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Sutter Butte Flood Control Agency
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October 14, 2014

Interested Parties,

The Sutter Butte Flood Control Agency (SBFCA) and the Yuba-Sutter Farm Bureau (YSFB) participated in the development of the 2012 Central Valley Flood Protection Plan (CVFPP). During the development of the CVFPP, we expressed concern that the impacts on the agricultural and local community due to expansion of the bypass system and the conversion of agriculture to either less productive agriculture or to habitat will have a significant and lasting impact on our region as well as the agricultural economy of the entire Central Valley. While we share the State's interest in reducing flood risk, and understand the need to for a more sustainable ecosystem, we do not support actions that have an adverse effect on agriculture. As the Basinwide Feasibility Studies progress and DWR refines the CVFPP as part of the 2017 update, it will not be enough to minimize impacts on agriculture. Agriculture will need to benefit from the structural and non-structural actions to modify our flood management system.

To help facilitate a discussion of how the system improvements could potentially affect agriculture in our region, SBFCA and the YSFB partnered to commission a study on how alternatives being considered to widen the Sutter Bypass could adversely affect agriculture in our region. The Study is not intended to be a definitive answer to the question, but rather is intended to begin the dialogue so interested parties would have a greater awareness of our concerns. We appreciate the fact that the system improvements being considered in the Basinwide Feasibility Studies will reduce flood risk in rural areas and that ecosystem restoration has the potential to provide economic benefits. Neither of these benefits was considered in the limited scope of our Study. We believe that a more detailed analysis of the benefits and impacts of the proposed actions should be conducted as part of the Basinwide Feasibility Studies. We support a collaborative process to define the scope of the proposed study in an effort to improve our understanding of how system improvements, and conversion of agricultural lands to habitat, will affect our region and the Central Valley as a whole.

Attached please find the draft of our economic impact analysis. We ask that you review it in this context. We look forward to engaging with the State and interested stakeholders to better understand this issue and work collaboratively to develop a common vision of flood management system modifications in our region.

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President
Yuba-Sutter Farm Bureau

Steve Lambert
Board Chair
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Economic Impacts of the Sutter Bypass Expansion

August 12, 2014

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EXECUTIVE SUMMARY

In June 2012 the Central Valley Flood Protection Board (CVFPB) passed the Central Valley Flood Protection Plan (CVFPP), a comprehensive flood management plan for the California Central Valley. This report examines how the proposed Sutter Bypass expansion element of the CVFPP is likely to affect agricultural production and regional economic activity in Sutter County. Specifically, the study focuses on the effects of the proposed widening of the east side of the Sutter Bypass by evaluating the economic loss resulting from two alternatives: (i) a 1,000 ft increase in the Bypass; and (ii) a 2,000 ft increase in the Bypass. We estimate the economic impact of converting productive agricultural land allocated to existing uses to a combination of habitat and less productive agricultural land uses that typify current land uses in the active floodplain under the 1,000 foot and 2,000 foot buffer alternatives.

Incorporating a 1,000 foot buffer on the east side of the Sutter Bypass is predicted to encompass 2,459 acres of land into the active floodplain. Land uses currently in the buffer zone are comprised of 90% productive agricultural land and 10% habitat. Incorporating the 2,000 foot buffer on the east side of the Sutter Bypass would move an estimated 5,324 acres of land, which is 91% productive agricultural land and 9% habitat, into the active floodplain. Within the current floodplain of the Sutter Bypass, the existing land use allocation is 36% habitat, 6% processing tomatoes, and 58% rice production, and land converted to the buffer in each case would likely be allocated to similar use.

Our study constructs an estimate of the total economic impact of incorporating the 1,000 foot or 2,000 foot buffer zones into the active floodplain as the difference in economic value between an ex-ante pattern of land use and an ex-post pattern of land use for each buffer alternative. The ex-ante value of land use represents the economic value of the crops currently grown in the buffer zones under the current land use allocation. The ex-post value of land use represents the economic value of the crops projected to be grown in the buffer zones under a land use allocation that matches cropping patterns in the active floodplain.

The ex-post value of land use considers the possibility that the land is not planted in a given year due to late season flooding. To account for the increased frequency of late season flooding, we use historical data on the frequency of over-topping of the Tisdale Wier with a cutoff date of April 15th as the last date for flooding where planting can still occur within the floodplain. According to historical flood data of the Tisdale Weir, there is an approximately 72% chance the land within the bypass is cropped in a given year, with the land remaining uncropped the remaining 28% of the time.

Table E.1 shows the economic impact from the annual loss of agricultural production from widening the Sutter Bypass to include the 1,000 foot buffer zone. The *direct impact* reflects the initial change in expected economic activity from lost wages and agricultural expenditures over the thirty-year horizon. The *indirect impact* results from local "business-to-business" transactions necessary to support the direct activity, for instance, local purchase of farm machinery, hiring of agricultural consultants, and other goods purchased from supporting industries. The *induced impact* results when wages generated by the direct and indirect economic activity are spent on local goods and services; for example, when agricultural laborers or farm proprietors use earnings to purchase food, clothing, automobiles, real estate, education, and health and social services.

Table E1. Annual Net Economic Impact of Incorporating the 1,000 Foot Buffer Zone into the Active Floodplain

Impact	Economic Activity	Job Years (FTEs)[1]	Employee Compensation[2]	Economic Output[3]
Direct	Land Use Conversion	25	$1,027,020	$3,042,988
Indirect	Local Supply Chain	12	$345,544	$839,278
Induced	Employee Spending	7	$236,115	$805,622
Total Economic Impact		**45**	**$1,608,680**	**$4,687,888**

[1] Job estimates include part-time and full-time employment
[2] Employee compensation includes wages, fringe benefits and payroll overhead.
[3] Economic output includes all local spending on labor, materials, and services.
Source: IMPLAN 2012 and Cal Poly calculations.

Moving the 1,000 ft buffer on the East side of the Sutter Bypass into the active floodplain is estimated to result in an annual loss of 45 job-years.[1] The total annual economic impact of the change in land use allocation is $4,687,888. The total economic impact over a thirty-year horizon is $141 million.

Table E.2 shows the economic impact from the annual loss of agricultural production from widening the Sutter Bypass to include the 2,000 foot buffer zone.

Table E2. Annual Net Economic Impact of Incorporating the 2,000 Foot Buffer Zone into the Active Floodplain

Impact	Economic Activity	Job Years (FTEs)[1]	Employee Compensation[2]	Economic Output[3]
Direct	Land Use Conversion	63	$2,178,527	$6,897,426
Indirect	Local Supply Chain	28	$778,323	$1,956,822
Induced	Employee Spending	15	$508,687	$1,735,635
Total Economic Impact		**106**	**$3,465,537**	**$10,589,883**

[1] Job estimates include part-time and full-time employment
[2] Employee compensation includes wages, fringe benefits and payroll overhead.
[3] Economic output includes all local spending on labor, materials, and services.
Source: IMPLAN 2012 and Cal Poly calculations.

1 A job-year or full-time equivalent (FTE) represents the equivalent of a single person employed for the entire fiscal year.

Moving the 2,000 ft buffer on the East side of the Sutter Bypass into the active floodplain is estimated to result in the annual loss of 106 job-years. The total annual economic impact of the change in land use allocation is $10,589,883. The total economic impact over a thirty-year horizon is $318 million.

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1. INTRODUCTION

In June 2012, the Central Valley Flood Protection Board (CVFPB) passed the Central Valley Flood Protection Program (CVFPP), a comprehensive flood management plan for the Central Valley. The CVFPP includes a proposal to widen the Sutter Bypass located in in Sutter County, California. This report evaluates the potential economic impacts of moving land within the 1,000 foot and 2,000 foot buffer zones on the East side of the Sutter Bypass into the active floodplain. The buffer zones contain several high value crops including almonds and walnuts that have significant establishment costs, which are susceptible to inundation by flooding.

This study constructs an estimate of the total economic impact of incorporating the 1,000 foot or 2,000 foot buffer zones into the active floodplain as the difference in economic value under ex-ante and ex-post land use allocations in the buffer zones. The ex-ante value represents the economic value of crop production in each buffer zone alternative under the existing land use pattern. The ex-post value represents the economic value of crop production after the land use pattern is converted to a land pattern characterized by current land uses in the active floodplain. The ex-post value also addresses the possibility of the land not being planted in a given year due to late season flooding.

The values presented in this report assume that land in the buffer zones would be inundated with a similar frequency, timing and duration as land currently in the active floodplain. Under similar flooding conditions, the land use pattern currently observed in the existing flooding is a reliable proxy for the land use pattern that would occur in the expanded bypass regions. The economic values do not attempt to quantify the economic value of acres converted to habitat.

