the South County project area would require approximately 180,300 tons of forage (TDME) per year (**Table A-10**). It was also estimated that the approximately 14,600 Marin County and Sonoma South County project area milk cows would require approximately 72,000 tons of forage (TDME) per year (**Table A-11**).

COMPARISON OF SUPPLY AND DEMAND FOR DAIRY FEED

When the total new supply of locally produced dairy feed (TDME) is compared to the total dairy demand it can be seen that the supply as a percent of demand is 14 percent or less in all cases (**Table A-12**). The total supply of new dairy feed converted to TDME represents between 9 and 13 percent of total demand in the West County, while the total TDME of new dairy feed represents between 8 and 14 percent of total demand in the South County (**Table A-12**). If irrigation water is available, and farmers choose to grow local forage crops and irrigated pasture, these preliminary results suggest that there is more than adequate demand for the new supply of dairy feed, under all Alternatives and cropping scenarios.

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[1] R. H. Bennett, Ph.D., dairy adviser, Cooperative Extension for Sonoma County, University of California. Telephone conversation November 14, 1995.

Table A-9
Potential Total New Dairy Feed in Dry Matter Equivalent (TDME) by Alternative
Santa Rosa Subregional Long-Term Wastewater Project

Alternative/ Cropping Scenario	Tons of Pasture TDME (1)			Tons of Forage TDME (2)			Tons of Pasture and Forage (TDME)		
	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech
West County	16,065	8,568	3,570	4,823	14,736	12,325	20,888	23,304	15,895
West County with Sebastopol	10,175	5,534	2,678	5,091	10,717	6,966	15,265	16,251	9,644
South County	4,320	2,070	540	5,043	8,196	5,043	9,363	10,266	5,583
South County with Sebastopol	2,700	810	360	3,783	6,935	2,522	6,483	7,745	2,882

TDME = Total Dry Matter Equivalent

(1) See (Table A-8).

(2) See (Table A-6).

Table A-10
Demand for Dairy Feed in Western Sonoma County
Santa Rosa Subregional Long-Term Wastewater Project

Item	Factor	Note	Pounds of Dry Matter Per Day	Tons of Dry Matter Per Day	Tons of Dry Matter Per Year
Number of Milk Cows	36,600	(1)			
Feed Required per Cow Day (lbs/tons of TDME)	45.00	(2)	1,647,000	824	300,578
less: Concentrate per Cow Day (lbs/tons of TDME)	18.00	(3)	658,800	329	120,231
Net Feed Required per Cow Day (lbs/tons of TDME)	27.00		988,200	494	180,347
Total Milk Cow Demand for Feed (tons per year)					**180,347**

(1) Includes all dairy cows in Sonoma County less approx. 1,400 milk cows in the South County reclamation area.
(2) TDME = Total Dry Matter Equivalent
(3) Assumes that a 1,400 lb. dairy cow requires 18 TDME lbs per day of concentrate in addition to forage or pasture.

Sources: Sonoma Agricultural Crop Report 1994; Dr. Vern Marble Agronomist; Dr. Rick Bennett, Dairy Adviser, UC Extension

Table A-11
Demand for Dairy Feed in Marin and Southern Sonoma County
Santa Rosa Subregional Long-Term Wastewater Project

Item	Factor	Note	Pounds of Dry Matter Per Day	Tons of Dry Matter Per Day	Tons of Dry Matter Per Year
Number of Milk Cows	14,600	(1)			
Feed Required per Cow Day (lbs/tons of TDME)	45.00	(2)	657,000	329	119,903
less: Concentrate per Cow Day (lbs/tons of TDME)	18.00	(3)	262,800	131	47,961
Net Feed Required per Cow Day (lbs/tons of TDME)	27.00		394,200	197	71,942
Total Milk Cow Demand for Feed (tons per year)					**71,942**

(1) Includes all dairy cows in Marin County plus approx. 1,400 milk cows in the South County reclamation area.
(2) TDME = Total Dry Matter Equivalent
(3) Assumes that a 1,400 lb. dairy cow requires 18 TDME lbs per day of concentrate in addition to forage or pasture.

