Chapter 12

Agricultural Resources

12.1 Introduction

This chapter describes agricultural resources in the Study Area, and potential changes that could occur as a result of implementing the alternatives evaluated in this Environmental Impact Statement (EIS). Implementation of the alternatives could affect land use through potential changes in operation of the Central Valley Project (CVP) and State Water Project (SWP) and ecosystem restoration.

Changes in non-agricultural land use and resources are described in Chapter 13, Land Use.

12.2 Regulatory Environment and Compliance Requirements

Potential actions that could be implemented under the alternatives evaluated in this EIS could affect agricultural resources served by CVP and SWP water supplies. Actions located on public agency lands; or implemented, funded, or approved by Federal and state agencies would need to be compliant with appropriate Federal and state agency policies and regulations, as summarized in Chapter 4, Approach to Environmental Analyses.

12.3 Affected Environment

This section describes agricultural resources that could be potentially affected by the implementation of the alternatives considered in this EIS. Changes in agricultural resources due to changes in CVP and SWP operations may occur in the Trinity River, Central Valley, San Francisco Bay Area, Central Coast, and Southern California regions. Direct or indirect agricultural resource effects due to implementation of the alternatives analyzed in this EIS are related to changes in agricultural land uses due to the availability and reliability of CVP and SWP water supplies.

Changes in agricultural resources can affect agriculture throughout the state. An overview of California agriculture is presented prior to discussions of agricultural resources in each of the regions.

12.3.1 Overview of California Agriculture

California agriculture is an important resource that produces over 400 types of crops. California is the nation's leading producer of nearly 80 commodities; and produces more than 99 percent of the nation's almonds, artichokes, dates, figs, raisins, kiwifruit, olives, clingstone peaches, pistachios, prunes, pomegranates, and walnuts (USDA-NASS 2012). In 2011, cultivation of 25.4 million acres of agricultural land contributed about $43.5 billion to California's economy and 11.6 percent of total agricultural revenues in the United States. This section provides:

- Recent trends in California agricultural resources
- Crop production practices
- Cropping pattern changes in response to water supply availability
- Water supply and crop acreage relationships in the San Joaquin Valley

12.3.1.1 Recent Trends in Agricultural Production

The United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) California Field Office publishes annual reports containing data from County Agricultural Commissioners and periodic statewide census of agricultural producers. County Agricultural Commissioners' data covers acres planted, total production, prices, yield per acre, and value of production across crop groups and counties.

From 1960 to 2012, total acreage in production fluctuated between eight and nine million acres, as summarized in Figure 12.1. Over the last fifteen years, total acreage has trended down. Most of the variability over time, and the more recent downward trend, are largely attributable to changes in field and forage crop acreage. The percentage of field and forage acreage decreased from 77 percent of total acreage in 1960 to 48 percent in 2012. The proportion of acreage of permanent crops (e.g. orchards and vine) has steadily increased from 1960 to 2012. Orchard and vine acreage rose from 14 percent of total acreage in 1960 to 38 percent in 2012.

From 1960 to 2012, statewide annual value of production rose from $20 billion (all values are in 2012 US dollars) to $45 billion, as summarized in Figure 12.2. Of the crop categories, orchard and vine values grew the fastest over this period, from around $3 billion in annual value of production in 1960 to over $17 billion in 2012. This increase may be attributable to both the expansion of acreage planted, as shown in Figure 12.1, as well as price and yield increases. Orchard and vine values of production rose from 17 percent of the total statewide value of production in 1960 to 38 percent in 2012. Other crop categories that have also experienced an increase in value of production over this time period are: vegetable, livestock, dairy and poultry, and nursery. Field crops have shown a downward trend. The percentage from field and forage crops decreased from the peak of 28 percent of state value of production in 1980 to 11 percent in 2012. Total value of production is influenced by both the acreage planted each year as well as market prices and yields.

12.3.1.2 Crop Production Practices

Crop production practices vary by crop and locational differences such as soil, slope, local climate, and water source and reliability. Production practices discussed in this subsection include:

- Crop rotation and fallowing.

- Crop water use.
- Crop irrigation methods.
- Crop responses to water quality.
- Crop drainage methods.
- Crop adaptation to changes in water supply availability.

12.3.1.2.1 Crop Rotation and Fallowing

Crop rotation is the planned variation in the crop grown on a given field. Growers rotate annual crops and some forage crops in order to control plant pests, diseases, and weeds, and to improve soil structure, microbial diversity, and nutrient and mineral availability. Growers select a series of crops that are compatible for rotation that are planned to be grown in a field in a succession of years and plan their operations schedule and build their on-farm infrastructure (e.g., equipment, facilities and staffing) to a scale that meets the production needs of those crop acreage mixes (Baldwin 2006).

Field fallowing is the practice of not planting a crop in a field for one or more growing seasons. Fallowing can be a planned part of the rotation, or may be a consequence of another event like water supply shortage, flooding, land improvement, or poor crop prices. Rotations are not fixed, so changes in market conditions or Federal farm programs can affect crop mix and the pattern and magnitude of fallowing.

Fallowed fields without cover crops can lose topsoil to surface drainage and wind erosion. Loss of topsoil to erosion reduces land productivity, and can reduce nearby crop yields and marketability.

12.3.1.2.2 Crop Water Use

Crop irrigation water use depends on crop type, stage of crop growth, soil moisture profile from winter rains, soil moisture holding capacity (total amount of water in the soil potentially available to plants), management of plant pests and diseases, weather conditions (solar radiation, temperature and humidity) and irrigation water use efficiency. Irrigation water use efficiency can be defined in different ways. The California Department of Water Resources (DWR) defines the agronomic water use fraction as the irrigation water beneficially used for necessary agronomic functions (e.g., transpiration, leaching, frost protection, germination) divided by the total applied water (DWR 2012). Applied irrigation water is transpired by plants (crops and weeds), percolates into the groundwater below the root zone (necessary salt leaching component or over-irrigation loss to groundwater), evaporates directly from water or soil surfaces, or runs off the field as surface drainage (Edinger-Marshall and Letey 1997).

Reuse of water from fields to irrigate other fields, often multiple times, occurs throughout California. As a result, relatively low field-level efficiency (agronomic water use fraction) can result in relatively high efficiency from a regional or basin perspective (DWR 2013a).

12.3.1.2.3 Crop Irrigation

Agricultural irrigation needs vary by season. In the winter, rainfall refills the soil moisture profile that was depleted from the crop root zone the previous summer and fall. If soil moisture is not adequate for planting of annual crops, pre-irrigation water is applied. Pre-irrigation and early growing season irrigations generally occur in the time period from March through May. Peak agricultural irrigation water supply demand generally occurs from the late spring through late summer. Permanent crops are irrigated post-harvest to refill the root zone. Post-harvest irrigation of annual crop land is sometimes used to help break down crop residue and suppress some pests and diseases, especially in rice fields.

Irrigation methods vary by area, soil, crop type, and existing facilities. Annual row crops are often sprinkler irrigated for crop germination and furrow irrigated for the rest of the season. Permanent crops are typically irrigated with drip, sprinkler, furrow, border, or flood irrigation methods. Irrigated pasture and alfalfa are typically irrigated with sprinkler or flood irrigation methods. Rice is generally irrigated with flood irrigation. Irrigation methods utilized in the Central Valley include:

- **Flood and Border Irrigation:** Water is released into a leveled field or block that is segmented into "checks" with a small berm to contain the water. Water applied to the check until it is flooded and the water seeps into the ground or some is allowed to drain off the lower elevation end of the field.
- **Furrow Irrigation:** Water is released into furrows at the higher side of the field and flows down to the lower end of the field. To provide adequate water to the low end of the field, surface irrigation requires that a certain amount of water be spilled or drained off as tailwater. Recycling the tailwater to the head of the field or to an adjacent field can significantly increase overall efficiency. Furrow irrigation is used on annual row crops and on some vineyards.
- **Sprinkler Irrigation:** Sprinkler irrigation uses pressurized water through movable or solid set pipe to a sprinkler. Sprinklers lose some irrigation water to evaporation in the air before the water reaches the ground. Sprinklers also apply water to ground that does not have crop roots, and this applied water goes to surface evaporation, weed transpiration, or percolation to groundwater leaching. Sprinklers are often used during the germination stage of vegetables, and can also be used for frost control on orchards, especially citrus. Sprinkler irrigation can be used on most crops except those for which direct contact with the water drops could cause fruit cracking, fungal growth, or other issues.
- **Surface Drip and Micro-sprinkler Irrigation:** Surface drip and micro-sprinkler irrigation also use pressurized water that is delivered through flexible tubes to drip emitters or micro-sprinkler heads. Surface drip irrigation generally applies water only to the crop root areas. Drip irrigation and micro-sprinklers are used on most orchards and vineyards.

- **Subsurface Drip Irrigation:** Subsurface drip irrigation is similar to the drip irrigation described above, but the tubing or drip tape is buried a few inches to several feet, depending on the crop. Subsurface drip irrigation generally applies water only to crop root areas and reduces surface evaporation. Subsurface drip is used on some row crops and vineyards.

Flood and furrow irrigated acreage has declined over time, especially for trees and vines by drip and micro-sprinkler irrigation (NCWA 2011). Crops that continue to rely upon flood irrigation, such as rice, have improved irrigation efficiency through the use of laser leveling of the fields. The use of furrow and flood irrigation has declined in California from 67 percent of the total irrigated acreage in 1991 to 43 percent in 2010 (DWR 2013a). During this same time period, the use of drip, micro-sprinkler, and subsurface drip irrigation increased from 16 percent of total irrigated acreage in 1991 to 42 percent in 2010.