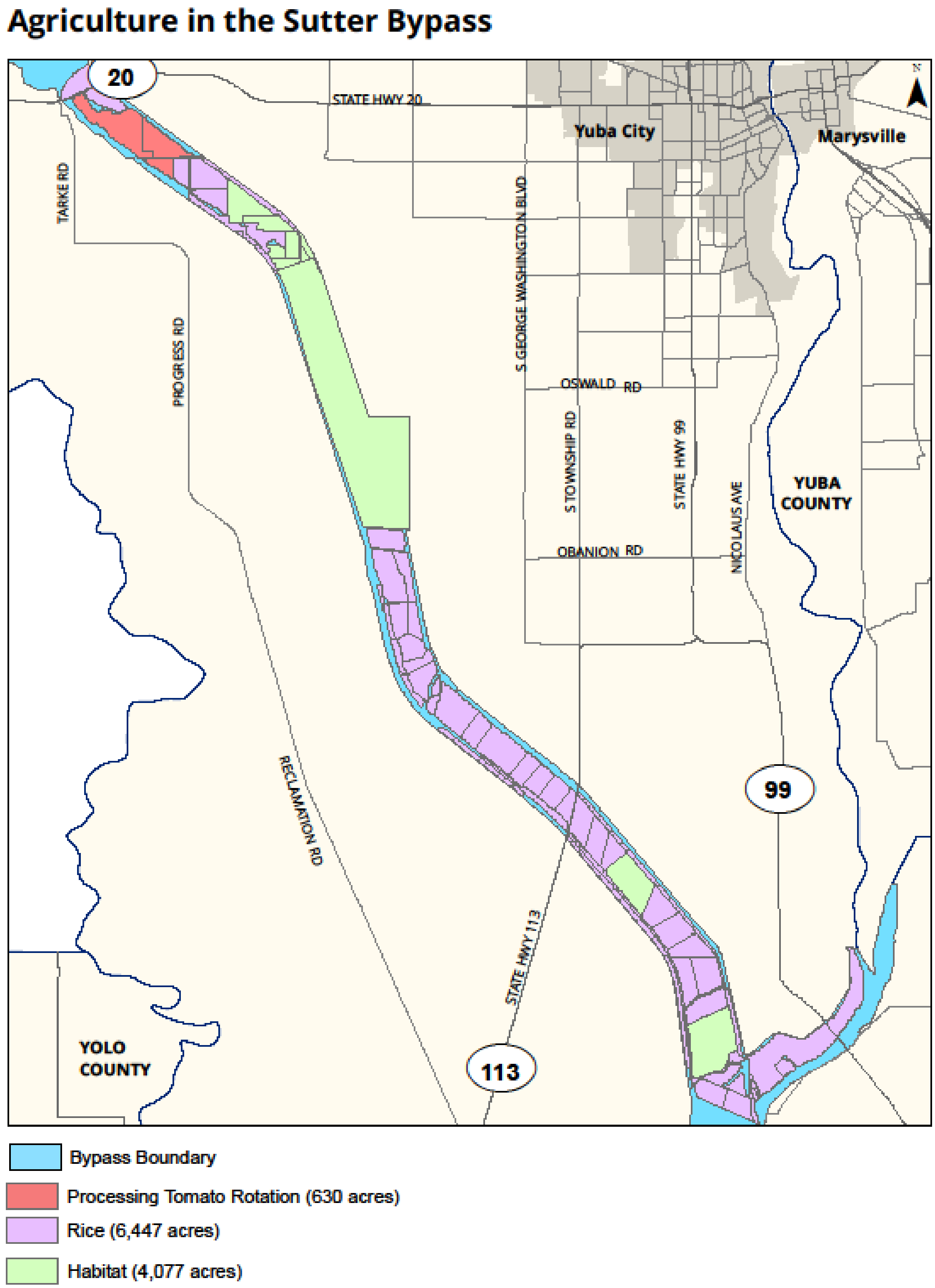
2. DATA OVERVIEW

We collected data for the Sutter Bypass region to evaluate the economic impact of widening the east side of the Sutter Bypass under the 1,000 or 2,000 foot buffer alternatives. The data utilized in the study include: (i) existing land use allocations in the Sutter Bypass floodplain and buffer zones, (ii) variable costs of production for each crop, and (iii) historical overflow data of the Tisdale Weir. We summarize the data in the following sections.

2.1 Land Use in the Sutter Bypass

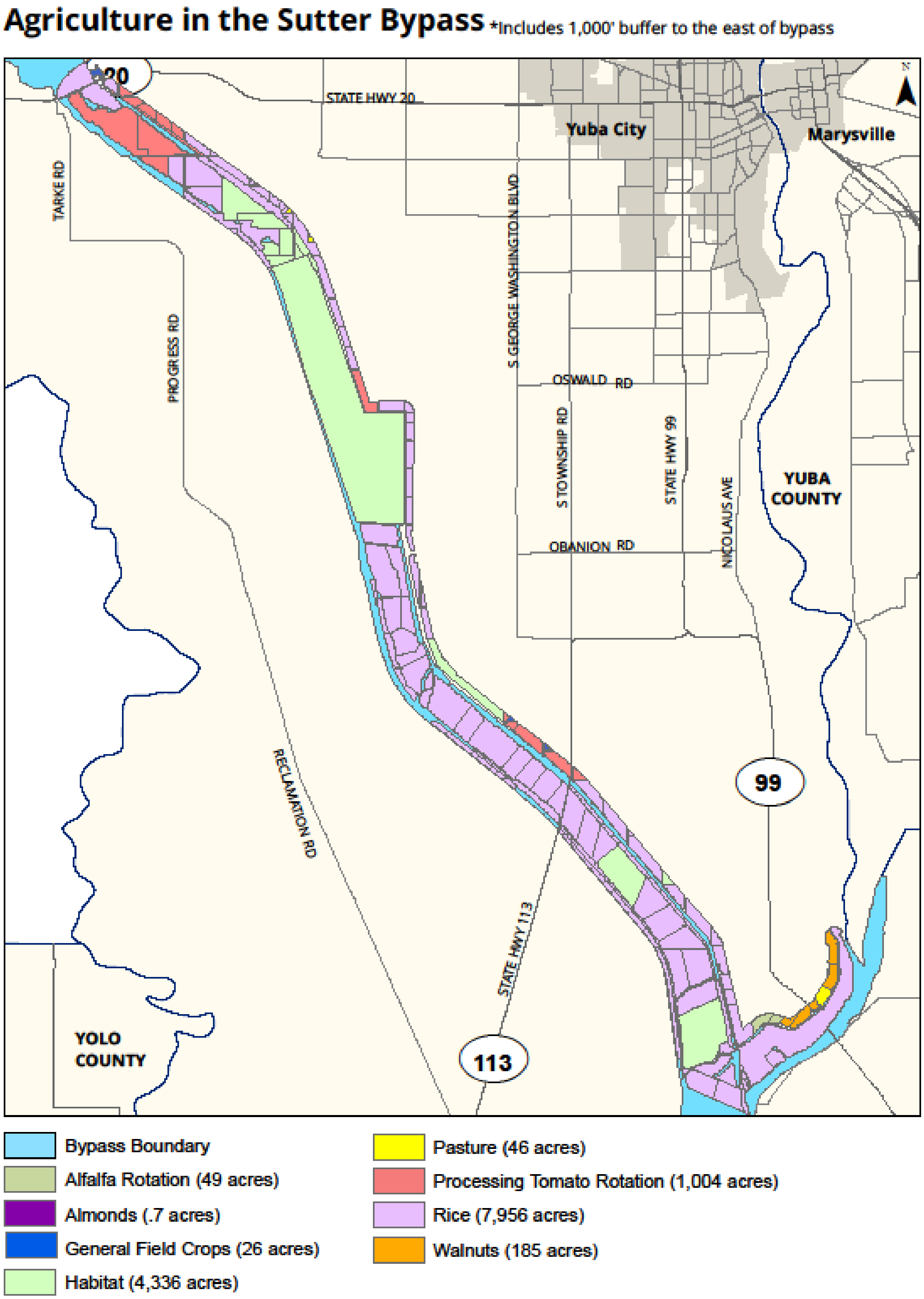
The Sutter Bypass and surrounding land contain productive agricultural acres. Figures 2.1, 2.2, and 2.3 illustrate land use within the Sutter Bypass, the 1,000 foot buffer zone, and the 2,000 foot buffer zone respectively.

Figure 2.1. Land use in the Sutter Bypass



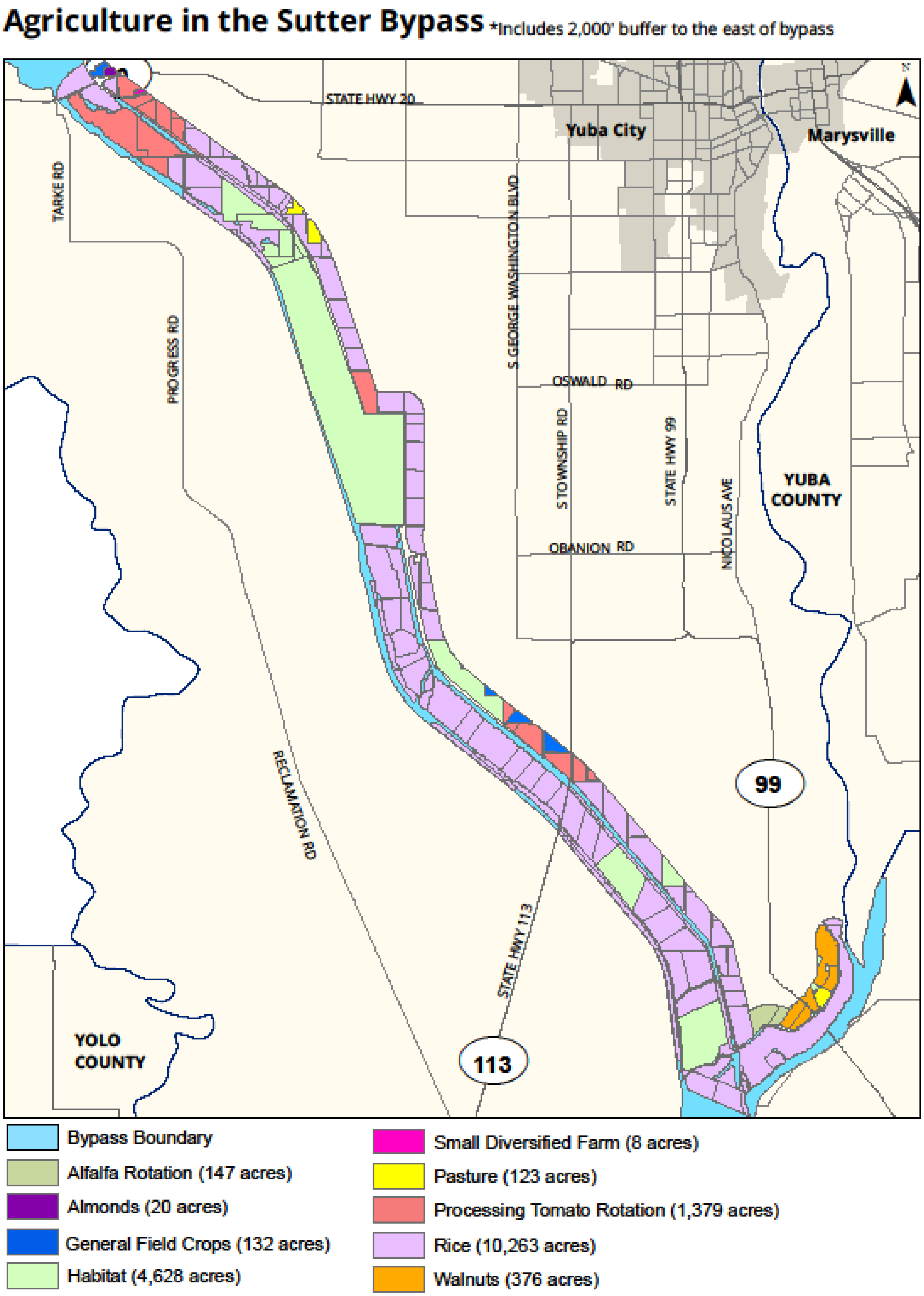
Source: Sacramento Area Council of Governments, 2013