Sources: Sonoma Agricultural Crop Report 1994; Dr. Vern Marble Agronomist; Dr. Rick Bennett, Dairy Adviser, UC Extension

Table A-12
Comparison of Total New Dairy Feed Supply versus Demand by Alternative
Santa Rosa Subregional Long-Term Wastewater Project

Alternative	New Tons of Dairy Feed (TDME) (1)			Demand less Supply (2)			Supply as Percent of Demand		
	Low	Medium	High	Low	Medium	High	Low	Med.	High
West County	20,888	23,304	15,895	(159,459)	(157,042)	(164,452)	12%	13%	9%
West County with Sebastopol	15,265	16,251	9,644	(165,081)	(164,096)	(170,703)	8%	9%	5%
South County	9,363	10,266	5,583	(62,578)	(61,676)	(66,358)	13%	14%	8%
South County with Sebastopol	6,483	7,745	2,882	(65,459)	(64,197)	(69,060)	9%	11%	4%

TDME = Total Dry Matter Equivalent

(1) See Table A-9. Includes pasture and forage mix in dry matter equivalent.

(2) See Table A-10 and Table A-11 for demand for feed in dry matter equivalent.

ESTIMATED VALUE OF ALFALFA HAY IMPORT SUBSTITUTION

In order to estimate the gross value to the local economy of substituting alfalfa hay imports with locally produced feed crops, the amount of alfalfa hay replacement was calculated. Based on the TDME of local feed produced under each Alternative and the current price of alfalfa hay at $135 per ton, it was estimated that between $2.1 million and $3.1 million of gross savings could be made on alfalfa hay imports in the West County and between $750,000 and $1.4 million could be saved in the South County depending on the cropping scenario (**Table A-13**). The maximum value of alfalfa hay import substitution under the medium technology cropping scenario was estimated to be about $86 per cow per year in the West County and $95 per cow per year in the South County (**Table A-13**).

NON-DAIRY IRRIGATED PASTURE SUPPLY

For the purposes of this analysis it was assumed that 30 and 70 percent of irrigated pasture, in the West and South County respectively, could be used for non-dairy animals such as beef cattle, non-milking heifers and calves, sheep, and horses. The value of the new irrigated pasture was measured in terms of its value as a substitute for imported alfalfa hay. Irrigated pasture can produce about 16 Animal Unit Months (AUMs) [2], which is equivalent to 12,000 pounds of forage dry matter or about 4.5 tons of alfalfa hay at $135 per ton. Therefore, the gross value irrigated pasture is estimated to be about $608 per acre.[3]

The Sonoma County Agricultural Commissioner's office uses a factor of $100 per acre to estimate the gross value of native pasture. In order to net out the value of existing native pasture the $600 gross value per acre for irrigated pasture was reduced to about $508 per acre. This $508 per acre factor was applied in the South County Alternative. The gross value per acre for irrigated pasture was reduced by another 15 percent in the West County Alternative to account for the cooler weather and shorter growing season (**Table A-14**). Based on gross value factors of $430 and $508 per acre for the West and South County Alternatives respectively, the total value of new irrigated pasture was estimated to be in the range of $129,000 and $582,000 per year in the West County and between $107,000 and $853,000 per year in the South County depending on the cropping scenario (**Table A-14**).

[2] An Animal Unit Month (AUM) is the amount of feed required to maintain one animal unit for a period of 30 days.

[3] Memorandum dated December 12, 1995 from R. H. Bennett, Ph.D., dairy adviser, Coopertive Extension for Sonoma County, University of California.

Table A-13
Estimate of Alfalfa Hay Import Replacement by Alternatives
Santa Rosa Subregional Long-Term Wastewater Project

Alternative	Factor	West County			West County w/Sebastopol			South County			South County w/Sebastopol		
		Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
New Tons of Dairy Feed (TDME) (1) (Alfalfa Substitute)		20,888	23,304	15,695	15,265	16,251	9,644	9,363	10,266	5,563	6,483	7,745	2,882
Average Price of Alfalfa ($ per ton)	$135												
Total Gross Annual Value of Alfalfa Substitution		$2,819,857	$3,146,096	$2,145,825	$2,060,810	$2,193,870	$1,301,914	$1,264,070	$1,385,863	$753,770	$875,152	$1,045,546	$389,035
Annual Savings per Milk Cow (2)		$77.05	$85.96	$58.63	$56.31	$59.94	$35.57	$86.58	$94.92	$51.63	$59.94	$71.61	$26.65
Annual Savings per Average Dairy Herd (3)		$26,956	$30,086	$20,520	$19,707	$20,980	$12,450	$30,303	$33,223	$18,070	$20,980	$25,064	$9,326

TDME = Total Dry Matter Equivalent

(1) See Table A-9. Includes pasture and forage mix in dry matter equivalents.