12.3.1.2.4 Crop Response to Water Quality

Water quality of the surface water streams in the Central Valley is generally very suitable for agricultural production with low salinity, neutral acidity/alkalinity (i.e., pH), minerals, nutrients, and dissolved metal concentrations that are appropriate for agricultural uses. However, groundwater quality varies substantially across California, as described in Chapter 7, Groundwater Resources and Groundwater Quality.

Agricultural production can be affected by high salinity, minerals, and boron in the irrigation water and the soils. In the Sacramento Valley, water temperature can reduce crop yields; cold water is a particular concern for rice production (Roel et al., 2005). Irrigation water can carry debris and biological contaminants that affect agricultural operations and the value of crop production (USDA 2006).

High salinity concerns occur on agricultural lands receiving CVP and SWP water from the Delta. As described in Chapter 6, Surface Water Quality, surface waters in the Delta and lower San Joaquin River water frequently are characterized by high salinity. These waters are used by agricultural water users in the Delta and CVP and SWP water users located within and to the south of the Delta.

Evaporation and transpiration of irrigation water cause salts to accumulate in soils unless adequate leaching and drainage are provided (Reclamation 2005). High water tables with elevated concentrations of salts can draw the salinity vertically through the soil by capillary action into the plant root zone and cause damage to the plant. Excessive irrigation water salinity and accumulated soil salinity can adversely affect soil structure, reduce water infiltration rates, reduce seed germination, increase seedling mortality, impede root growth, impede water uptake by the plant (from increased osmotic pressure), reduce plant growth rate, and reduce yields.

All irrigation water adds soluble salts to the soil, including sodium, calcium, magnesium, potassium, sulfate, and chlorides (Grattan 2002). Salinity is usually measured either in parts per million of total dissolved solids or by electrical conductivity (EC). Water salinity of irrigation water is measured as "EC_w."

Accumulated salts in the soil are measured as "EC_e." The strength of the electrical conductivity depends upon the water temperature, types of salts, and salt concentrations.

High salinity can affect the amount of irrigation water applied for crop irrigation and necessary soil leaching component (washing soil salts out of the plant root zone) compared to the total quantity of irrigation water applied (Reclamation 2005). Irrigation in the San Joaquin Valley typically includes a salt leaching component. The leaching water generally conveys the salts into installed drains in the fields or into the groundwater. Therefore, in locations where adequate drainage does not exist, continued irrigation with high salinity water has increased groundwater salinity, as described in Chapter 7, Groundwater Resources and Groundwater Quality.

Table 12.1 presents EC_e and EC_w values for salinity tolerances of a range of crops grown in the Central Valley.

Table 12.1 Salinity Tolerance of Selected Crops (as percent of maximum yield)

Crops[a, b]	Crop Tolerance based on Soil Salinity (measured as EC_e)			Crop Tolerance based on Water Salinity (measured as EC_w)		
	100%	50%	0%[c]	100%	50%	0%[c]
Alfalfa	2.0	8.8	16	1.3	5.9	10
Almond[d]	1.5	4.1	6.8	1.0	2.8	4.5
Apricot[d]	1.6	3.7	5.8	1.1	2.5	3.8
Bean	1.0	3.6	6.3	0.7	2.4	4.2
Corn, sweet	1.7	5.9	10	1.1	3.9	6.7
Cucumber	2.5	6.3	10	1.7	4.2	6.8
Grape[e]	1.5	6.7	12	1.0	4.5	7.9
Peach	1.7	4.1	6.5	1.1	2.7	4.3
Rice (paddy)	3.0	7.2	11	2.0	4.8	7.6
Squash, Zucchini	4.7	10	15	3.1	6.7	10
Sudan Grass	2.8	14	26	1.9	9.6	17
Sugar Beet[e]	7.0	15	24	4.7	10	16
Tomato	2.5	7.6	13	1.7	5.0	8.4

Sources: Ayers and Westcot 1994; Grattan 2002; Maas and Hoffman 1977

Notes:

a. These data should be used as a guide to relative tolerances among crops. Absolute tolerances will change based upon climate, soil conditions, and cultural practices. Plants will tolerate about 2 deciSiemens per meter (dS/m) higher soil salinity (EC_e) than indicated if soils have high gypsum, however the water salinity (EC_w) tolerances do not change.

b. EC_e is average root zone salinity as measured by electrical conductivity of the saturation extract of the soil, and EC_w is electrical conductivity of the irrigation water, both reported in dS/m) at 25°C. The data is based upon a relationship between soil salinity and water salinity of $EC_e = 1.5\ EC_w$ with a 15 to 20 percent leaching fraction and a 40-30-20-10 percent water use pattern for the upper to lower quarters of the root zone.

c. The zero yield potential or maximum EC_e indicates the theoretical soil salinity (EC_e) at which crop growth ceases.

d. Tolerance evaluations are based on tree growth and not on yield.

e. For beets, which are more sensitive during germination, the EC_e should not exceed 3 dS/m in the seeding area for garden beets and sugar beets.

The most sensitive crops are affected when EC_e values exceed 1 dS/m, and include the following crops with threshold values: beans (1.0 dS/m); walnuts 1.1 dS/m), bulb onions (1.2 dS/m); grapes, peppers and almonds (1.5 dS/m); apricots (1.6 dS/m); corn and peaches (1.7 dS/m); alfalfa (2.0 dS/m); and cucumbers and tomatoes (2.5 dS/m).

In addition to salinity, boron is also a concern in some areas. Dry beans are one of the more boron sensitive crops with a threshold value of 0.75 to 1.0 mg/l in the soil water within the crop root zone.

12.3.1.2.5 Crop Drainage Methods

Agricultural crop surface and subsurface drainage is important for the suitability of agricultural production (DWR 2013a; Reclamation 2005; SJVDIP 1998). Drainage of most agricultural fields occurs by a combination of surface drainage and subsurface drainage. Poor drainage can lead to crop loss or damage from lack of soil oxygen availability for plant roots, pest infestations (e.g., pathogenic root fungi, such as *phytothora*), and salt accumulation in the root zone. High water tables, high salinity, and poor drainage can limit crop selection and limit the ability of farmers to use irrigation water to leach excess salts out of the crop root zone.

Surface water drainage from agricultural fields is collected in on-farm drainage ditches which are typically connected to larger drainage facilities. The drainage water either flows by gravity or is pumped into adjacent water bodies. Water quality issues related to disposal of surface water drainage can include high concentrations of sediment; nutrients from fertilizers; or residual organic carbon constituents from herbicides, pesticides, or nematicides. On-farm surface drainage systems sometimes include local methods to remove sediment or nutrients, such as the inclusion of vegetative strips to remove sediment and improve drain water quality (CALFED 2000). During the irrigation season, surface drainage water collected from irrigation can be recirculated for subsequent irrigation; however, this can lead to a long-term increase in soil salinity (DWR 2013a; SJVDIP 1998).

Subsurface drainage is used to control groundwater depth to avoid or limit its encroachment into the root zone of crops (Panuska, 2011). For example in the Delta, subsurface and surface drainage is used not only to control groundwater depths related to irrigation practices, but also to control groundwater that seeps into the soils from the surface water that surrounds the islands and tracts. Areas in the western and southern San Joaquin Valley are affected by shallow, saline groundwater that accumulates due to irrigation; and the shallow groundwater is underlain by soils with poor drainage (CALFED 2000; DWR 2013a; SJVDP 1990; SJVDIP 1998; WWD 2013a, 2013b). Some areas of northern San Joaquin, Valley collect and discharge subsurface drainage to the San Joaquin River (Reclamation, 2013). Areas in the central and southern San Joaquin Valley manage poor drainage conditions by careful and integrated management of crop patterns, land retirement, irrigation methods and application rates, and/or drainage water reuse and blending, (USGS 2008; WRCD 2004).

12.3.1.2.6 Crop Adaptation in Response to Changes in Water Supply Availability

Farmers and water suppliers can react to changes in water supply in a range of ways. Some farmers adapt to variability by maintaining a mix of crops that can be shifted or fallowed in response to water supply changes. Some farmers have groundwater wells that can be used to replace surface water in times of shortage. Short term responses can also include reducing irrigation water application below what is needed to maintain full crop yield (water stressing). Over the long term, irrigation systems and management can be changed to apply less water. Decisions that farmers make in response to changes in water supply affect other aspects of their operations, and affect the economy of the surrounding community. For example, crop mix and irrigation methods affect the kinds of tractors and other equipment used on the farm.

Some types of on-farm infrastructure also are specialized for the crops grown including: grain driers and storage, hullers, fruit sorting and packing, fruit driers, cotton gins and cold storage plants. Crop-specific equipment, infrastructure, and marketing agreements may prevent a grower from change crops quickly due to changes in water supply availability.

Input suppliers, equipment dealers, labor force, and processing facilities are also dependent on, and affected by, cropping decisions. As crop types change, the mix of these related economic activities also change. This can happen over a period of time, but is difficult to achieve in the short term.

Response to Variability in CVP and SWP Water Supplies

Water availability provided by the CVP and SWP varies each year based upon hydrologic conditions and regulatory requirements, as described in Chapter 5, Surface Water Resources and Water Supplies. The CVP and SWP water supply allocations are initially announced in the late winter. The allocations can be revised throughout the spring months as the hydrologic conditions become more certain. Growers often delay finalizing some of their crop decisions until water supply allocations are announced as late as April or May. Delays in finalizing crop decisions also can result in delays in finalizing crop financing and orders to suppliers (e.g., seed, fertilizer), and contracting with labor suppliers and crop processors. Responses to variations in water allocations depend on many factors, including but not limited to: feasibility of alternative water supplies (availability, suitability of water quality, cost); types of crops grown and need for changes in equipment, processing, and labor; and long-term crop supply contracts and obligations, (WWD 2013a, 2013b). A study of changes that occurred during the 1986 through 1992 drought indicated that implementation of the changes will probably occur over a longer period of time and not necessarily during the water supply shortage, especially if groundwater or other surface water supplies can be obtained within the growing season (Dale et al. 1998).