Figure 2.2. Land use in the Sutter Bypass and the 1,000 foot Eastern Buffer Zone



Source: Sacramento Area Council of Governments, 2013

Figure 2.3. Land use in the Sutter Bypass and the 2,000 foot Eastern Buffer Zone



Source: Sacramento Area Council of Governments, 2013

Table 2.1 details the existing land use allocation within the current bypass, the 1,000 foot buffer zone, and the 2,000 foot buffer zone. Within the bypass, land is predominantly used for rice production and habitat, and processing tomato production. In the buffer zones, the primary affected crops are alfalfa, almonds, pasture, processing tomatoes, rice, and walnuts. This analysis focuses on these six crops. In addition, 26 acres (132 acres) of agricultural land is allocated to general field crops and small diversified farms within the 1,000 foot (2,000 foot) buffer region. Our study incorporates the value of these crops by taking cost and return data for sweet corn as a proxy for the value of land allocated to general field crops. Information regarding crops and acreage was obtained through the Sacramento Area Council of Governments (SACOG) from maps produced June 14th, 2013.

Under the ex post scenario of land use, land in the 1,000 foot or 2,000 foot buffer zones are assumed to switch to a land use allocation characterized by existing cropping patterns within the active floodplain of Sutter Bypass. The expected land use conversion therefore involves an increase in land allocated to habitat (i.e., to 36.5% of the total acreage) and a change in cropping pattern from alfalfa, almonds, general field crops, pasture, processing tomatoes, rice, and walnuts to a mix of processing tomatoes and rice.[2]

Table 2.1. Current Land Use Allocation Within the Sutter Bypass and Buffer Zones

	Bypass		1,000 ft. Buffer		2,000 ft. Buffer	
Crop	**Acres**	**Percent Acreage**	**Acres**	**Percent Acreage**	**Acres**	**Percent Acreage**
Alfalfa Rotation			49	2.00%	147	2.48%
Almonds			1	0.03%	20	0.34%
General Field Crop			26	1.06%	132	2.23%
Habitat	4,077	36.55%	259	10.58%	551	9.30%
Pasture			46	1.88%	123	2.08%
Processing Tomatoes	630	5.65%	374	15.27%	749	12.65%
Rice	6,447	57.80%	1,509	61.62%	3816	64.44%
Small Diversified Farms			0		8	0.14%
Walnuts			185	7.56%	376	6.35%
TOTAL	**11,154**		**2,449**		**5,922**	

[2] Independent evaluation of an earlier draft of this report has indicated that the SACOG maps may over-estimate the amount of rice produced in the bypass by including State and private lands that have historically been used for habitat and dry-land pasture. To the extent that acreage historically used for habitat is classified as rice acreage in the floodway, use of SACOG data on existing cropping patterns in the bypass as a proxy for land conversion in the buffer zones results in a conservative estimate of economic losses by converting a greater portion of land in the buffer regions into a higher-valued agricultural use. The losses calculated in this report would be larger if a greater portion of land in the buffer zones was converted to habitat as opposed to rice production.

2.2 Prices and Yields

We obtained average yields and prices for the crops considered in the analysis from the Sutter County Agricultural Commissioner reports (Agricultural Commissioners Reports, 2003-2012). In the case of pasture, no price data per animal unit month (AUM) or hay production was available in these reports, so we used price estimate per AUM per acre provided in the Cost and Returns study for flood irrigated pasture grown in the Sacramento Valley (UC Cooperative Extension, 2003).

Table 2.2 summarizes the average crop yield and price (dollars per ton) for each of the crops included in the analysis. The entries in Table 2.2 compare average yields and prices over a 10-year horizon (2003-2012) and a 3-year horizon (2010-2012). Yield per acre is fairly consistent over both time horizons, with the notable exception of Almonds and Walnuts, where yield per acre is determined by the age of the stand. The price entries in Table 2.2, which are inflation-adjusted into 2013 dollars, reveal that 2010-2012 average crop prices are broadly representative of the average prices over the period 2003-2012. Walnut and corn prices are slightly higher than the 10 year average, while other crop prices are generally lower.

Table 2.2. Average Yields and Prices (2013 $s) for Selected Crops

	Yield (Tons/Acre)		Price ($/Ton)	
Crop	**2003-2012 Average**	**2010-2012 Average**	**2003-2012 Average**	**2010-2012 Average**
Alfalfa Rotation	6.32	6.40	$204	$204
Almonds	0.74	0.64	$5,467	$4,594
Corn	5.65	5.81	$198	$219
Pasture[1]	1.00	1.00	$199	$172
Processing Tomatoes	36.75	37.43	$89	$80
Rice[2]	4.15	4.14	$445	$395
Walnuts	1.69	1.77	$2,480	$2,619

[1] Pasture yields and prices are in per acre terms, based on $35 per AUM

[2] Rice prices do not include direct payments, counter-cyclical program payments, or marketing loan payments.

Our analysis uses average prices over the period 2010-2012 as representative of the annual crop prices received by producers in the affected region of the study. Average prices over the period 2003-2012 include an initial period of declining crop prices 2003-2006, followed by an unprecedented spike in commodity prices over the period 2007-2008, and recent stabilization on a higher trend. For yield per acre, with the exception of Almonds and Walnuts, we use the 10-year average yield per acre for each crop over the period 2003-2012. Yield per acre for almonds and walnuts depends critically on the age of the stand, with typical yields in the Sacramento Valley for a mature stand (age 7-25 years) characterized by 1.1 tons per acre for almonds and 2.7 tons per acre for walnuts (UCCE, 2012). Acreage allocated to almonds and walnuts in Sutter County varies considerably over the period 2003-2012, for instance walnut acreage increased nearly twofold over the period from 15,431 to 26,060. In light of substantial differences in yield per acre for immature and mature stands of nut trees, we take the UCCE values as typical of per acre production for a mature stand of almonds and walnuts as representative of future production on these acres.

2.3 Costs of Production

Variable costs of production for each crop were obtained from Cost and Return studies published by UC Cooperative Extension (UCCE) and obtained from the University of California-Davis Agricultural and Resource Economics website. The cost and return studies develop comprehensive reports for costs of production for a variety of crops throughout California. This study utilizes the UCCE reports for alfalfa, almonds, corn, pasture, processing tomatoes, rice, and walnuts grown in the Sacramento Valley. The cost and return studies are representative of crops grown in the Sacramento Valley and typify crops grown in the affected region of Sutter County. The values are converted to June, 2013 dollars using the Produce Price Index for Farm Products. Table 2.3 summarizes the variable production costs for the crops within the affected region.