(2) Assumes that there are 36,600 milk cows in the West County forage market area. (See Table Table A-10).
Assumes that there are 14,600 milk cows in the South County forage market area. (See Table Table A-11).

(3) Average size of a Sonoma Dairy herd is 350 cows.

Table A-14
Gross Value of New Irrigated Pasture (TDME) Produced for Non-Dairy Livestock
Santa Rosa Subregional Long-Term Wastewater Project

Alternative/ Cropping Scenario	Acres of Irrigated Pasture (1),(2) Low Tech	Medium Tech	High Tech	Gross Value of Pasture Produced (3),(4) Low Tech	Medium Tech	High Tech
West County	1,350	720	300	$582,356	$310,590	$129,413
West County with Sebastopol	855	465	225	$368,826	$200,589	$97,059
South County	1,680	805	210	$852,600	$408,538	$106,575
South County with Sebastopol	1,050	315	140	$532,875	$159,863	$71,050

(1) For West Co. assumes that 30% of all irrigated pasture produced will be used to feed cattle, horses, and sheep.
(2) For South Co. assumes that 70% of all irrigated pasture produced will be used to feed cattle, horses, and sheep.
(3) For West Co. assumes that $431 gross value per acre. This amount is net of the value of native pasture ($100 per acre).
(3) For South Co. assumes that $508 gross value per acre. This amount is net of the value of native pasture ($100 per acre).
Assumes that irrigated pasture produces 16 AUM or 12,000 lbs. of TDME forage per acre which is equivalent to 4.5 tons of alfalfa at $135 per ton.

Sources: Jeffrey Peters, Questa Engineering Corporation; Rick Bennett, UC Cooperative Extension; Sonoma Agricultural Crop Report 1994 and Economic & Planning Systems, Inc.

NON-DAIRY IRRIGATED PASTURE DEMAND

Assuming 16.00 AUMs[3] per acre the new irrigated pasture could support between 4,800 and 22,000 AUMs in the West County and between 3,400 and 27,000 AUMs in the South County depending on the cropping scenario (**Table A-15**). There are currently about 63,000 head of non-milk producing cattle and calves, 17,700 sheep and lambs, and 15,000 head of horses in Sonoma County[4] which combined make-up approximately 73,000 animal units (AUs).[5] While not all non-dairy animals are close enough to the project areas to take advantage of the new irrigated pasture it appears that there should be sufficient demand from cattle, sheep, and horse ranchers in and near the project areas to utilize the new irrigated pasture.

ESTIMATED VALUE OF NEW IRRIGATED PASTURE PRODUCTION

The total gross value to the local economy of the increased pasture production was estimated for each Alternative and cropping scenario. The gross value of irrigated pasture in dry matter equivalent was estimated at $608 per acre as described above. This $608 per acre factor was adjusted as described above to account for the value of existing native pasture and for climate differences between the West and South County. Using gross values of $430 and $508 per acre for the West and South County Alternatives respectively, the total value of the new irrigated pasture was estimated (**Table A-16**).

ESTIMATED VALUE OF NEW LOCAL DAIRY FEED PRODUCTION

The Sonoma County Agricultural Commissioner uses standard factors to convert oat and corn silage and green chop to alfalfa hay value equivalents. A weighted average gross value of $41 per ton was estimated based on a five year average of forage crop values per ton from the Sonoma Crop Reports 1990-1994 (**Tables A-4** and **A-5**). The weighted average value per ton of $41 was multiplied by the tons of new forage produced under each Alternative (**Table A-17**). The final combined gross value of both the new local forage crops and the new irrigated dairy pasture was estimated to be in the range of $1.4 million and $2.1 million in the West County and between $500,000 and $910,000 in the South County depending on the cropping scenario (**Table A-17**). Under the West County with Sebastopol Sub-Alternative, the gross value of total local dairy feed production ranged between $850,000 and $1.4 million and under the South County with Sebastopol Sub-Alternative, the gross value of total local dairy feed produced ranged between $260,000 and $690,000 depending on the cropping scenario (**Table A-17**).