The effects on the surrounding communities of the variability of CVP and SWP water supplies are discussed in Chapter 19, Socioeconomics, and Chapter 21, Environmental Justice.

Typical responses of a farmer or water supplier to increasing shortage of water supplies include the following actions.

- **Increase the use of groundwater**: Reduction in surface water supplies can induce substitution with groundwater using new or existing wells. Water supplies are used conjunctively in some areas with groundwater storage so that during surface water shortages, water historically used to recharge groundwater can be used for applied irrigation uses.
- **Use alternative/supplemental surface water supplies**: Alternative water supplies may include local exchanges or transfers of surface water, water transfers/purchases from more distant areas, and/or use of water stored in surface water reservoirs or groundwater banks. These all depend on the infrastructure to convey the water and the financial ability to pay for the alternatives water supplies.
- **Increased water use efficiency:** Reduced use of irrigation water may be achieved by on-farm system and irrigation management improvements, water reuse, water source blending, and delivery system improvements. Specific on-farm and delivery system improvements can include irrigation scheduling, field leveling, application system changes, and conveyance system loss reduction such as canal lining, spill reduction, and automation. Some of the changes require only management changes, such as irrigation scheduling, and can occur within the growing season. Other changes, such as conveyance system modifications, require capital investments and generally require several years to implement.
- **Field fallowing or changing to lower-water-use crops:** Fallowing, or temporary idling, reduces gross water use by the entire applied water amount, and reduces net water use by at least the evapotranspiration of the crop not planted. Typically fields with higher water use crops or lower value rotation crops would be the first fields to be fallowed. Farmers generally would avoid or minimize fallowing permanent crops or crops with long-term obligations (e.g., cannery contracts). A farmer receiving a partial allocation of water could decide to reduce irrigated acreage and transfer that acreage’s water allocation to the remaining fields in production or sell the water to other water users. A smaller reduction in water use can be achieved by switching from a crop using more water to one using less water (Dale et al. 1998). Permanent crops, such as trees and vines, that are the least economically viable or that are approaching the end of their lifespan can be removed or abandoned, and the

land fallowed until adequate water is available. In extreme dry periods, such as 2014 when there were no deliveries of CVP water to San Joaquin Valley water supply agencies with CVP water service contracts, permanent crops were removed because the plants would not survive the stress of no water or saline groundwater (Fresno Bee 2014).

- **Stress Irrigation:** Farmers generally try to irrigate to achieve maximum economic yield. For some permanent crops, severe pruning could reduce water use, but could reduce yield over multiple years (AgAlert 2010).

12.3.1.3 Cropping Pattern Changes in Response to Water Supply Availability

Conversion of farm lands to other land uses has occurred historically and continues to occur. Agricultural lands have been converted to different crop patterns, urban areas, habitat restoration, off-farm infrastructure (e.g., utilities and transportation), and on-farm infrastructure (e.g., storage, maintenance, and processing facilities). Crop conversions occur in response to changes in water supply reliability, changes in market demand for specific crops, and decisions to convert lands to urban or infrastructure land uses.

One method used to indicate changes in California agricultural acreage is related to a loss of the value of production on "Important Farmland" and "Grazing Land" acreages, as reported by the California Department of Conservation since 1988 (CDOC 2004). The comparison of the acreage of lands within each category can be used to identify trends in agricultural land conversions. This information is provided in the following subsections for the years 2000 and 2010 for counties within the Study Area.

Another factor to be considered prior to crop conversion is the costs related to crop establishment. Costs of irrigated crop production include labor, purchased inputs (e.g., seed, fertilizer, chemicals), custom services, investment in growing stock, other capital (including machinery and structures), and other overhead costs.

Reliability of water supply can be especially important for maintaining substantial investments in growing stock of perennial and multi-year crops. Perennial crops include orchards and vineyards that may have useful lives of 25 years or more. Multiyear forage crops, such as alfalfa and irrigated pasture, also may be in production for years. Investment in growing stock may be expressed as the accumulated costs incurred during the period when the crop is planted and brought to bearing age, called the establishment period. Establishment costs for perennial crops can range up to $15,000 per acre in total costs (including cash outlays plus noncash and allocated overhead costs). The example establishment costs provided in Table 12.2 are for the Central Valley, but are generally representative of establishment costs in other regions.

Table 12.2 Typical Establishment Costs for Some Perennial Crops in the Central Valley

Example Crop	Establishment Period (years)	Assumed Life of Stand (years)	Accumulated Total Cost during Establishment ($ per acre)	University of California Cooperative Extension Cost of Production Study
Alfalfa Hay	1	4	534	Sacramento Valley, 2013
Almonds	4	25	10,117	San Joaquin Valley North, 2011
Irrigated Pasture	1	20	408	Sacramento Valley, 2003
Walnuts	5	25	14,133	San Joaquin Valley North, 2013
Wine Grapes	3	25	18,495	Cabernet Sauvignon, SJ Valley North, 2012

Sources: UCCE 2003, 2011, 2012a, 2013a

Notes: All costs are converted to 2012 dollar equivalent values using the Gross Domestic Product Implicit Price Deflator (USDOC 2014). Assumed stand life is the financial life used for the cost and budget analysis. Individual growers may decide to keep stands in production longer or to remove them sooner.

Farm expenditures are largely spent in the surrounding community in the form of input purchases, hired labor, rents paid to landlords, well drilling, and custom consulting services. Total labor in the agricultural production sector is discussed in relation to the regional economy in Chapter 19, Socioeconomics. Labor hours and input purchases vary substantially among crops, as shown in Table 12.3.

Table 12.3 Land Rent, Labor Hours, and Custom Services for Example Crops in the Central Valley

Example Crop	Typical Rent ($ per acre)	Typical Annual Labor (hours per acre)	Custom Services Purchased ($ per acre)	University of California Cooperative Extension Cost of Production Study
Alfalfa Hay	284	2	368	Sacramento Valley, 2013
Almonds	763	31	828	San Joaquin Valley North, 2011
Corn, Grain	147	3	324	San Joaquin Valley South, 2012
Irrigated Pasture	63	3	159	Sacramento Valley, 2003
Rice	280	5	329	Sacramento Valley, 2012
Walnuts	690	8	1,203	San Joaquin Valley North, 2013
Wheat	246	2	57	San Joaquin Valley South, 2013
Wine Grapes	633	68	505	Cabernet Sauvignon, SJ Valley North, 2012

Sources: UCCE 2003, 2011, 2012a, 2012b, 2012c, 2013a, 2013b, 2013c

Notes: All costs are converted to 2012 dollar equivalent values using the Gross Domestic Product Implicit Price Deflator (USDOC 2014).

12.3.1.4 Water Supply and Crop Acreage Relationships in the San Joaquin Valley

Most publically-available information on irrigated acreage and crop types is compiled at the county level, not the water district level. Water availability for CVP and SWP water is provided at a smaller geographic level, such as a water supply entity or several adjacent entities. Therefore, it is difficult to analyze the correlation of water supply availability, irrigated acreage, and crop types. However, the Westlands Water District does provide more detailed information related to water availability, irrigated acreage, and crop types in their publically-available reports, as summarized in this sub-section of Chapter 12. The purpose of this summary is to describe the relationships between cropping patterns, irrigation methods, and water supply availability. Due to the increased frequency of water supply reductions, especially in drier years (as described in Chapter 5, Surface Water Resources and Water Supplies), the amount of fallowed and non-harvested lands has increased as a percentage of total lands within Westlands Water District.

12.3.1.4.1 Water Supplies in Westlands Water District

Formed in 1952, Westlands Water District currently serves over 700 farmers across 604,000 acres located on the west side of Fresno and Kings Counties, as described in Chapter 5, Surface Water Resources and Water Supplies (WWD 2013a, 2013b). There are approximately 568,000 irrigable acres in the district.

Westlands Water District began receiving CVP water in 1968. In the first 10 years of operations, irrigation water conveyance facilities were completed and cropping patterns became established. The CVP water supplies were reduced during the 1976 to 1977 drought. Crop acreage and water supply information are available for Westlands Water District from 1978 through 2013 (WWD 2013a, 2014b, 2014c).

This time period includes several major happenings and/or changes in the CVP water supplies, as described in Chapter 5, Surface Water Resources and Water Supplies, and Chapter 6, Surface Water Quality.

- In 1978, the CVP water supplies were recovering from the 1976 to 1977 drought.
- In the late 1980s, high selenium concentrations were detected in subsurface drainage flows from areas on the west side of the San Joaquin Valley where naturally occurring selenium deposits are located. Subsequently, farmers in these areas changed irrigation practices and in some cases, eliminated irrigation of some lands.
- Between 1987 and 1992, another drought occurred.
- In mid-1990s, the CVP water supplies recovered from a six year drought; however, CVP water supplies available to the district were limited due to initial restrictions on CVP operations to protect winter-run Chinook salmon

and delta smelt and to provide refuge water supplies in accordance with the federal Central Valley Project Improvement Act (Public Law 102-575).