Table 2.3. Variable Production Costs (2013 $/acre) for Selected Crops

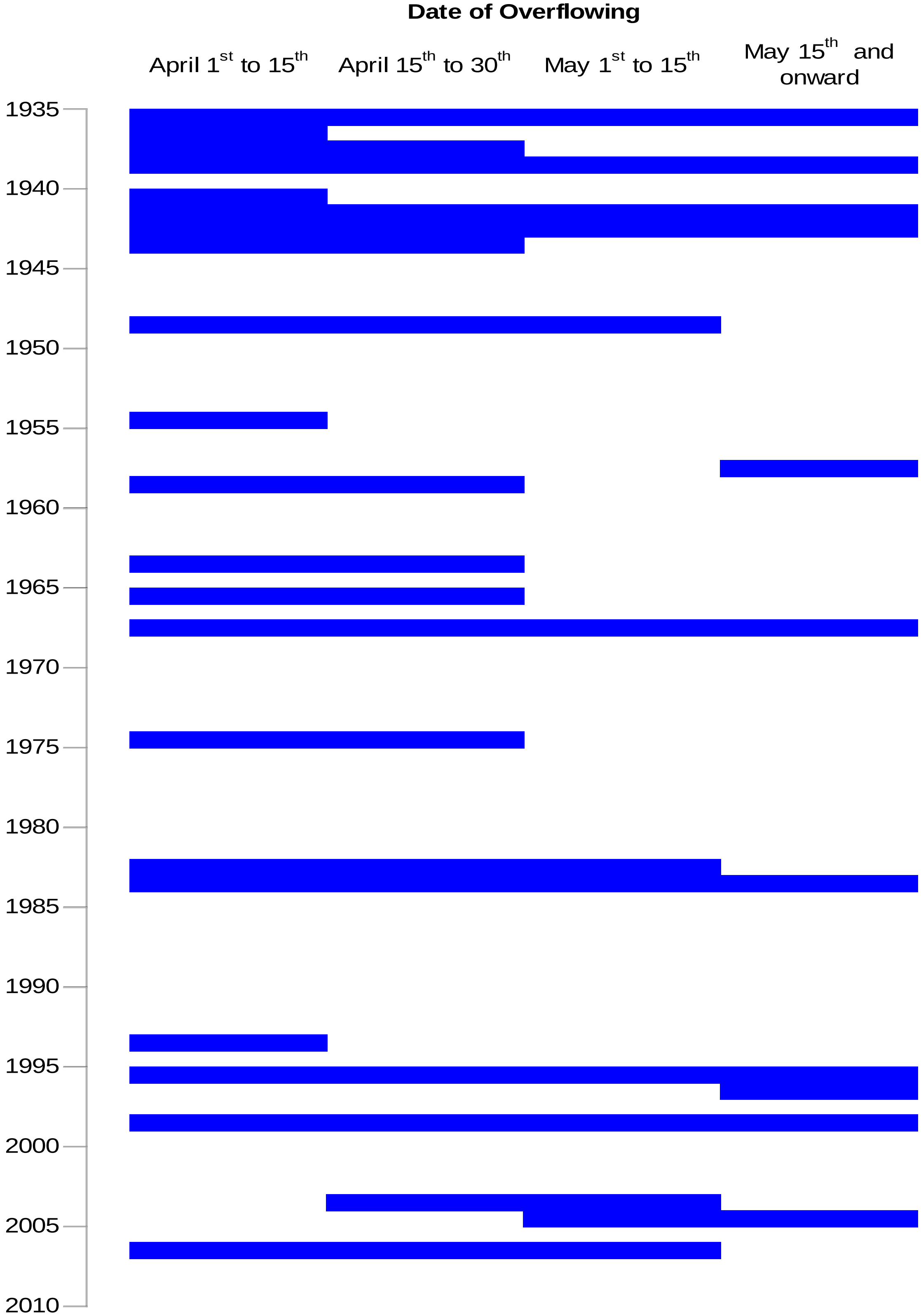
Crop	Variable Cost
Alfalfa Rotation	$657
Almonds	$2,616
Corn	$758
Pasture	$491
Processing Tomatoes	$2,236
Rice	$1,196
Walnuts	$1,971

2.4 Historical Overflow Dates of the Tisdale Weir

We evaluate the potential inundation frequency to agricultural land added to the active floodplain using historical flood data of the Tisdale Weir from 1935 to 2010. The Tisdale Weir connects the Sacramento River to the Sutter Bypass and the Weir's primary function is to release overflow waters from the Sacramento River into the Sutter Bypass. Of the five weirs of the Sacramento River Flood Control System, Tisdale Weir, Colusa Weir, Fremont Weir, Moulton Weir, and the Sacramento Weir, Tisdale Weir is typically the first to over-top and spills for the longest duration.[3]

3 State of California. The Resources Agency. Department of Water Resources, Division of Flood Management. *Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures*. Comp. Mitch Russo. CA.gov, Dec. 2010. Web. 30 July 2013.

Figure 2.4. Tisdale Weir Historical Overflow Data, 1935-2010



Source: Department of Water Resources Division of Flood Control, 2010

For the purpose of this analysis, we consider over-topping of the Tisdale Weir after April 15th to represent the cutoff date for farmers to crop their land. Although flooding after April 1st may be detrimental to crop yields, and may even preclude cropping entirely, this study uses a cutoff date of April 15th as a proxy for reduced yields per acre by assuming that all acres within the floodplain will remain un-cropped in the event flooding occurs after April 15th, but that flood events prior to this date have no implications for reduced crop yields.[4]

Figure 2.4 illustrates over-topping of the Tisdale Weir between April 1st and 15th, April 15th and 30th, May 1st and 15th, and May 15th onward for the years between 1935 and 2010. We use seventy-five years of historical flood data over the period 1935-2010 as a proxy for future flood events for the expanded bypass region. This approach does not account for extreme events that may stress the system or changes in rainfall patterns due to environmental change such as global warming.

Table 2.4 summarizes the historical frequency over the period 1935 to 2010 of the Tisdale Weir flooding between April 1st – 15th, April 15th – 30th, May 1st – 15th, and from May 15th onward. This historical data is used to develop ex-post values for agricultural land moved from the buffer zones into the active floodplain on the basis that land flooded after April 15th would not be cropped that year. [5]

Table 2.4. Historical Frequency of Tisdale Weir Overflow, 1935 to 2010

Overflow Frequency by Date				Cumulative Frequency
April 1st to 15th	April 15th to 30th	May 1st to 15th	May 15th and onward	After April 15th
27.63%	23.68%	17.11%	14.47%	27.63%

3. METHODOLOGY

The economic analysis in this report is developed using IMPLAN (Impact analysis for Planning), an input-output model developed and maintained by the Minnesota IMPLAN Group ("MIG")

[4] The Tisdale Weir intersects the Sutter Bypass at the mid-point of the study's geography. The frequency of overtopping at the Tisdale Weir is taken as a proxy for flood events in the region that reduce yields. Modeling the soil structures of farmland at different points in the Bypass, the ability of land to be planted after an April 15 flood event, and the effect of flooding at earlier dates on reducing agricultural yields is beyond the scope of this study.
[5] The historical period considered in this study (1935-2010) consists of a pre-Shasta dam period (1935-1945), a post-Shasta dam period (1945-2010), and a post-Black Butte dam period (1963-2010). Use of the entire historical record is important, as two of the top five wettest years in California's recorded history occurred in the 1937-1938 and 1940-1941 water years prior to the construction of Shasta Dam. The overflow data in Table 2.4 roughly coincides with the frequency of flood years on or after April 1 in the post-Shasta dam period. In the post-Shasta Dam period 1945-2010, the Tisdale weir overflowed after April 1 in 26.15% of the growing seasons. The hydrologic record was slightly drier over this period (over 30 inches of Statewide precipitation in 9 out of 65 –13.8 percent—of water years) than in the pre-Shasta Dam period (over 30 inches of Statewide precipitation in 2 out of 11 –18.2 percent—of water years).

that is used for economic impact analysis by over 2,000 public and private institutions[6]. The analysis draws on data collected from numerous state and federal sources, including the Bureau of Economic Analysis, Bureau of Labor Statistics (BLS), and the U.S. Census Bureau.

3.1 Overview of IMPLAN

The IMPLAN modeling system relies on a matrix representation of the economy that describes the relationships among industries, consumers, government and foreign suppliers in order to derive the economy-wide impacts of changes in a specific industry. This matrix representation is the so-called Leontief matrix, which contains average input (purchase) coefficients that describe the mix of goods, services and labor that are required to produce a unit of output; that is, how the output of one industry is used as an input in other related industries. The resulting input-output coefficients represent what economists refer to as production functions.7 The basic input-output model can be expressed in a straightforward equation: $X= (I-A)^{-1} *dY$ where (I-A) is the inverse of the Leontief matrix, dY is a change in final demand and X is output.

The IMPLAN model refines the US economy into 440 unique sectors and allows for regional disaggregation down to the county level. The model can be used to estimate the direct, indirect and induced impacts on employment, earnings and output as a result of final demand changes that result from a new investment in a particular industry or compilation of industries.[8] The *direct effect* captures the initial change in economic activity resulting from the loss of productive agricultural acreage. For example, the loss of full-time equivalent (FTE) job-years in each year from the change in cropping pattern is a direct employment effect of moving the 2,000 foot buffer zone into the active floodplain. The *indirect effect* reflects lost economic activity that would have been stimulated by the direct investment in industries that supply inputs to the sector of initial change. For example, reduced agricultural production in the Sutter Bypass will result in producers purchasing fewer farm inputs during the growing season. The *induced effect* captures the economic activity that results when the earnings generated by the direct and indirect economic activity is spent on local goods and services. In this case, it is the decreased spending of agricultural workers and farm proprietors on groceries, clothing, financial services, real estate, and healthcare following a reduction in annual wages and revenue. The total economic impact of widening the Sutter Bypass is the sum of these direct, indirect and induced effects.

3.2 Direct Economic Impact of Existing Land Use

The county-level economic impacts of the proposed widening of the Sutter Bypass are estimated using IMPLAN v3 (2012). For both the 1,000 foot and 2,000 foot buffer alternatives, this report estimated the current economic value of the ex-ante agricultural production in the buffer zone. We run the IMPLAN model using data inputs described above to derive the indirect and induced economic value of cropping the 1,000 foot and 2,000 foot buffer regions under two scenarios: (i)

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6 MIG. "What Is IMPLAN." *IMPLAN Group, LLC*. N.p., 2012. Web. 31 July 2013.
7 The production functions used in IMPLAN are based on the US Bureau of Economic Analysis' (BEA's) Benchmark Input-Output Accounts.
8 *Final Demand* is the demand of units external to the industrial sectors that constitute the producers in the economy, *e.g.*, households, government and foreign trade (Miller and Blair, 1985). Output represents the value of industry production, including wages and proprietor income.

an ex ante scenario that reflects current land use patterns; and (ii) an ex-post scenario that incorporates the 1,000 foot and 2,000 foot buffer zones into the active floodplain. The net economic impact is the difference between the ex-ante and the ex-post values for acreage comprising the buffer zone in each case.