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[4] *Agricultural Crop Report*, Sonoma County, 1994.

[5] Assumes that one animal unit is equal to one mature cow; 1.25 horses; 0.2 sheep or 0.8 mature beef cattle.

The gross value of the dairy feed was compared to the number of milk cows in the market area to estimate the potential savings per cow, assuming that local dairy feed produced can reduce the cost of imported feeds. In the West County Alternative, the medium technology

Table A-15
Potential Number of Non-Dairy Livestock Supported by New Irrigated Pasture Produced
Santa Rosa Subregional Long-Term Wastewater Project

Alternative/ Cropping Scenario	Acres of Irrigated Pasture (1),(2) Low Tech	Medium Tech	High Tech	AUMs (3) Low Tech	Medium Tech	High Tech
West County	1,350	720	300	21,600	11,520	4,800
West County with Sebastopol	855	465	225	13,680	7,440	3,600
South County	1,680	805	210	26,880	12,880	3,360
South County with Sebastopol	1,050	315	140	16,800	5,040	2,240

(1) For West Co. assumes that 30% of all irrigated pasture produced will be used to feed cattle, horses, and sheep.
(2) For South Co. assumes that 70% of all irrigated pasture produced will be used to feed cattle, horses, and sheep.
(3) Assumes 16.00 AUMs (Animal Unit Months) per Acre

Table A-16
Gross Value of New Irrigated Pasture (TDME) Produced for Dairy Cows
Santa Rosa Subregional Long-Term Wastewater Project

Alternative/ Cropping Scenario	Acres of Irrigated Pasture (1),(2) Low Tech	Medium Tech	High Tech	Gross Value of Pasture Produced (3),(4) Low Tech	Medium Tech	High Tech
West County	3,150	1,680	700	$1,358,831	$724,710	$301,963
West County with Sebastopol	1,995	1,085	525	$860,593	$468,042	$226,472
South County	720	345	90	$365,400	$175,088	$45,675
South County with Sebastopol	450	135	60	$228,375	$68,513	$30,450

(1) For West Co. assumes that 70% of all irrigated pasture produced will be used to feed dairy cows.
(2) For South Co. assumes that 30% of all irrigated pasture produced will be used to feed dairy cows.
(3) For West Co. assumes that $431 gross value per acre. This amount is net of the value of native pasture ($100 per acre).
(3) For South Co. assumes that $508 gross value per acre. This amount is net of the value of native pasture ($100 per acre).
Assumes that irrigated pasture produces 16 AUM or 12,000 lbs. of TDME forage per acre which is equivalent to 4.5 tons of alfalfa at $135 per ton.

Sources: Jeffrey Peters, Questa Engineering Corporation; Rick Bennett, UC Cooperative Extension; Sonoma Agricultural Crop Report 1994 and Economic & Planning Systems, Inc.

Table A-17
Total Value of New Dairy Feed Produced
Santa Rosa Subregional Long-Term Wastewater Project

Alternative/ Cropping Scenario	West County			West County w/Sebastopol			South County			South County w/Sebastopol		
	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech
Gross Value of Dairy Pasture Produced	$1,358,831	$724,710	$301,963	$860,593	$468,042	$226,472	$365,400	$175,088	$45,675	$228,375	$68,513	$30,450
Tons of New Local Forage Produced (Actual weight)	10,496	32,071	26,823	11,079	23,324	15,161	10,976	17,836	10,976	8,232	15,092	5,488
Gross Value of Forage Produced (1)	$433,375	$1,324,202	$1,107,515	$457,452	$963,056	$625,986	$453,203	$736,455	$453,203	$339,902	$623,154	$226,601
Total Gross Value of Local Dairy Feed	$1,792,207	$2,048,912	$1,409,477	$1,318,045	$1,431,098	$852,458	$818,603	$911,542	$498,878	$568,277	$691,666	$257,051
Annual Value of Feed per Milk Cow (2)	$48.97	$55.98	$38.51	$36.01	$39.10	$23.29	$56.07	$62.43	$34.17	$38.92	$47.37	$17.61
Annual Value per Average Dairy Herd (3)	$17,139	$19,593	$13,479	$12,604	$13,685	$8,152	$19,624	$21,852	$11,959	$13,623	$16,581	$6,162
Gross Value of Non-Dairy Pasture Prod.	$582,356	$310,590	$129,413	$368,826	$200,589	$97,059	$852,600	$408,538	$106,575	$532,875	$159,863	$71,050
Total Gross Value of Local Animal Feed (Potential Substitute for Alfalfa Hay Imports)	$2,374,563	$2,359,502	$1,538,890	$1,686,870	$1,631,687	$949,518	$1,671,203	$1,320,080	$605,453	$1,101,152	$851,529	$328,101