- By 2000, the CVP was initially operated under the requirements of State Water Resources Control Board Decision 1641 and the federal Central Valley Project Improvement Act which reduced the long-term availability of CVP water as compared to the 1980s.
- In 2007, the CVP operations were modified in accordance with the Interim Remedial Order issued by the U.S. District Court for the Eastern District of California in *Natural Resources Defense Council, et al. v. Kempthorne*.
- In 2009, the CVP operations were modified in accordance with the 2008 U.S. Fish and Wildlife Service and 2009 National Marine Fisheries Services biological opinions.
- Between 2007 and 2013, six of the seven years were designated as Below Normal, Dry, or Critical Dry water years, which reduced CVP water supplies.

As CVP water supplies have declined over the past 35 years, Westland Water District has needed to implement major conservation programs and purchase water from other CVP and SWP water users and water rights holders. Concurrently, growers have increased groundwater pumping, as illustrated in Figure 12.3. Total supply over this time period ranges from a low of 787,554 acre-feet in 2010 to a high of 1,546,883 acre-feet in 1984 (WWD 2013a, 2014a).

12.3.1.4.2 Cropping Patterns in Westlands Water District

In response to varying water supplies and market factors, farmers in Westlands Water District have changed cropping patterns. In 1978, the predominant crops were cotton and grain crops, including wheat and barley, with some vegetables, including tomatoes and cantaloupe, as summarized in Figure 12.4 (WWD 2013a). Between 1980 and 1996, grain crops were replaced by vegetable crops because other areas in California that traditionally grew crops were experiencing urbanization and groundwater shortages, including southern Santa Clara County and Monterey County (WWD 2008). Planting of permanent crops, including orchards and grapevines, increased between 1978 and 2013 as the markets factors became favorable (WWD 2013a, 2014b, 2014c). Total cotton acreage remained stable between 1978 and 2000, with Acala cotton as the primary crop (WWD No Date-a, No Date-b). After 2000, the total acreage of cotton declined and the primary crop was Pima cotton due to higher market price for this crop; however, cotton prices declined in the early 2000s.

12.3.1.4.3 Irrigation Methods in Westlands Water District

Conversion of the major crops from annual grains to more orchards and vines resulted in Westlands Water District modifying water conveyance facilities because the water demand patterns changed both in quantities and seasonal timing (WWD No Date-c). The change in cropping patterns and the concurrent emphasis on water conservation also resulted in changes in irrigation methods within the district, as summarized in Table 12.4.

Table 12.4 Irrigation Methods Used in Westlands Water District, as a percentage of total irrigation methods

Years	Furrow or Border Strip Irrigation	Sprinker Irrigation	Drip or Trickle Irrigation	Sprinkler and Furrow Irrigation
1985	63%	21%	1%	15%
1990	43%	16%	3%	38%
1995	36%	15%	6%	43%
2000	30%	13%	13%	44%
2005	23%	10%	33%	34%
2010	11%	11%	67%	22%
2011	13%	12%	65%	22%

Source: WWD 2013a

These changes represent a major investment by the farmers and are considered in the cost of crop establishment costs, a consideration described in above in subsection 12.32.3.1, Crop Establishment Costs. The lower-valued grain and forage crops generally use furrow or border strip irrigation (WWD 2013a). Shallow-rooted vegetables frequently are irrigated with sprinklers or a combination of sprinklers and furrow irrigation. Recently, tomatoes for fresh-pack have been grown with drip irrigation. New orchard and vines have been planted with pressurized drip or trickle irrigation. Other methods, including leveling lands with lasers guided by global positioning satellites and aerated irrigation to introduce air to plant roots, are used to increase irrigation efficiency and improve crop yield (WWD No Date-a).

12.3.1.4.4 Response to Reduced Water Supplies in Westlands Water District

Westlands Water District acquired over 95,000 acres of land with inadequate drainage and the water supplies allocated to these lands are now available for other lands in the district (WWD 2008, 2013a, No Date-c). Much of the purchased land is leased to farmers for non-irrigated crops, or made available for buildings or other economic development, including about 600 acres to the U.S. Bureau of Prisons and about 1,250 acres to Pacific Gas & Electric Company for solar projects.

Frequently, the amount of available surface water is not adequate to meet the irrigation water demand. For example in the drier years of 1991, 1992, 2009, and 2013, groundwater provided more than 50 percent of the irrigation water supply. This extensive reliance on groundwater can substantially reduce groundwater elevations, as described in Chapter 7, Groundwater Resources and Groundwater Quality.

The Westlands Water District *Water Management Handbook* discusses that during droughts, water supplies are reduced and the cost of available water supplies are generally high due to costs of water transfers and/or implementing new or expanded groundwater facilities (WWD 2013b). At the farm level, Westlands' growers use a mix of methods to respond to reduced water supplies: groundwater pumping, land fallowing, and stress irrigation. The decision to fallow land or stress crops by applying less than full irrigation depends upon the crop. Some crops require full irrigation in order to produce a profitable yield, so stress irrigation is not practical – if water is short, acreage of these crops is reduced. Other crops may be able to withstand some stress and produce profitable yield. In the most severe shortage years, such as 2014, even some orchards and vineyards may be stressed or removed from production. From 1978 through the late 1990s when the primary crops were grains and cotton, those crops continued to be grown under stressed conditions and the fallowed and non-harvested land ranged from 3 to 16 percent of the total land in the district, as summarized in Figure 12.5 (WWD 2013a, 2014b, 2014c). However, since 2000, over 40 to 55 percent of the total land in the district is planted in high value orchards, vine, and vegetable crops which cannot sustain stress. Therefore, farmers have increased the amount of fallowed and non-harvested acres to 10 to 34 percent of the total land in the district. When permanent orchards and vines are removed from production, the overall value of production in the district declines for number of years as the permanent crops require several years to become established.

12.3.2 Trinity River Region

The Trinity River Region includes the area in Trinity County along the Trinity River from Trinity Lake to the confluence with the Klamath River; and in Humboldt and Del Norte counties along the Klamath River from the confluence with the Trinity River to the Pacific Ocean.

Agriculture in the Trinity River Region is primarily related to timber products and cattle ranching which generally do not rely upon irrigation. Small farms and vineyards are located adjacent to or near the Trinity River rely primarily upon groundwater that is recharged by precipitation and infiltration from local streams, as described in Chapter 7, Groundwater Resources and Groundwater Quality. No lands in Trinity River Region are irrigated with water supplies delivered through the CVP or SWP.

Total value of production and acreage by crop category in the counties that include portions of the Trinity River Region are listed in Table 12.5.

Table 12.5 Average Annual Agricultural Acreage and Value of Production in Trinity, Humboldt, and Del Norte Counties from 2007 through 2012

	Orchards, Vineyards, and Berries	Field and Forage	Livestock, Dairy, Poultry	Nursery, Other	Vegetable	Total
Acreage[a]	114	30,846	N/A	231	–	31,191
Value[b]	$1.8	$8.1	$108.2	$64.5	$1.7	$184

Sources: USDA-NASS2008, 2009, 2010, 2011a, 2012a, 2013a

Notes:

a Not all acreages and/or production values are reported for every crop in every county. Therefore the implied value of production per acre may be misleading for some crop categories.

b Values in million dollars, 2012 basis.

12.3.3 Central Valley Region

The Central Valley Region extends from above Shasta Lake to the Tehachapi Mountains, and includes the Sacramento Valley and San Joaquin Valley. In this chapter, the counties within the Delta and Suisun Marsh area are included in the description of the Sacramento and San Joaquin valleys or the San Francisco Bay Area Region. The Delta counties of Sacramento, Yolo, and Solano counties are included within the Sacramento Valley discussion. Solano County also includes the Suisun Marsh. San Joaquin County is included within the San Joaquin Valley discussion. Contra Costa County is included within the San Francisco Bay Area Region discussion.

Central Valley agriculture is highly productive due to favorable climate, adequate supplies of good quality irrigation water, and deep, fertile soils. Most of the Central Valley receives rainfall in the late fall through the winter months. Very little of the annual rainfall occurs during the peak agricultural irrigation season which extends from early spring through fall. The seasonality of rainfall in the Central Valley is important for agricultural resources, as the timing of precipitation does not reliably support dryland (non-irrigated) farming. Lower value over-winter non-irrigated crops (e.g., winter wheat) can be grown economically in many years but higher value row crops and permanent crops require substantial supplemental irrigation (DWR 2009). Irrigation water provided by the CVP and SWP, local surface water, and groundwater have transformed lands in the Central Valley into some of the most productive and diverse agricultural lands in the United States.

12.3.3.1 Sacramento Valley Crop Patterns

The Sacramento Valley includes the counties of Shasta, Plumas, Tehama, Glenn, Colusa, Butte, Sutter, Yuba, Nevada, Placer, El Dorado, Sacramento, Yolo, and Solano counties. Other counties in Sacramento Valley are not anticipated to be affected by changes in CVP and SWP operations, and are not discussed here, including: Alpine, Sierra, Lassen, and Amador counties.

Field and forage crops dominate the irrigated acreage in Sacramento Valley with over 1.4 million acres irrigated and about 38 percent of crop value produced, as summarized in Table 12.6. Rice, irrigated pasture, and hay are the largest acreages. Second to field and forage are orchard and vine crops, making up roughly 21 percent of total acreage, but providing more than 38 percent crop value produced. Almonds and walnuts are the largest acreages in this category. Crop establishment and production costs are as summarized in Tables 12.2 and 12.3. In total, the Sacramento Valley contains nearly two million agricultural acres generating over four billion dollars per year in value of production.