Tables 3.1 and 3.2 detail direct economic values for the ex-ante 1,000 foot and 2,000 foot buffer zones, respectively, with land allocated to existing uses. The annual value of output produced under the existing land use allocation is $5.0 million in the 1,000 foot buffer zone and $11.7 million in the 2,000 foot buffer zone. These values comprise the value of crops grown on the acreage in each zone and do not account for habitat benefits on acreage allocated to habitat. Acreage allocated to habitat provides ecological values that are not considered in the calculation of direct economic benefits. Accordingly, the change in ecological value from land converted from existing uses to a land use allocation that involves an alternative combination of rice production, processing tomato production, and habitat is outside the scope of the present study.[9]

Table 3.1. Direct Economic Value of the Current Land Use Allocation in the 1,000 ft. Buffer Zone (2013 $s)

		Value per Acre			Value per Crop	
Crop	**Acres**	**Yield (Tons/Acre)**	**Variable Cost ($/Acre)**	**Output ($/Acre)**	**Total Variable Cost**	**Total Output**
Alfalfa Rotation	49	6.32	$657	$1,293	$32,169	$63,352
Almonds	1	1.10	$2,616	$5,054	$1,831	$3,538
Corn	26	5.65	$758	$1,238	$19,709	$32,186
Pasture	46	1.00	$491	$681	$22,573	$31,318
Processing Tomatoes	374	36.75	$2,236	$2,958	$836,290	$1,106,352
Rice	1509	4.15	$1,196	$1,641	$1,805,466	$2,475,596
Walnuts	185	2.70	$1,971	$7,066	$364,702	$1,307,132
Habitat	259					
TOTAL	**2,449**				**$3,082,741**	**$5,019,474**

[9] It is not clear *a priori* that land converted from walnut production to habitat in the buffer zone generates superior or inferior ecological benefits. This issue merits further study as a companion study to this project.

Table 3.2. Direct Economic Value of the Current Land Use Allocation in the 2,000 ft. Buffer Zone (2013 $s)

			Value per Acre		Value per Crop	
Crop	**Acres**	**Yield (Tons/Acre)**	**Variable Cost ($/Acre)**	**Output ($/Acre)**	**Total Variable Cost**	**Total Output**
Alfalfa Rotation	147	6.32	$657	$1,293	$96,508	$190,057
Almonds	20	1.10	$2,616	$5,054	$52,327	$101,079
Com	132	5.65	$758	$1,238	$100,062	$163,407
Pasture	123	1.00	$491	$681	$60,359	$83,741
Processing Tomatoes	749	36.75	$2,236	$2,958	$1,674,816	$2,215,663
Rice	3816	4.15	$1,196	$1,641	$4,565,711	$6,260,355
Walnuts	376	2.70	$1,971	$7,066	$741,232	$2,656,657
Habitat	551					
TOTAL	**5,914**				**$7,291,015**	**$11,670,958**

3.3 Direct Economic Impact of Converted Land Use

Tables 3.3 and 3.4 detail the inputs for the ex-post 1,000 and 2,000 foot buffer alternatives, respectively. The annual value of output produced under the predicted land use allocation is $2.0 million in the 1,000 foot buffer zone and $4.8 million in the 2,000 foot buffer zone. The predicted land use allocation considers a land use allocation commensurate with the cropping pattern currently observed in the existing flood plain and involves the displacement of alfalfa, almonds, general field crops, pasture and walnuts, which are predicted to be replaced by increases acreage allocated to rice, processing tomatoes, and habitat. Net of the existing acreage allocated to habitat in each buffer zone, the predicted land use conversion to habitat is 29.0% in the 1,000 ft. buffer zone and 30.0% in the 2,000 ft. buffer zone.

Table 3.3. Direct Economic Value of the Predicted Land Use Allocation in the 1,000 ft. Buffer Zone (2013 $s)

			Value per Acre			Value per Crop	
Crop	**Acres**	**Yield (Tons/Acre)**	**Variable Cost ($/Acre)**	**Output ($/Acre)**	**Probability Cropped**	**Total Variable Cost**	**Total Output**
Alfalfa Rotation	0	6.32	$657	$1,293		$0	$0
Almonds	0	1.10	$2,616	$5,054		$0	$0
Com	0	5.65	$758	$1,238		$0	$0
Pasture	0	1.00	$491	$681		$0	$0
Processing Tomatoes	138	36.75	$2,236	$2,958	72%	$223,815	$296,091
Rice	1415	4.15	$1,196	$1,641	72%	$1,225,522	$1,680,396
Walnuts	0	2.70	$1,971	$7,066		$0	$0
Habitat	895						
TOTAL	**2,449**					**$1,449,337**	**$1,976,488**

Table 3.4. Direct Economic Value of the Predicted Land Use Allocation in the 2,000 ft. Buffer Zone (2013 $s)

			Value per Acre			Value per Crop	
Crop	**Acres**	**Yield (Tons/Acre)**	**Variable Cost ($/Acre)**	**Output ($/Acre)**	**Probability Cropped**	**Total Variable Cost**	**Total Output**
Alfalfa Rotation	0	6.32	$657	$1,293		$0	$0
Almonds	0	1.10	$2,616	$5,054		$0	$0
Corn	0	5.65	$758	$1,238		$0	$0
Pasture	0	1.00	$491	$681		$0	$0
Processing Tomatoes	334	36.75	$2,236	$2,958	72%	$540,549	$715,108
Rice	3418	4.15	$1,196	$1,641	72%	$2,959,831	$4,058,425
Walnuts	0	2.70	$1,971	$7,066		$0	$0
Habitat	2162						
TOTAL	**5,914**			**$19,930**		**$3,500,380**	**$4,773,533**

The direct economic loss resulting from the predicted land use conversion in each buffer zone is the difference between the direct economic value attained through the existing land allocation and the direct economic value attained through the predicted land use allocation. The direct economic loss from the land use conversion is $3.0 million per annum in the 1,000 foot buffer zone and $6.9 million in the 2,000 foot buffer zone.

4. RESULTS

4.1 Economic Value of Existing Land Use

The results of modeling inputs described in Tables 3.1 and 3.2 in IMPLAN are displayed below in Tables 4.1 and 4.2, respectively. The current annual economic value of agriculture in the 1,000 foot buffer is $7.7 million and supports 80 FTE job-years. The current annual economic value of agriculture in the 2,000 foot buffer is $17.8 million and supports 192 FTE job-years.

Table 4.1. Economic Value of the Current Land Use Allocation in the 1,000 Foot Buffer Zone (2013 $s)

Impact	Economic Activity	Job Years (FTEs)[1]	Employee Compensation[2]	Economic Output[3]
Direct	Land Use Conversion	50	$1,369,085	$5,019,475
Indirect	Local Supply Chain	20	$554,127	$1,503,042
Induced	Employee Spending	10	$331,435	$1,130,859
Total Economic Impact		**80**	**$2,254,646**	**$7,653,375**

[1] Job estimates include part-time and full-time employment

[2] Employee compensation includes wages, fringe benefits and payroll overhead.

[3] Economic output includes all local spending on labor, materials, and services.

Source: IMPLAN 2012 and Cal Poly calculations.

Table 4.2. Economic Value of the Current Land Use Allocation in the 2,000 Foot Buffer Zone (2013 $s)

Impact	Economic Activity	Job Years (FTEs)[1]	Employee Compensation[2]	Economic Output[3]
Direct	Land Use Conversion	124	$3,004,667	$11,670,959
Indirect	Local Supply Chain	46	$1,282,082	$3,559,916
Induced	Employee Spending	22	$738,900	$2,521,134
Total Economic Impact		**192**	**$5,025,649**	**$17,752,010**

[1] Job estimates include part-time and full-time employment

[2] Employee compensation includes wages, fringe benefits and payroll overhead.

[3] Economic output includes all local spending on labor, materials, and services.

Source: IMPLAN 2012 and Cal Poly calculations.

4.2 Economic Value of Converted Land Use

The results of modeling the inputs described in Tables 3.3 and 3.4 in IMPLAN are displayed below in Tables 4.3 and 4.4, respectively. The economic value of agricultural output in the 1,000 foot buffer after the predicted land use conversion is $3.0 million with an associated 36 FTE job-years. The economic value of agricultural output in the 2,000 foot buffer after the predicted land use conversion is $7.2 million with an associated 86 FTE job-years.

Table 4.3. Economic Value of the Predicted Land Use Allocation in the 1,000 Foot Buffer Zone (2013 $s)

Impact	Economic Activity	Job Years (FTEs)[1]	Employee Compensation[2]	Economic Output[3]
Direct	Land Use Conversion	25	$342,064	$1,976,487
Indirect	Local Supply Chain	8	$208,582	$663,763
Induced	Employee Spending	3	$95,320	$325,237
Total Economic Impact		**36**	**$645,966**	**$2,965,487**

[1] Job estimates include part-time and full-time employment

[2] Employee compensation includes wages, fringe benefits and payroll overhead.

[3] Economic output includes all local spending on labor, materials, and services.

Source: IMPLAN 2012 and Cal Poly calculations.

Table 4.4. Economic Value of the Predicted Land Use Allocation in the 2,000 Foot Buffer Zone (2013 $s)

Impact	Economic Activity	Job Years (FTEs)[1]	Employee Compensation[2]	Economic Output[3]
Direct	Land Use Conversion	61	$826,140	$4,773,533
Indirect	Local Supply Chain	19	$503,759	$1,603,095
Induced	Employee Spending	7	$230,212	$785,499
Total Economic Impact		**86**	**$1,560,112**	**$7,162,127**

[1] Job estimates include part-time and full-time employment

[2] Employee compensation includes wages, fringe benefits and payroll overhead.

[3] Economic output includes all local spending on labor, materials, and services.

Source: IMPLAN 2012 and Cal Poly calculations.