(1) Assumes a weighted average gross value of $41.29 per ton
(2) Assumes that there are 36,600 milk cows in the West County forage market area.
Assumes that there are 14,600 milk cows in the South County forage market area.
(3) Average size of a Sonoma Dairy herd is 350 cows.

cropping scenario produced the maximum annual potential savings of $56 per cow or $19,600 per year for the average sized dairy herd (350 cows), while in the South County Alternative the maximum potential annual savings were estimated to be $62 per cow or $22,000 per year for the average dairy herd (**Table A-17**).

TABLE A-ESTIMATED VALUE OF INCREASED PRODUCTION OF APPLES, WINE GRAPES, BERRY, AND VEGETABLE CROPS

Average yields and gross values per ton for each category of crop was estimated based on data from UC Cooperative Extension[6] and from the last five years of *Sonoma County Agricultural Crop Reports* **(Table A-18)**.[7] Due to the cooler climate in the West County all yields, except for strawberries, which benefit from the cooler climate, were assumed to be equal to 80 percent of average countywide yields (**Table A-19**). The South County project area was assumed to have yields close to the countywide average. In the case of apples it was assumed that there would be no net increase in the number of acres under production but that apple yields would triple as a result of the availability of reclaimed water for irrigation and the apple grower's ability to switch to high yielding dwarf-stock varieties such as Gala, Fuji, and Sierra Beauty.

The total new acreage of wine grapes, apples, berry, and vegetable crops under each Alternative and cropping scenario was multiplied by the appropriate yields and gross values per acre. The total gross value from all new fruit and vegetable crops was estimated to range between $740,000 and $70.4 million in the West County and between $925,000 and $34.4 million in the South County depending on the cropping scenario (**Table A-20**). The West County with Sebastopol Sub-Alternative was estimated to produce between $51.1 and $101.4 million and the South County with Sebastopol Sub-Alternative was estimated to produce between $52.3 and $81.9 million depending on the cropping scenario (**Table A-20**).

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6 *"Impacts of Irrigation Water"* by Paul Vossen, Cooperative Extension for Sonoma County, University of California, January 8, 1996.

7 *Agricultural Crop Reports*, Sonoma County, 1990-1994

Table A-18

Gross Values of Various Crops in Sonoma County - Applied to South County Acreage
Santa Rosa Subregional Long-Term Wastewater Project

Crop	Average Bearing Acres (1)	Average Yield Tons/Pounds per Acre	Unit	Notes	Average Gross Value per Acre	Average Gross Value per Ton/Pound (1)	Unit	Cost to Produce Per Ton	Comments/ Source
Wine Grapes	31,001	5.00	Tons		$4,970.91	$994.18	Ton		Sonoma County Crop Report
Apples	5,077	35.00	Tons	(2)	$31,500.00	$900.00	Ton	$285.71	Sonoma County Crop Report
Berry Crops (3)	na	na	Tons		$16,700.00	na	Ton		Paul Vossen, Horticultural Adviser, UC Cooperative Extension - Sonoma County
Vegetable Crops (4)	na	na	Tons		$18,500.00	na	Ton		Paul Vossen, Horticultural Adviser, UC Cooperative Extension - Sonoma County
Forage/Hay/Silage Crops									
Oat Hay	15,955	5.00	Tons	(5)	$297.49	$59.50	Ton		Vern Marble, Agronomist, Sonoma County Crop Report
Green Chop	1,206	12.98	Tons	(1)	$215.88	$16.63	Ton		Sonoma County Crop Report
Oats Grain	1,244	0.90	Tons	(1)	$198.71	$220.79	Ton		Sonoma County Crop Report
Corn/Sudan Grass Ensilage	378	19.77	Tons	(1)	$797.36	$40.34	Ton		Sonoma County Crop Report
Oats Silage	6,683	14.98	Tons	(1)	$541.38	$36.14	Ton		Sonoma County Crop Report
Misc. Field Crops	1,449	na	Tons		$252.87	na	Ton		Sonoma County Crop Report