Table 12.6 Sacramento Valley Average Annual Agricultural Acreage and Value of Production from 2007 through 2012

	Orchards, Vineyards, and Berries	Field and Forage	Livestock, Dairy, Poultry	Nursery, Other	Vegetable	Total
Acreage[a]	419,263	1,435,923	N/A	1,658	91,684	1,948,527
Value[b]	$1,569	$1,581	$506	$135	$322	$4,113

Sources: USDA-NASS 2008, 2009, 2010, 2011a, 2012a, 2013a

Notes:

a Not all acreages and/or production values are reported for every crop in every county. Therefore the implied value of production per acre may be misleading for some crop categories.

b Values in million dollars, 2012 basis

Most of the counties within the Sacramento Valley have experienced losses in Important Farmland between 2000 and 2010, as summarized in Table 12.7.

Table 12.7 Farmland Mapping and Monitoring Program Acreages in the Sacramento Valley in 2000 and 2010

County		Important Farmland[b]			Grazing Land		
	Total[a]	2000	2010	Change	2000	2010	Change
Butte	1.08	257,316	237,351	-19,965	264,982	402,999	138,017
Colusa	0.72	565,890	554,695	-11,195	7,526	9,161	1,635
El Dorado	1.1	68,292	64,259	-4,033	203,798	193,883	-9,915
Glenn	0.84	407,906	348,147	-59,759	176,072	226,837	50,765
Nevada	0.64	21,973	25,934	3,961	129,758	116,808	-12,950
Placer	0.96	156,701	132,741	-23,960	23,708	24,193	485
Sacramento	1.1	227,931	211,744	-16,187	168,144	155,822	-12,322
Shasta	2.4	35,349	19,716	-15,633	409,479	414,052	4,573
Solano	0.58	169,934	147,464	-22,470	201,813	209,195	7,382
Sutter	0.39	301,176	285,820	-15,356	50,958	53,538	2,580
Tehama	1.7	244,782	231,592	-13,190	706,027	1,547,951	841,924
Yolo	0.65	409,796	374,534	-35,262	143,365	160,450	17,085
Yuba	0.41	90,173	82,538	-7,635	144,519	141,509	-3,010

Sources: Butte County 2010; CDOC 2013; Colusa County 2011; El Dorado County 2003; Glenn County 1993; Nevada County 1995; Placer County 2011; Sacramento County 2010; Shasta County 2004; Solano County 2008; Sutter County 2010; Tehama County 2008; Yolo County 2009; Yuba County 2011

Notes:

a. Total acreage of county in million acres

b. Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland.

No data was reported by California Department of Conservation for Plumas County.

12.3.3.2 San Joaquin Valley

The San Joaquin Valley includes the counties of Stanislaus, Merced, Madera, San Joaquin, Fresno, Kings, Tulare, and Kern counties. Other counties in the San Joaquin Valley are not anticipated to be affected by changes in CVP and SWP operations, and are not discussed here, including: Calaveras, Mariposa, and Tuolumne counties.

Field and forage crops are also the largest category in by acreage in this region, as summarized in Table 12.8. Hay, cotton, and silage have the largest acreage in this category. Second to field and forage is orchard and vine crops with almost two million acres, but providing more than three times the value of production. Almonds and grapes are the two largest acreages of orchard and vine crops in the San Joaquin Valley. Crop establishment and production costs are as summarized in Tables 12.2 and 12.3. In total, the San Joaquin Valley contains over 5.5 million irrigated acres, generating over twenty-six billion dollars in value of production.

Important differences exist in water supply mix and reliability within the San Joaquin Valley. The CVP water users that are located on the west side of the valley and the SWP water users in Kings and Kern counties rely primarily on surface water conveyed through the Delta and groundwater, as discussed in Chapter 5, Surface Water Resources and Water Supplies. Agricultural producers within these CVP water service contractors and SWP entitlement holders are especially susceptible to large variation in available surface water supplies. The San Joaquin River Exchange Contractors receive CVP water supplies in exchange for their water rights on the San Joaquin River; and therefore, have much higher water supply reliability than CVP water service contractors or SWP entitlement holders, as described in Chapter 5, Surface Water Resources and Water Supplies.

On the east side of the San Joaquin Valley at the base of the Sierra Nevada, surface water is delivered under senior water rights on streams from the Sierra Nevada, or by the CVP from Millerton Lake at Friant Dam, as described in Chapter 5, Surface Water Resources and Water Supplies. The reliability of CVP water supplies from Friant Dam have generally been similar to or higher than that of CVP water supplies conveyed through the Delta. However, in 2014, the allocations were reduced to zero and available water from Friant Dam was provided to the water rights holders along the San Joaquin River (e.g., San Joaquin River Exchange Contractors).

A number of agricultural areas throughout the valley have no or very low priority surface water rights. Growers in these areas rely on groundwater for irrigation water.

Table 12.8 San Joaquin Valley Average Annual Agricultural Acreage and Value of Production from 2007 through 2012

	Orchards, Vineyards, and Berries	Field and Forage	Livestock, Dairy, Poultry	Nursery, Other	Vegetable	Total
Acreage[a]	1,943,549	3,078,803	N/A	3,838	510,370	5,536,560
Value[b]	$10,915	$3,049	$9,429	$469	$2,789	$26,651

Sources: USDA-NASS 2008, 2009, 2010, 2011a, 2012a, 2013a

Notes:

a. Not all acreages and/or production values are reported for every crop in every county. Therefore the implied value of production per acre may be misleading for some crop categories.

b. Values in million dollars, 2012 basis.

Most counties within the San Joaquin Valley Region have experienced losses in Important Farmland between 2000 and 2010, as summarized in Table 12.9. The acreage of Important Farmland in Kern County grew substantially due to reclassification of lands in the foothills of the county.

Table 12.9 Farmland Mapping and Monitoring Program Acreages in the San Joaquin Valley in 2000 and 2010

County		Important Farmland[b]			Grazing Land		
	Total[a]	2000	2010	Change	2000	2010	Change
Fresno	3.8	1,400,535	1,370,273	-30,262	835,870	825,752	-10,118
Kern	5.3	990,422	914,084	-76,338	1,777,640	1,827,391	49,751
Kings	0.82	607,274	552,087	-55,187	238,485	271,831	33,346
Madera	1.4	60,617	39,812	-20,805	216,795	231,475	14,680
Merced	1.3	374,762	361,582	-13,180	401,592	400,604	-988
San Joaquin	0.91	630,990	614,994	-15,996	150,341	139,235	-11,106
Stanislaus	0.94	386,534	403,802	17,268	375,367	429,544	54,177
Tulare	3.1	880,604	859,991	-20,613	434,047	440,042	5,995

Sources: CDOC 2013; Fresno County 2000; Kern County 2004; Kings County 2009; Madera County 1995; Merced County 2012; San Joaquin 2009; Stanislaus County 2010; Tulare County 2010

Notes:

a. Total acreage of county in million acres

b. Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland

12.3.4 San Francisco Bay Area Region

The San Francisco Bay Area Region includes portions of Napa, Contra Costa, Alameda, Santa Clara, and San Benito counties that are within the CVP and SWP service areas.

Crops grown in the San Francisco Bay Area Region include berries, vegetables, orchards, nursery plants, and irrigated and non-irrigated pasture. Permanent crops (orchards, vineyards, and berries) cover the largest acreage in this region with around 60,000 acres planted, as summarized in Table 12.10. Field and forage crops and vegetables also cover substantial acreage. Crop establishment and production costs are generally similar to those shown in Tables 12.2 and 12.3, except that land costs and rent may be substantially higher in this region. In total, the San Francisco Bay Area Region contains about 150,000 acres planted, creating over one billion dollars per year in value of production.

Table 12.10 San Francisco Bay Area Average Annual Agricultural Acreage and Value from 2007 through 2012

	Orchards, Vineyards, Berries	Field and Forage	Livestock, Dairy, Poultry	Nursery, Other	Vegetable	Total
Acreage[a]	60,239	50,715	N/A	942	41,564	153,460
Value[b]	$589	$22	$62	$145	$329	$1,148

Sources: USDA-NASS 2008, 2009, 2010, 2011a, 2012a, 2013a

Notes:

a. Not all acreages and/or production values are reported for every crop in every county. Therefore the implied value of production per acre may be misleading for some crop categories.

b. Values in million dollars, 2012 basis

Changes in farmland in the San Francisco Bay Area Region counties are summarized in Table 12.11.

Table 12.11 Farmland Mapping and Monitoring Program Acreages in the San Francisco Bay Area Region in 2000 and 2010

County		Important Farmland[b]			Grazing Land		
	Total[a]	2000	2010	Change	2000	2010	Change
Alameda	0.47	10,346	7,566	-2,780	247,218	244,033	-3,185
Contra Costa	0.52	102,294	90,148	-12,146	172,053	168,646	-3,407
Napa	0.51	78,406	76,210	-2,196	180,920	179,029	-1,891
San Benito	0.89	81,701	57,460	-24,241	595,537	614,821	19,284
Santa Clara	0.84	44,025	27,751	-16,274	389,210	392,777	3,567

Sources: Alameda County 2000; CDOC 2013; Contra Costa County 2005; Napa County 2007; San Benito County 2013; Santa Clara County 1994

a. Total acreage of county in million acres

b. Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland

12.3.5 Central Coast Region

The Central Coast Region includes portions of San Luis Obispo and Santa Barbara counties served by the SWP.

Crops grown in this region include orchards and vineyards, berries, vegetables, and irrigated pasture. Permanent crops and vegetables dominate the irrigated acreage in this region, accounting for about eighty percent of both the acres planted and the annual value of production, as summarized in Table 12.12. Crop establishment and production costs are generally similar to those shown in Tables 12.2 and 12.3, except that land costs and rent may be higher in this region. On average, the Central Coast Region contains almost 230,000 acres planted and almost two billion dollars per year in value of production.