4.3 Net Impact of the Sutter By-Pass Expansion

The net economic impact of incorporating the 1,000 foot or 2,000 foot buffer zone into the active floodplain is the difference between the existing (ex-ante) and predicted (ex-post) values of the buffer zones. Tables 4.5 and 4.6 display the estimated annual net economic impact of the 1,000 foot and 2,000 foot buffer alternatives, respectively.

The net impact from incorporating the 1,000 foot buffer zone into the active floodplain is an annual loss of $4.7 million and 45 FTE job-years. The total economic impact over a thirty-year horizon is $141 million.

Table 4.5. Annual Net Economic Impact of Incorporating the 1,000 Foot Buffer Zone into the Active Floodplain

Impact	Economic Activity	Job Years (FTEs)[1]	Employee Compensation[2]	Economic Output[3]
Direct	Land Use Conversion	25	$1,027,020	$3,042,988
Indirect	Local Supply Chain	12	$345,544	$839,278
Induced	Employee Spending	7	$236,115	$805,622
Total Economic Impact		**45**	**$1,608,680**	**$4,687,888**

[1] Job estimates include part-time and full-time employment

[2] Employee compensation includes wages, fringe benefits and payroll overhead.

[3] Economic output includes all local spending on labor, materials, and services.

Source: IMPLAN 2012 and Cal Poly calculations.

Table 4.5 decomposes the total annual economic loss into the loss of direct economic value (the difference in value reported in Tables 3.1 and 3.3), indirect economic value from local supply chain effects and induced spending by wage earners and farm proprietors on goods and services in the local economy. The estimated indirect impact of the land use conversion is a loss of $839,278 per annum in economic output and the destruction of 12 FTE jobs in agricultural input and support sectors of the regional economy. The induced effect of reduced employee spending is projected to result in an annual loss of $805,622 per annum in economic output and the destruction of 7 FTE jobs as a result of farm workers and proprietors purchasing fewer goods and services in the local economy.

Table 4.6. Annual Net Economic Impact of Incorporating the 2,000 Foot Buffer Zone into the Active Floodplain

Impact	Economic Activity	Job Years (FTEs)[1]	Employee Compensation[2]	Economic Output[3]
Direct	Land Use Conversion	63	$2,178,527	$6,897,426
Indirect	Local Supply Chain	28	$778,323	$1,956,822
Induced	Employee Spending	15	$508,687	$1,735,635
Total Economic Impact		**106**	**$3,465,537**	**$10,589,883**

[1] Job estimates include part-time and full-time employment

[2] Employee compensation includes wages, fringe benefits and payroll overhead.

[3] Economic output includes all local spending on labor, materials, and services.

Source: IMPLAN 2012 and Cal Poly calculations.

The net impact of incorporating the 2,000 foot buffer zone into the active floodplain is an annual loss of $10.6 million and 106 FTE job-years. The total economic impact over a thirty-year horizon is $318 million.

Table 4.6 also provides a breakdown of the total annual economic loss into the loss of direct economic value (the difference in value reported in Tables 3.2 and 3.4), indirect economic value from local supply chain effects and induced spending by wage earners and farm proprietors on goods and services in the local economy. The estimated indirect impact of the land use conversion is a loss of $2.0 million per annum in economic output and the destruction of 28 FTE jobs in agricultural input and support sectors of the regional economy. The induced effect of reduced employee spending is projected to result in an annual loss of $1.7 million per annum in economic output and the destruction of 15 FTE jobs as a result of farm workers and proprietors purchasing fewer goods and services in the local economy.

4.4 Distribution of the Net Impact

The total annual economic loss for the 1,000 foot and 2,000 foot buffer zones are estimated to be $4,687,888 and $10,589,883, respectively. The total annual economic loss includes the loss of indirect economic value from local supply chain effects and induced spending by wage earners and farm proprietors on goods and services in the local economy.

Figures 4.1 and 4.2 provide a breakdown of the estimated change in induced spending in Sutter County resulting from the incorporation of the 1,000 foot and 2,000 foot buffer zones into the active floodplain, respectively. In each case, the local sectors most heavily impacted by the loss in induced spending are real estate, insurance, and finance, professional services, and retail trade.

Figures 4.3 and 4.4 present a breakdown of lost indirect employment from incorporating the 1,000 foot and 2,000 foot buffer zone and the into the active floodplain, respectively. In each case, the majority of the jobs lost will be from the support activities for agriculture sector.

Figures 4.5 and 4.6 present a breakdown of lost induced employment from incorporating the 1,000 foot and 2,000 foot buffer zone and the into the active floodplain, respectively. In each case, the majority of induced effects are in the services sector, retail trade, food and beverage industry and real estate, finance and insurance.