(1) Represents a five year average of bearing acres, yields, and average dollars per acre from Sonoma Crop Reports 1990-1994.

(2) Apple yields assume that with the availability of irrigation water, apple growers will switch to new dwarf stock varietals such as Gala, Fuji and Sierra Beauty.

(3) Specialty berries include strawberries, blueberries, raspberries and blackberries.

(4) Specialty vegetables include lettuce, mustards, salad greens, zucchini, leeks, onions, and peppers.

(5) Oat hay yields provided by Vern Marble, Agronomist (telephone conversation December 11, 1995).

Sources: Sonoma County Crop Reports, 1990-1994; Vern Marble, Agronomist; Paul Vossen and Rick Bennett, UC Cooperative Extension; Economic & Planning Systems, Inc.

Table A-19

Average Crop Yields and Gross Values per Acre for Various Crops in West County
Santa Rosa Subregional Long-Term Wastewater Project

Crop	Average Yield Tons/Pounds per Acre	Unit	Notes	Average Gross Value per Acre	Average Gross Value per Ton/Pound	Unit
Wine Grapes	na	Tons	(1)	na	na	Ton
Apples	na	Tons	(1)	na	na	Ton
Berry Crops (3)	na	Tons		$25,200.00	na	Ton
Vegetable Crops (4)	na	Tons		$14,800.00 (2)	na	Ton
Forage/Hay/Silage Crops						
Oat Hay	4.00	Tons	(2)	$237.99	$59.50	Ton
Green Chop	10.38	Tons	(2)	$172.70	$16.63	Ton
Oats Grain	0.72	Tons	(2)	$158.97	$220.79	Ton
Corn/Sudan Grass Ensilage	15.81	Tons	(2)	$637.89	$40.34	Ton
Oats Silage	11.98	Tons	(2)	$433.10	$36.14	Ton
Misc. Field Crops	na			$202.29	na	Ton

(1) There are no additional acres of apples or vineyards assumed for the West County Alternative.

(2) It is assumed that yields will be 80% of average countywide yields due to the cooler climate and shorter growing season.

(3) Specialty berries include strawberries, blueberries, raspberries and blackberries. Strawberry yields are assumed to be higher in the West County, while other berry yields are assumed to be about 20 percent lower (telephone conversation with Paul Vossen on January 10, 1996).

(4) Specialty vegetables include lettuce, mustards, salad greens, zucchini, leeks, onions, and peppers.

Sources: Sonoma County Crop Reports, 1990-1994; Vern Marble, Agronomist; Paul Vossen and Rick Bennett, UC Cooperative Extension; Economic & Planning Systems, Inc.

Table A-20
Gross Annual Value of Apples, Wine Grapes, Berry and Vegetable Crops Produced by Alternative
Santa Rosa Subregional Long-Term Wastewater Project

Alternative/ Cropping Scenario	West County			West County w/Sebastopol			South County			South County w/Sebastopol		
	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech
Apples (1), (5)	$0	$0	$0	$50,400,000	$50,400,000	$50,400,000	$0	$0	$0	$50,400,000	$50,400,000	$50,400,000
Wine Grapes (2)	$0	$0	$0	$0	$0	$0	$0	$497,091	$5,468,001	$0	$1,242,728	$2,982,546
Berry Crops (3),(6)	$0	$11,340,000	$50,400,000	$0	$7,560,000	$34,020,000	$0	$4,175,000	$15,030,000	$0	$3,340,000	$10,020,000
Vegetable Crops (4),(7)	$740,000	$6,660,000	$19,980,000	$740,000	$5,920,000	$17,020,000	$925,000	$12,025,000	$13,875,000	$1,850,000	$9,250,000	$18,500,000
Total Gross Annual Value	$740,000	$18,000,000	$70,380,000	$51,140,000	$63,880,000	$101,440,000	$925,000	$16,697,091	$34,373,001	$52,250,000	$64,232,728	$81,902,546