Table 12.12 Central Coast Region Average Annual Agricultural Acreage and Value from 2007 through 2012

	Orchards, Vineyards, Berries	Field and Forage	Livestock, Dairy, Poultry	Nursery, Other	Vegetable	Total
Acreage[a]	86,394	43,078	N/A	1,749	97,17	228,397
Value[b]	$874	$22	$98	$268	$641	$1,904

Sources: USDA-NASS 2008, 2009, 2010, 2011a, 2012a, 2013a

Notes:

a. Not all acreages and/or production values are reported for every crop in every county. Therefore the implied value of production per acre may be misleading for some crop categories.

b. Values in million dollars, 2012 basis

Changes in farmland in the Central Coast Region between 2000 and 2010 are summarized in Table 12.13.

Table 12.13 Farmland Mapping and Monitoring Program Acreages in the Central Coast and Southern California Regions in 2000 and 2010

County		Important Farmland[b]			Grazing Land		
	Total[a]	2000	2010	Change	2000	2010	Change
San Luis Obispo	2.3	496,116	409,726	-86,390	1,105,169	1,181,015	75,846
Santa Barbara	1.8	139,810	125,292	-14,518	583,709	581,642	-2,067

Sources: CDOC 2013; San Luis Obispo County 2013; Santa Barbara County 2009

Notes:

a. Total acreage of county in million acres

b. Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland

12.3.6 Southern California Region

The Southern California Region includes portions of Ventura, Los Angeles, Orange, San Diego, Riverside, and San Bernardino counties served by the SWP.

Two crop categories, orchards, vineyards, and berries; and field and forage, account for more than three quarters of the irrigated acreage and about sixty percent of the annual value of production in the Southern California Region, as summarized in Table 12.14). Vegetables account for about one fifth of the irrigated acreage and production value. Crop establishment and production costs are generally similar to those shown in Tables 12.2 and 12.3, except that land costs and rent may be higher in parts of this region. In total, the Southern California Region contains almost 380,000 acres irrigated and generates over five billion dollars per year in value of production.

Table 12.14 Southern California Average Annual Agricultural Acreage and Value from 2007 through 2012

	Orchards, Vineyards, Berries	Field and Forage	Livestock, Dairy, Poultry	Nursery, Other	Vegetable	Total
Acreage[a]	141,447	143,747	N/A	10,143	81,306	376,642
Value[b]	$1,693	$161	$809	$1,851	$925	$5,439

Sources: USDA-NASS 2008, 2009, 2010, 2011a, 2012a, 2013a

Notes:

a. Not all acreages and/or production values are reported for every crop in every county. Therefore the implied value of production per acre may be misleading for some crop categories.

b. Values in million dollars, 2012 basis

Changes in farmland in the Southern California Region between 2000 and 2010 are summarized in Table 12.15.

Table 12.15 Farmland Mapping and Monitoring Program Acreages in the Southern California Region in 2000 and 2010

County		Important Farmland[b]			Grazing Land		
	Total[a]	2000	2010	Change	2000	2010	Change
Los Angeles	2.6	60,617	39,812	-20,805	216,795	231,475	14,680
Orange	0.61	16,953	7,264	-9,689	37,963	37,639	-324
Riverside	4.7	484,821	428,989	-55,832	124,714	110,841	-13,873
San Bernardino	12.9	44,738	22,761	-21,977	936,090	902,590	-33,500
San Diego	2.9	193,103	218,921	25,818	137,619	126,496	-11,123
Ventura	1.2	131,512	119,683	-11,829	208,752	197,278	-11,474

Sources: CDOC 2013; Los Angeles County 2011; Orange County 2005; RCIP 2000; San Bernardino County 2007; San Diego County 2011; Ventura County 2005

Notes:

a. Total acreage of county in million acres

b. Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland

12.4 Impact Analysis

This section describes the potential mechanisms and analytical methods for change in agricultural resources; results of the impact analysis; potential mitigation measures; and cumulative effects.

12.4.1 Potential Mechanisms for Change in Agricultural Resources

As described in Chapter 4, Approach to Environmental Analysis, the impact analysis considers changes in agricultural resources related to changes in CVP and SWP operations under the alternatives as compared to the No Action Alternative and Second Basis of Comparison.

Changes in CVP and SWP operations under the alternatives as compared to the No Action Alternative and Second Basis of Comparison could change irrigated acreage and total production value in areas that use CVP and SWP water supplies under long-term conditions (based upon the 81-year model simulation period) and dry and critical dry years.

This chapter only includes the analysis of economic changes in agricultural revenues. Chapter 19, Socioeconomics, includes economic changes related to municipal and industrial water supplies and changes in regional economics.

12.4.1.1 Changes in Irrigated Agricultural Acreage and Total Production Value

Changes in CVP and SWP operations under the alternatives could change the extent of irrigated acreage and total production value over the long-term average condition and in dry and critical dry years as compared to the No Action Alternative and Second Basis of Comparison.

Agricultural impacts were evaluated using a regional agricultural production model developed for large-scale analysis of irrigation water supply and cost changes. The Statewide Agricultural Production (SWAP) model is a regional model of irrigated agricultural production and economics that simulates the decisions of producers (farmers) in 27 agricultural subregions in the Central Valley Region, as described in Appendix 12A. The model selects the crops, water supplies, and other inputs that maximize profit subject to constraints on water and land, and subject to economic conditions regarding prices, yields, and costs.

The SWAP model incorporates CVP and SWP water supplies, other local water supplies represented in the CalSim II model, and groundwater. As conditions change within a SWAP subregion (e.g., the quantity of available project water supply declines), the model optimizes production by adjusting the crop mix, water sources and quantities used, and other inputs. The model also fallows land when that appears to be the most cost-effective response to resource conditions.

SWAP was used to compare the long-run agricultural economic responses to potential changes in CVP and SWP irrigation water delivery and to changes in groundwater conditions associated with the alternatives. Results from the surface water analysis that used the CalSim II model, as described in Chapter 5, Surface Water Resources and Water Supplies, were provided as inputs into SWAP through a standardized data linkage procedure. Results from the groundwater analysis that used the CVHM model, as described in Chapter 7, Groundwater Resources and Groundwater Quality, were used to develop changes in pumping lift in SWAP. SWAP produces estimates of the change in value and costs of agricultural production.

The analysis only reduces groundwater withdrawals based upon an optimization of agricultural production costs. The analysis does not restrict groundwater withdrawals based upon groundwater overdraft or groundwater quality conditions. As described in Chapter 7, Groundwater Resources and Groundwater Quality, the Sustainable Groundwater Management Act requires preparation of Groundwater Sustainability Plans (GSPs) by 2020 or 2022 for most of the groundwater basins in the Central Valley Region. The GSPs will identify methods to implement measures that will achieve sustainable groundwater operations by 2040 or 2042. The analysis in this chapter is focused on conditions that would occur in 2030. If local agencies fully implement GSPs prior to the regulatory deadline, increasing groundwater use would be less of an option for agricultural water users. However, to achieve sustainable conditions, some measures could require several years to design and construct new water supply facilities, and sustainable groundwater conditions are not required until the 2040s. Therefore, it was assumed that Central Valley agriculture water users would not reduce groundwater use by 2030, and that groundwater use would change in response to changes CVP and SWP water supplies.

12.4.1.2 Effects Related to Water Transfers

Historically water transfer programs have been developed on an annual basis. The demand for water transfers is dependent upon the availability of water supplies to meet water demands. Water transfer transactions have increased over time as CVP and SWP water supply availability has decreased, especially during drier water years.

Parties seeking water transfers generally acquire water from sellers who have available surface water who can make the water available through releasing previously stored water, pump groundwater instead of using surface water (groundwater substitution); idle crops; or substitute crops that uses less water in order to reduce normal consumptive use of surface water.

Water transfers using CVP and SWP Delta pumping plants and south of Delta canals generally occur when there is unused capacity in these facilities. These conditions generally occur drier water year types when the flows from upstream reservoirs plus unregulated flows are adequate to meet the Sacramento Valley water demands and the CVP and SWP export allocations. In non-wet years, the CVP and SWP water allocations would be less than full contract amounts; therefore, capacity may be available in the CVP and SWP conveyance facilities to move water from other sources.

Projecting future agricultural resources conditions related to water transfer activities is difficult because specific water transfer actions required to make the water available, convey the water, and/or use the water would change each year due to changing hydrological conditions, CVP and SWP water availability, specific local agency operations, and local cropping patterns. Reclamation recently prepared a long-term regional water transfer environmental document which evaluated potential changes in agricultural resources conditions related to water transfer actions (Reclamation 2014c). Results from this analysis were used to inform the impact assessment of potential effects of water transfers under the alternatives as compared to the No Action Alternative and the Second Basis of Comparison.

12.4.2 Conditions in Year 2030 without Implementation of Alternatives 1 through 5

This EIS includes two bases of comparison, as described in Chapter 3, Description of Alternatives: the No Action Alternative and the Second Basis of Comparison. Both of these bases are evaluated at 2030 conditions. Changes that would occur over the next 15 years without implementation of the alternatives are not analyzed in this EIS. However, the changes to agricultural resources that are assumed to occur by 2030 under the No Action Alternative and the Second Basis of Comparison are summarized in this section. Many of the changed conditions would occur in the same manner under both the No Action Alternative and the Second Basis of Comparison.