Figure 4.1. Loss of Induced Spending from Incorporating the 1,000 foot Buffer

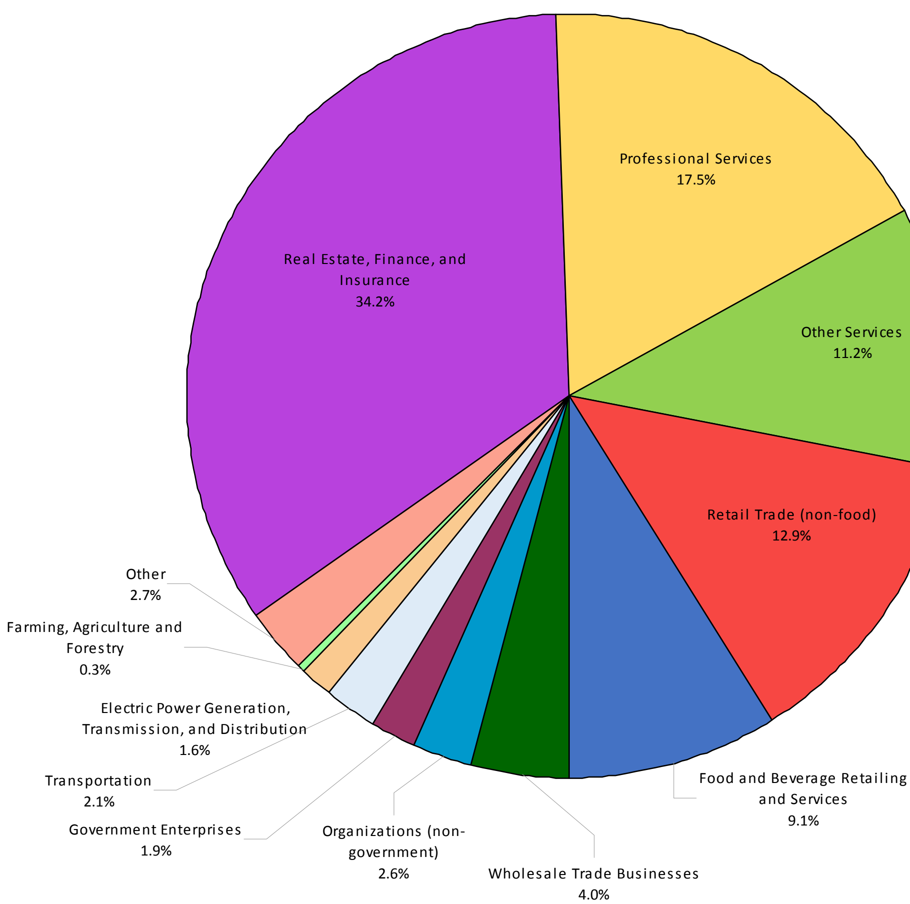


Figure 4.2. Loss of Induced Spending from Incorporating the 2,000 foot Buffer

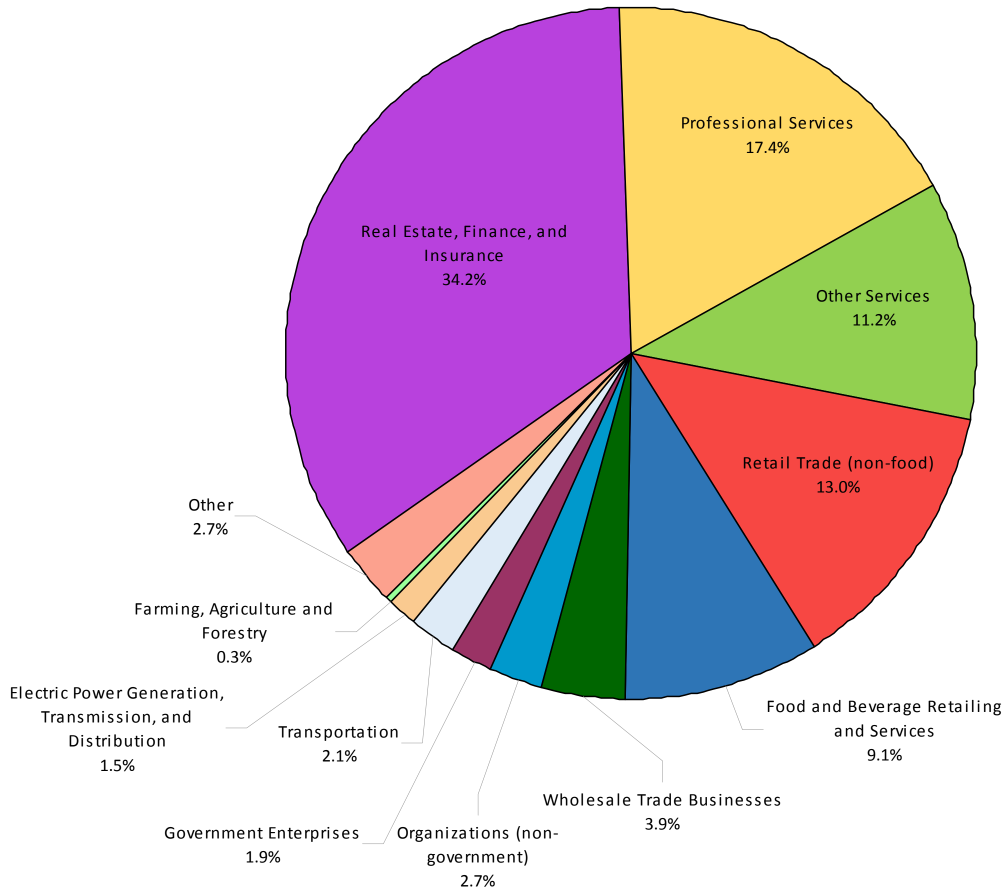


Figure 4.3. Loss of Indirect Employment from Incorporating the 1,000 foot Buffer

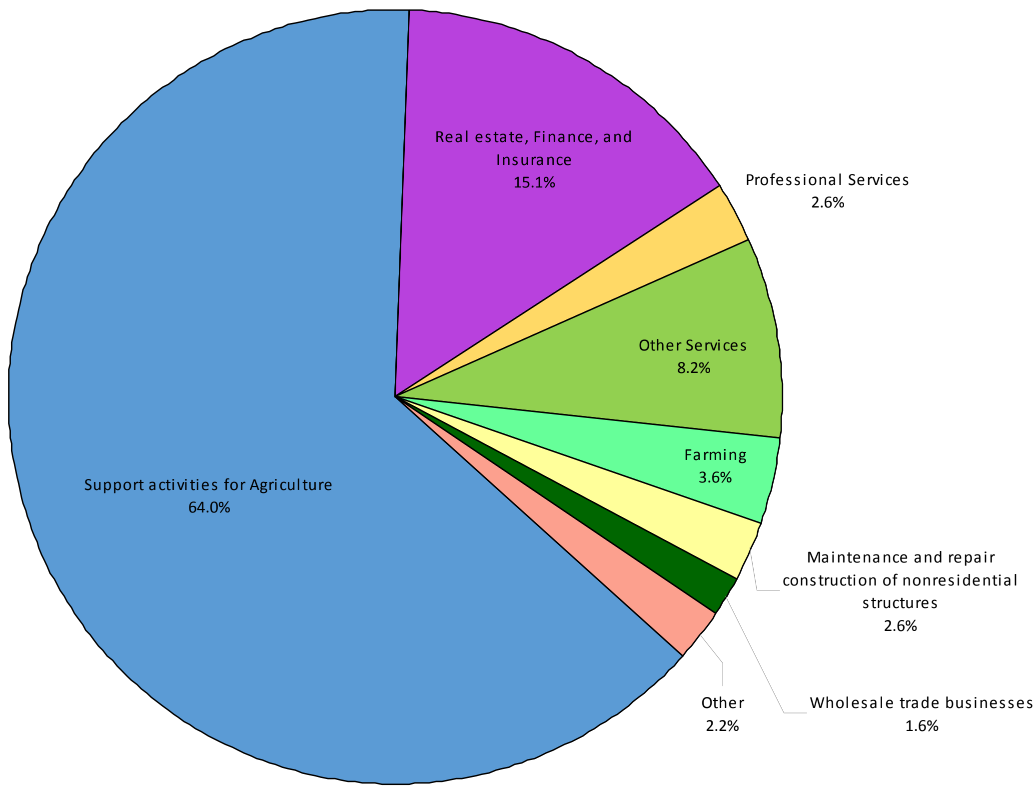


Figure 4.4. Loss of Indirect Employment from Incorporating the 2,000 foot Buffer

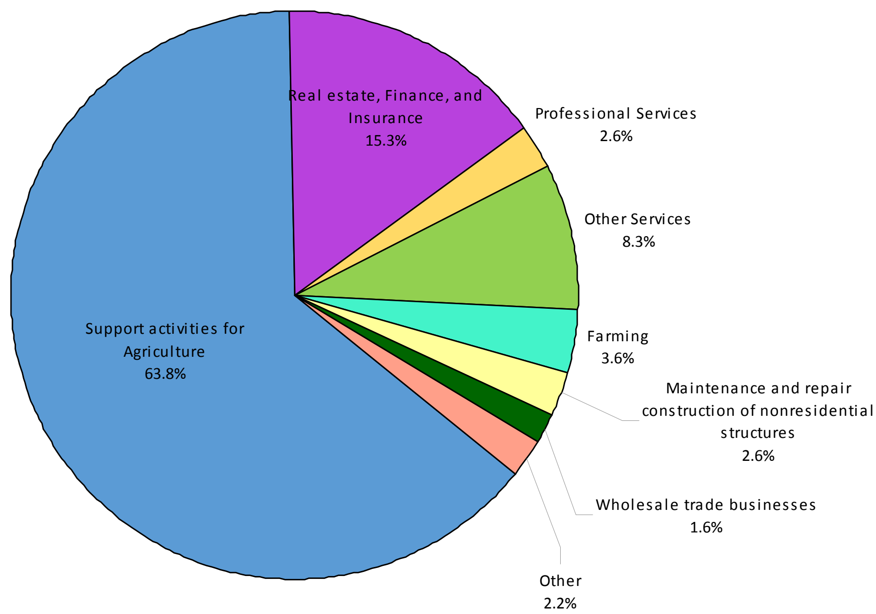


Figure 4.5. Loss of Induced Employment from Incorporating the 1,000 foot Buffer

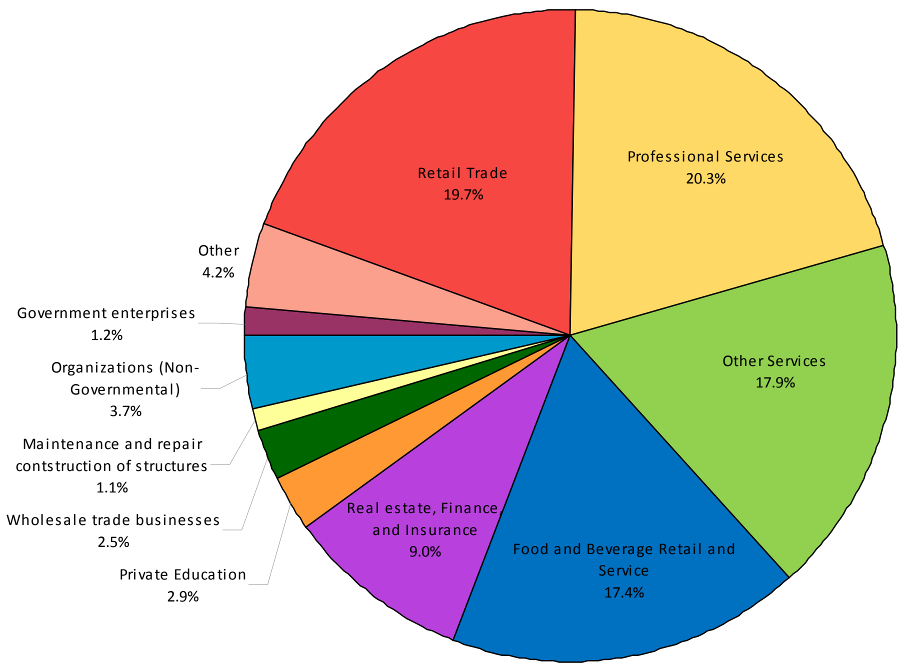
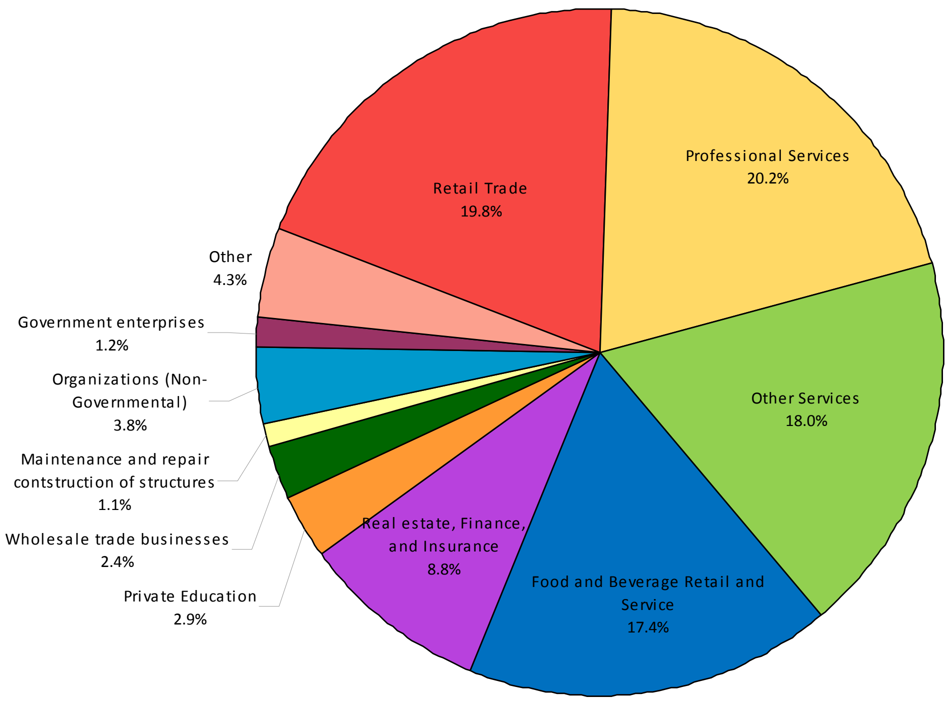


Figure 4.6. Loss of Induced Employment from Incorporating the 2,000 foot Buffer



4.5 Net Impact with No Net Habitat Conversion

The net economic impact of incorporating the 1,000 foot or 2,000 foot buffer zone into the active floodplain can be decomposed as the sum of two effects: (i) changes in cropping pattern on the existing acreage; and (ii) land use changes from cropping to habitat. Tables 4.7 and 4.8 make this decomposition by holding habitat acres fixed under the predicted change in cropping pattern. Notice that habitat acres remain at 259 acres in the 1,000 foot buffer zone and 551 acres in the 2,000 foot buffer zone, which accords with the current habitat designation in Tables 3.1 and 3.2. The entries in Table 4.7 (4.8) differ from the entries in Table 3.1 (3.2) by accommodating a change in cropping pattern to processing tomatoes and rice, which are scaled up proportionately from the entries in Tables 3.3 and 3.4 to represent the case of no net habitat conversion. This calculation allows the economic impact of the bypass expansion to be decomposed into a land use conversion effect, which results from the conversion of land from existing crops to the predicted land use allocation absent any change in land use designation to habitat, and the economic effect of the anticipated conversion of additional acreage to habitat.