(1) Assumes an average gross value for South County of	$31,500	per acre of apples (See Table A-18).
(2) Assumes an average gross value for South County of	$4,971	per acre of wine grapes (See Table A-18).
(3) Assumes an average gross value for South County of	$16,700	per acre of specialty crops (See Table A-18).
(4) Assumes an average gross value for South County of	$18,500	per acre of misc. truck crops (See Table A-18).
(5) Assumes average gross value for Sebastopol of	$31,500	per acre of apples (See Table A-18).
(6) Assumes an average gross value for West County of	$25,200	per acre of specialty crops (See Table A-19).
(7) Assumes an average gross value for West County of	$14,800	per acre of misc. truck crops (See Table A-19).

Sources: Jeffray Peters, Questa Engineering Corporation; Sonoma Agricultural Crop Reports 1990-1994; Paul Vossen, UC Cooperative Extension and Economic & Planning Systems, Inc.

CONCLUSIONS

In summary the total value of all new production of fruit, vegetable, wine grape, and forage crops range between $3.1 and $71.9 million in the West County Alternative and between $2.6 and $35.0 million in the South County Alternative depending on the cropping scenario (**Table A-21**). The Sebastopol Sub-Alternatives indicate an increased value of crop production between $52.8 and $102.4 million in the West County with Sebastopol Alternative and between $53.4 and $82.2 million in the South County with Sebastopol Alternative (**Table A-21**). The Sebastopol Sub-Alternatives add another $50.4 million due to increased apple yields and a switch by apple growers to the higher yielding dwarf and semi-dwarf apple varieties.

The conclusions described above represent the potential increase in gross annual income to the agricultural sector. Economic benefits of the multiplier effect from increased purchases of farm support products (fencing, fertilizer, tractors, etc.) to the local economy are discussed in the Socio-Economics Chapter of the EIR.

Table A-21
Summary of Annual Gross Value of New Irrigated Fruit, Vegetable and Forage Crops
Santa Rosa Subregional Long-Term Wastewater Project

Crop/Alternative/ Cropping Scenario (1)	West County			West County w/Sebastopol			South County			South County w/Sebastopol		
	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech	Low Tech	Medium Tech	High Tech
Apples	$0	$0	$0	$50,400,000	$50,400,000	$50,400,000	$0	$0	$0	$50,400,000	$50,400,000	$50,400,000
Wine Grapes	$0	$0	$0	$0	$0	$0	$0	$497,000	$5,468,000	$0	$1,243,000	$2,983,000
Berry Crops	$0	$11,340,000	$50,400,000	$0	$7,560,000	$34,020,000	$0	$4,175,000	$15,030,000	$0	$3,340,000	$10,020,000
Vegetable Crops	$740,000	$6,660,000	$19,980,000	$740,000	$5,920,000	$17,020,000	$925,000	$12,025,000	$13,875,000	$1,850,000	$9,250,000	$18,500,000
Total Fruit & Vegetable Crops	$740,000	$18,000,000	$70,380,000	$51,140,000	$63,880,000	$101,440,000	$925,000	$16,697,000	$34,373,000	$52,250,000	$64,233,000	$81,903,000
Local Feed	$2,375,000	$2,360,000	$1,539,000	$1,687,000	$1,632,000	$950,000	$1,671,000	$1,320,000	$605,000	$1,101,000	$852,000	$328,000
Grand Total	$3,115,000	$20,360,000	$71,919,000	$52,827,000	$65,512,000	$102,390,000	$2,596,000	$18,017,000	$34,978,000	$53,351,000	$65,085,000	$82,231,000

(1) Cropping Scenarios refer to the three different levels of farming intensity. (See Table A-3).

Sources: Questa Engineering Corporation; Sonoma Agricultural Crop Reports 1990-1994; Rick Bennett and Paul Vossen, UC Cooperative Extension;Economic & Planning Systems