12.4.2.1 Common Changes in Conditions under the No Action Alternative and Second Basis of Comparison

Conditions in 2030 would be different than existing conditions due to:

- Climate change and sea level rise
- General plan development throughout California, including increased water demands in portions of Sacramento Valley
- Implementation of reasonable and foreseeable water resources management projects to provide water supplies

It is anticipated that climate change would result in more short-duration high-rainfall events and less snowpack in the winter and early spring months. The reservoirs would be full more frequently by the end of April or May by 2030 than in recent historical conditions. However, as the water is released in the spring, there would be less snowpack to refill the reservoirs. These changes would result in a decline of the long-term average CVP and SWP water supply deliveries by 2030 as compared to recent historical long-term average deliveries under the No Action Alternative and the Second Basis of Comparison. However, the CVP and SWP water deliveries would be less under the No Action Alternative as compared to the Second Basis of Comparison, as described in Chapter 5, Surface Water Resources and Water Supplies, which could result in more crop idling.

Under the No Action Alternative and the Second Basis of Comparison, land uses in 2030 would occur in accordance with adopted general plans. Development under the general plans would result in disruption of agricultural resources; however, the development of general plans includes preparation of environmental documentation that would identify methods to minimize adverse impacts to agricultural resources.

Under the No Action Alternative and the Second Basis of Comparison, development of future water resources management projects by 2030 which would result in improved water supply flexibility and availability, including water supplies for agricultural resources, as described in Chapter 3, Description of Alternatives.

By 2030 under the No Action Alternative and the Second Basis of Comparison, it is assumed that ongoing programs would result in restoration of more than 10,000 acres of intertidal and associated subtidal wetlands in Suisun Marsh and Cache Slough; and 17,000 to 20,000 acres of seasonal floodplain restoration in the Yolo Bypass. The restoration programs could disrupt agricultural resources depending upon the location of the restoration.

12.4.3 Evaluation of Alternatives

Alternatives 1 through 5 have been compared to the No Action Alternative; and the No Action Alternative and Alternatives 1 through 5 have been compared to the Second Basis of Comparison.

During review of the numerical modeling analyses used in this EIS, an error was determined in the CalSim II model assumptions related to the Stanislaus River operations for the Second Basis of Comparison, Alternative 1, and Alternative 4 model runs. Appendix 5C includes a comparison of the CalSim II model run results presented in this chapter and CalSim II model run results with the error corrected. Appendix 5C also includes a discussion of changes in the comparison of groundwater conditions for the following alternative analyses.

- No Action Alternative compared to the Second Basis of Comparison
- Alternative 1 compared to the No Action Alternative
- Alternative 3 compared to the Second Basis of Comparison
- Alternative 5 compared to the Second Basis of Comparison.

12.4.3.1 No Action Alternative

The No Action Alternative is compared to the Second Basis of Comparison.

12.4.3.1.1 Trinity River Region

Potential Changes in Irrigated Agricultural

There are no agricultural lands irrigated with CVP and SWP water supplies in the Trinity River Region. Therefore, there would be no changes in irrigated lands under the No Action Alternative as compared to the Second Basis of Comparison.

12.4.3.1.2 Central Valley Region

Potential Changes in Irrigated Agriculture.

Sacramento Valley

Results of the SWAP analysis indicated that agricultural crop patterns in the Sacramento Valley would be similar (less than 5 percent change) under the No Action Alternative and the Second Basis of Comparison over long-term average conditions and in dry and critical dry years, as summarized in Tables 12.16 and 12.17.

Table 12.16 Changes in Sacramento Valley Irrigated Acreage over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Crops	No Action Alternative (1000s acres)	Second Basis of Comparison (1000s acres)	Changes (1000s acres)
Grain Crops	155	154	1
Rice	548	548	0
Field Crops	59	59	0
Forage Crops	199	200	-1
Vegetables and Truck Crops	119	119	0
Orchards and Vineyards	456	457	0
Total	1,537	1,537	0

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Table 12.17 Changes in Sacramento Valley Irrigated Acreage in Dry and Critical Dry Years under the No Action Alternative as Compared to the Second Basis of Comparison

Crops	No Action Alternative (1000s acres)	Second Basis of Comparison (1000s acres)	Changes (1000s acres)
Grain Crops	155	155	0
Rice	544	548	-4
Field Crops	59	59	0
Forage Crops	197	198	-1
Vegetables and Truck Crops	119	119	0
Orchards and Vineyards	456	457	-1
Total	1,529	1,536	-7

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Agricultural production in the Sacramento Valley would be similar (less than 5 percent change) under the No Action Alternative and the Second Basis of Comparison over long-term average conditions and in dry and critical dry years due to increased use of groundwater, as summarized in Tables 12.18 and 12.19.

Table 12.18 Changes in Sacramento Valley Agricultural Production over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Crops	No Action Alternative ($ millions)	Second Basis of Comparison ($ millions)	Changes ($ millions)
Grain Crops	150	149	0.8
Rice	1,114	1,115	-0.9
Field Crops	77	77	0.1
Forage Crops	246	246	-0.7
Vegetables and Truck Crops	967	967	0.0
Orchards and Vineyards	3,192	3,193	-0.9
Total	5,745	5,747	-1.6

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Table 12.19 Changes in Sacramento Valley Agricultural Production in Dry and Critical Dry Years under the No Action Alternative as Compared to the Second Basis of Comparison

Crops	No Action Alternative ($ millions)	Second Basis of Comparison ($ millions)	Changes ($ millions)
Grain Crops	150	150	-0.5
Rice	1,107	1,114	-7.3
Field Crops	77	77	-0.1
Forage Crops	243	245	-1.4
Vegetables and Truck Crops	967	967	-0.2
Orchards and Vineyards	3,191	3,193	-1.7
Total	5,735	5,746	-11.3

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

San Joaquin Valley

Results of the SWAP analysis indicated that irrigated acreage in the San Joaquin Valley, including the Tulare Lake area, would be similar under the No Action Alternative as compared to the Second Basis of Comparison over long-term average conditions and in dry and critical dry years, as summarized in Tables 12.20 and 12.21.

Table 12.20 Changes in San Joaquin Valley Irrigated Acreage over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Crops	No Action Alternative (1000s acres)	Second Basis of Comparison (1000s acres)	Changes (1000s acres)
Grain Crops	1,024	1,024	0
Rice	17	17	0
Field Crops	828	828	0
Forage Crops	735	735	0
Vegetables and Truck Crops	633	633	0
Orchards and Vineyards	2,156	2,156	0
Total	5,392	5,392	0

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Table 12.21 Changes in San Joaquin Valley Irrigated Acreage in Dry and Critical Dry Years under the No Action Alternative as Compared to the Second Basis of Comparison

Crops	No Action Alternative (1000s acres)	Second Basis of Comparison (1000s acres)	Changes (1000s acres)
Grain Crops	1,010	1,024	-14
Rice	17	17	0
Field Crops	827	828	0
Forage Crops	735	735	-1
Vegetables and Truck Crops	633	633	0
Orchards and Vineyards	2,154	2,156	-2
Total	5,375	5,392	-17

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Agricultural production in the Sacramento Valley would be similar under the No Action Alternative and the Second Basis of Comparison over long-term average conditions and in dry and critical dry years due to increased use of groundwater, as summarized in Tables 12.22 and 12.23.

Table 12.22 Changes in San Joaquin Valley Agricultural Production over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Crops	No Action Alternative ($ millions)	Second Basis of Comparison ($ millions)	Changes ($ millions)
Grain Crops	1,373	1,373	-0.2
Rice	31	31	0.0
Field Crops	1,436	1,437	-0.4
Forage Crops	1,426	1,426	-0.1
Vegetables and Truck Crops	4,623	4,623	0.1
Orchards and Vineyards	16,547	16,547	0.0
Total	25,437	25,438	-0.5

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Table 12.23 Changes in San Joaquin Valley Agricultural Production in Dry and Critical Dry Years under the No Action Alternative as Compared to the Second Basis of Comparison

Crops	No Action Alternative ($ millions)	Second Basis of Comparison ($ millions)	Changes ($ millions)
Grain Crops	1,359	1,373	-14.4
Rice	31	31	0.0
Field Crops	1,436	1,437	-0.9
Forage Crops	1,426	1,426	-0.4
Vegetables and Truck Crops	4,623	4,623	-0.2
Orchards and Vineyards	16,542	16,547	-4.4
Total	25,417	25,437	-20.3

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Effects Related to Cross Delta Water Transfers

Potential effects to agricultural resources could be similar to those identified in a recent environmental analysis conducted by Reclamation for long-term water transfers from the Sacramento to San Joaquin valleys (Reclamation 2014c). Potential effects to agricultural resources were identified as reduced cultivation of agricultural lands over the term of the transfer in the seller's service area. However, the amount of land effected by the water transfers would be relatively small as compared to the total cultivated acreage within a region. Beneficial changes would occur related to agricultural resources in the purchaser's service areas. The analysis indicated that these potential impacts would not be substantial.

Under the No Action Alternative, the timing of cross Delta water transfers would be limited to July through September and include annual volumetric limits, in accordance with the 2008 USFWS BO and 2009 NMFS BO. Under the Second Basis of Comparison, water could be transferred throughout the year without an annual volumetric limit. Overall, the potential for cross Delta water transfers would be less under the No Action Alternative than under the Second Basis of Comparison.

12.4.3.1.3 San Francisco Bay Area, Central Coast, and Southern California Regions

Potential Changes in Irrigated Agricultural

It is anticipated that reductions in CVP and SWP water supplies within the San Francisco Bay Area, Central Coast, and Southern California regions would not result in reductions in irrigated acreage or land use changes due to the use of other water supplies in the same manner that is projected to occur in the Central Valley Region.

12.4.3.2 Alternative 1

Alternative 1 is identical to the Second Basis of Comparison. Alternative 1 is compared to the No Action Alternative and the Second Basis of Comparison. However, because agricultural resource conditions under Alternative 1 are identical to agricultural resource conditions under the Second Basis of Comparison; Alternative 1 is only compared to the No Action Alternative.