In Table 4.7, the converted land in the 1,000 foot buffer zone has a direct economic value of $2.79 million under the assumption of no net habitat conversion. Comparing this value with the entries in Table 3.3 implies that $809,151 (= $2.79m – $1.98m) of the expected decline in the value of land in the 1,000 foot buffer zone is due to the anticipated conversion of additional acreage to habitat.

Table 4.7. Direct Economic Value of the Predicted Land Use Allocation in the 1,000 ft. Buffer Zone with No Net Habitat Conversion (2013 $s)

		Value per Acre				Value per Crop	
Crop	**Acres**	**Yield (Tons/Acre)**	**Variable Cost ($/Acre)**	**Output ($/Acre)**	**Probability Cropped**	**Total Variable Cost**	**Total Output**
Alfalfa Rotation	0	6.32	$657	$1,293		$0	$0
Almonds	0	1.10	$2,616	$5,054		$0	$0
Corn	0	5.65	$758	$1,238		$0	$0
Pasture	0	1.00	$491	$681		$0	$0
Processing Tomatoes	195	36.75	$2,236	$2,958	72%	$315,442	$417,308
Rice	1995	4.15	$1,196	$1,641	72%	$1,727,236	$2,368,330
Walnuts	0	2.70	$1,971	$7,066		$0	$0
Habitat	259						
TOTAL	**2,449**					**$2,042,678**	**$2,785,638**

In Table 4.8, the converted land in the 2,000 foot buffer zone has a direct economic value of $6.82 million, Comparing this value to the entries in Table 3.4, $2.05 million (= $6.82m – $4.77m) of the decline in the value of land in the 2,000 foot buffer zone is due to the anticipated conversion of additional acreage to habitat.

Table 4.8. Direct Economic Value of the Predicted Land Use Allocation in the 2,000 ft. Buffer Zone with No Net Habitat Conversion (2013 $s)

		Value per Acre				Value per Crop	
Crop	**Acres**	**Yield (Tons/Acre)**	**Variable Cost ($/Acre)**	**Output ($/Acre)**	**Probability Cropped**	**Total Variable Cost**	**Total Output**
Alfalfa Rotation	0	6.32	$657	$1,293		$0	$0
Almonds	0	1.10	$2,616	$5,054		$0	$0
Corn	0	5.65	$758	$1,238		$0	$0
Pasture	0	1.00	$491	$681		$0	$0
Processing Tomatoes	477	36.75	$2,236	$2,958	72%	$772,579	$1,022,067
Rice	4886	4.15	$1,196	$1,641	72%	$4,230,336	$5,800,500
Walnuts	0	2.70	$1,971	$7,066		$0	$0
Habitat	551						
TOTAL	**5,914**					**$5,002,915**	**$6,822,567**

Tables 4.9 and 4.10 display the estimated annual net economic impact of the 1,000 foot and 2,000 foot buffer alternatives, respectively, in the case of no net habitat conversion.

The net impact from incorporating the 1,000 foot buffer zone into the active floodplain with no net habitat conversion is an annual loss of $3.5 million and 30 FTE job-years. Comparing these values with the entries in Table 4.5, the change in cropping pattern accounts for 74.1% of the anticipated decline in the economic value of the land and 66.7% of the loss in FTE job-years. The remaining loss of $1.2 million per year in economic value and 15 FTE job-years in Table 4.5 that is not accounted for in Table 4.9 is due to the additional conversion of land to habitat.

Table 4.9. Annual Net Economic Impact of Incorporating the 1,000 Foot Buffer Zone into the Active Floodplain with No Habitat Conversion

Impact	Economic Activity	Job Years (FTEs)[1]	Employee Compensation[2]	Economic Output[3]
Direct	Land Use Conversion	15	$886,983	$2,233,837
Indirect	Local Supply Chain	9	$260,153	$567,541
Induced	Employee Spending	6	$197,092	$672,474
Total Economic Impact		**30**	**$1,344,229**	**$3,473,852**

[1] Job estimates include part-time and full-time employment
[2] Employee compensation includes wages, fringe benefits and payroll overhead.
[3] Economic output includes all local spending on labor, materials, and services.
Source: IMPLAN 2012 and Cal Poly calculations.

The net impact from incorporating the 2,000 foot buffer zone into the active floodplain with no net habitat conversion is an annual loss of $7.5 million and 69 FTE job-years. Comparing these values with the entries in Table 4.6, the change in cropping pattern accounts for 71.0% of the anticipated decline in the economic value of the land and 65.1% of the loss in FTE job-years. The remaining loss of $3.1 million per year in economic value and 37 FTE job-years in Table 4.6 that is not accounted for in Table 4.10 is due to the additional conversion of land to habitat.

Table 4.10. Annual Net Economic Impact of Incorporating the 2,000 Foot Buffer Zone into the Active Floodplain with No New Habitat Conversion

Impact	Economic Activity	Job Years (FTEs)[1]	Employee Compensation[2]	Economic Output[3]
Direct	Land Use Conversion	37	$1,823,907	$4,848,392
Indirect	Local Supply Chain	20	$562,085	$1,268,695
Induced	Employee Spending	12	$409,869	$1,398,460
Total Economic Impact		**69**	**$2,795,861**	**$7,515,547**

[1] Job estimates include part-time and full-time employment
[2] Employee compensation includes wages, fringe benefits and payroll overhead.
[3] Economic output includes all local spending on labor, materials, and services.
Source: IMPLAN 2012 and Cal Poly calculations.

5. CONCLUSION

This study compiled data on agricultural uses of the Sutter Bypass and buffer zones, variable costs of production, employee compensation, and farm proprietor income. We used this data to estimate the current economic value of the agricultural production in the buffer zone alternatives and an ex-post economic value of the agricultural production in buffer zone alternatives under a change in land use allocation towards uses currently represented by existing land uses in the active floodplain. For both the 1,000 foot and 2,000 foot bypass expansion alternatives, we constructed the ex-post value of crop production in the expanded bypass region under the assumption that flooding after April 15th in each year would preclude planting operations in the Sutter Bypass in that year, but that no other economic losses would occur from earlier flood events in terms of reduced yields from delayed planting events. We computed the estimated economic loss from each bypass expansion scenario as the difference in the economic value of the predicted land use allocation in the ex-ante and ex-post scenarios.

For the 1,000 foot buffer scenario, the estimated net impact from incorporating the 1,000 foot buffer zone into the active floodplain is an annual loss of $4.69 million and 45 FTE job-years. The total economic impact over a thirty-year horizon is $141 million and the loss of 1,341 job-years. These results can be decomposed into an annual loss of $3.47 million and 30 FTE job-years due to the conversion of existing agricultural land into lower-valued crops and an additional annual impact of $1.22 million and 15 FTE job-years due to increased habitat conversion.

For the 2,000 foot buffer scenario, the estimated net impact of incorporating the 2,000 foot buffer zone into the active floodplain is an annual loss of $10.59 million and 106 FTE job-years. The total economic impact over a thirty-year horizon is $318 million and the loss of 3,175 job-years. These results can be decomposed into an annual loss of $7.52 million and 69 FTE job-years due to the conversion of existing agricultural land into lower-valued crops and an additional annual impact of $3.07 million and 37 FTE job-years due to increased habitat conversion.

It should be noted that our model results are sensitive to several assumptions. In particular, we have applied a weighted average price for future crops grown in the buffer zone under each alternative that is broadly representative of average prices received by farmers in Sutter County over the past 10 years. The 3-year average price for each crop over the period 2010-2012 excludes the recent commodity price spike over the period 2007-2008 as well as the earlier depressed agricultural conditions that led to lower farm prices in the early part of the decade. To the extent that future crop prices diverge from the levels employed in this study, the annual economic losses may be smaller or larger than those estimated in our study.

We also assume that land incorporated into the floodplain in the expanded bypass regions would be characterized by a similar frequency, timing and duration of flooding as land currently in the floodplain. A similar flood pattern would imply a land use conversion from high-value crops currently grown in the buffer zones to the lower-value crops (and increased designation of land to habitat) that currently occurs in the existing floodplain. To the extent that land in the expanded bypass regions are characterized by an increased (decreased) frequency, timing and duration of flooding than land in the existing floodplain, the actual land use allocation that occurs would likely involve greater (smaller) economic losses.

Finally, we have not attempted to quantify the economic value of land converted to habitat. For example, land converted from orchards to habitat results in a loss of economic value from agricultural production, but may also increase (or decrease) the ecological productivity of the land. The values calculated in this report implicitly assume that the conversion of land from crops to habitat produces no net change in the ecological value of the land and further study would be needed to adjust these values for additional gains and losses due to changes in the non-market values of habitat.

It is also important to emphasize that our study calculates only the expected cost to the regional economy of Sutter County. Our study does not attempt to calculate changes in ecological services from the predicted change in land use allocation, nor does our study account for changes in risk management strategies, decreases in property values, and increases in flood insurance premiums for which farm proprietors would be subject if their land is remapped into the active floodplain.

6. REFERENCES

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