12.4.3.2.1 Alternative 1 Compared to the No Action Alternative

Trinity River Region

Potential Changes in Irrigated Agricultural

There are no agricultural lands irrigated with CVP and SWP water supplies in the Trinity River Region. Therefore, there would be no changes in irrigated lands under Alternative 1 as compared to the No Action Alternative.

Central Valley Region

Potential Changes in Irrigated Agricultural

Sacramento Valley

Results of the SWAP analysis indicated that agricultural crop patterns in the Sacramento Valley would be similar under Alternative 1 as compared to the No Action Alternative over long-term average conditions and in dry and critical dry years, as summarized in Tables 12.24 and 12.25.

Table 12.24 Changes in Sacramento Valley Irrigated Acreage over the Long-term Average Conditions under Alternative 1 as compared to the No Action Alternative

Crops	Alternative 1 (1000s acres)	No Action Alternative (1000s acres)	Changes (1000s acres)
Grain Crops	154	155	-1
Rice	549	548	0
Field Crops	59	59	0
Forage Crops	200	199	1
Vegetables and Truck Crops	119	119	0
Orchards and Vineyards	457	456	0
Total	1,537	1,537	0

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Table 12.25 Changes in Sacramento Valley Irrigated Acreage in Dry and Critical Dry Years under Alternative 1 as compared to the No Action Alternative

Crops	Alternative 1 (1000s acres)	No Action Alternative (1000s acres)	Changes (1000s acres)
Grain Crops	155	155	0
Rice	548	544	4
Field Crops	59	59	0
Forage Crops	198	197	1
Vegetables and Truck Crops	119	119	0
Orchards and Vineyards	457	456	1
Total	1,536	1,529	7

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Agricultural production in the Sacramento Valley would be similar (less than 5 percent change) under Alternative 1 as compared to the No Action Alternative over long-term average conditions and in dry and critical dry years due to reduced use of groundwater, as summarized in Tables 12.26 and 12.27.

Table 12.26 Changes in Sacramento Valley Agricultural Production over the Long-term Average Conditions under Alternative 1 as compared to the No Action Alternative

Crops	Alternative 1 ($ millions)	No Action Alternative ($ millions)	Changes ($ millions)
Grain Crops	149	150	-0.8
Rice	1,115	1,114	0.9
Field Crops	77	77	-0.1
Forage Crops	246	246	0.7
Vegetables and Truck Crops	967	967	0.0
Orchards and Vineyards	3,193	3,192	0.9
Total	5,747	5,745	1.6

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Table 12.27 Changes in Sacramento Valley Agricultural Production in Dry and Critical Dry Years under Alternative 1 as compared to the No Action Alternative

Crops	Alternative 1 ($ millions)	No Action Alternative ($ millions)	Changes ($ millions)
Grain Crops	150	150	0.5
Rice	1,114	1,107	7.3
Field Crops	77	77	0.1
Forage Crops	245	243	1.4
Vegetables and Truck Crops	967	967	0.2
Orchards and Vineyards	3,193	3,191	1.7
Total	5,746	5,735	11.3

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

San Joaquin Valley

Results of the SWAP analysis indicated that irrigated acreage in the San Joaquin Valley, including the Tulare Lake area, would be similar under Alternative 1 as compared to the No Action Alternative over long-term average conditions and in dry and critical dry years, as summarized in Tables 12.28 and 12.29.

Table 12.28 Changes in San Joaquin Valley Irrigated Acreage over the Long-term Average Conditions under Alternative 1 as compared to the No Action Alternative

Crops	Alternative 1 (1000s acres)	No Action Alternative (1000s acres)	Changes (1000s acres)
Grain Crops	1,024	1,024	0
Rice	17	17	0
Field Crops	828	828	0
Forage Crops	735	735	0
Vegetables and Truck Crops	633	633	0
Orchards and Vineyards	2,156	2,156	0
Total	5,392	5,392	0

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Table 12.29 Changes in San Joaquin Valley Irrigated Acreage in Dry and Critical Dry Years under Alternative 1 as compared to the No Action Alternative

Crops	Alternative 1 (1000s acres)	No Action Alternative (1000s acres)	Changes (1000s acres)
Grain Crops	1,024	1,010	14
Rice	17	17	0
Field Crops	828	827	0
Forage Crops	735	735	1
Vegetables and Truck Crops	633	633	0
Orchards and Vineyards	2,156	2,154	2
Total	5,392	5,375	17

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Agricultural production in the San Joaquin Valley would be similar under Alternative 1 as compared to the No Action Alternative over long-term average conditions and in dry and critical dry years due to reduced use of groundwater, as summarized in Tables 12.30 and 12.31.

Table 12.30 Changes in San Joaquin Valley Agricultural Production over the Long-term Average Conditions under Alternative 1 as compared to the No Action Alternative

Crops	Alternative 1 ($ millions)	No Action Alternative ($ millions)	Changes ($ millions)
Grain Crops	1,373	1,373	0.2
Rice	31	31	0.0
Field Crops	1,437	1,436	0.4
Forage Crops	1,426	1,426	0.1
Vegetables and Truck Crops	4,623	4,623	-0.1
Orchards and Vineyards	16,547	16,547	0.0
Total	25,438	25,437	0.5

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Table 12.31 Changes in San Joaquin Valley Agricultural Production in Dry and Critical Dry Years under Alternative 1 as compared to the No Action Alternative

Crops	Alternative 1 ($ millions)	No Action Alternative ($ millions)	Changes ($ millions)
Grain Crops	1,373	1,359	14.4
Rice	31	31	0.0
Field Crops	1,437	1,436	0.9
Forage Crops	1,426	1,426	0.4
Vegetables and Truck Crops	4,623	4,623	0.2
Orchards and Vineyards	16,547	16,542	4.4
Total	25,437	25,417	20.3

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Effects Related to Water Transfers

Potential effects to agricultural resources could be similar to those identified in a recent environmental analysis conducted by Reclamation for long-term water transfers from the Sacramento to San Joaquin valleys (Reclamation 2014c) as described above under the No Action Alternative compared to the Second Basis of Comparison. For the purposes of this EIS, it is anticipated that similar conditions would occur during implementation of cross Delta water transfers under Alternative 1 and the No Action Alternative, and that impacts on agricultural resources would not be substantial in the seller's service area due to implementation requirements of the transfer programs.

Under Alternative 1, water could be transferred throughout the year without an annual volumetric limit. Under the No Action Alternative, the timing of cross Delta water transfers would be limited to July through September and include annual volumetric limits, in accordance with the 2008 USFWS BO and 2009 NMFS BO. Overall, the potential for cross Delta water transfers would be increased under Alternative 1 as compared to the No Action Alternative.

San Francisco Bay Area, Central Coast, and Southern California Regions

Potential Changes in Irrigated Agricultural

It is anticipated that reductions in CVP and SWP water supplies within the San Francisco Bay Area, Central Coast, and Southern California regions would not result in reductions in irrigated acreage or land use changes due to the use of other water supplies in the same manner that is projected to occur in the Central Valley Region.

12.4.3.2.2 Alternative 1 Compared to the Second Basis of Comparison

Alternative 1 is identical to the Second Basis of Comparison.

12.4.3.3 Alternative 2

The agricultural resources under Alternative 2 would identical to the conditions under the No Action Alternative; therefore, Alternative 2 is only compared to the Second Basis of Comparison.

12.4.3.3.1 Alternative 2 Compared to the Second Basis of Comparison

Changes to agricultural resources under Alternatives 2 as compared to the Second Basis of Comparison would be the same as the impacts described in Section 12.4.3.1, No Action Alternative.

12.4.3.4 Alternative 3

The CVP and SWP operations under Alternative 3 are similar to the Second Basis of Comparison with modified Old and Middle River flow criteria and New Melones Reservoir operations.

12.4.3.4.1 Alternative 3 Compared to the No Action Alternative

Trinity River Region

Potential Changes in Irrigated Agricultural

There are no agricultural lands irrigated with CVP and SWP water supplies in the Trinity River Region. Therefore, there would be no changes in irrigated lands under Alternative 3 as compared to the No Action Alternative.

Central Valley Region

Potential Changes in Irrigated Agricultural

Sacramento Valley

Results of the SWAP analysis indicated that agricultural crop patterns in the Sacramento Valley would be similar under Alternative 3 as compared to the No Action Alternative over long-term average conditions and in dry and critical dry years, as summarized in Tables 12.32 and 12.33.

Table 12.32 Changes in Sacramento Valley Irrigated Acreage over the Long-term Average Conditions under Alternative 3 as compared to the No Action Alternative

Crops	Alternative 3 (1000s acres)	No Action Alternative (1000s acres)	Changes (1000s acres)
Grain Crops	154	155	-1
Rice	548	548	0
Field Crops	59	59	0
Forage Crops	200	199	1
Vegetables and Truck Crops	119	119	0
Orchards and Vineyards	457	456	0
Total	1,537	1,537	0

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Table 12.33 Changes in Sacramento Valley Irrigated Acreage in Dry and Critical Dry Years under Alternative 3 as compared to the No Action Alternative

Crops	Alternative 3 (1000s acres)	No Action Alternative (1000s acres)	Changes (1000s acres)
Grain Crops	155	155	0
Rice	547	544	3
Field Crops	59	59	0
Forage Crops	197	197	1
Vegetables and Truck Crops	119	119	0
Orchards and Vineyards	456	456	1
Total	1,533	1,529	4

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Agricultural production in the Sacramento Valley would be similar under Alternative 3 as compared to the No Action Alternative over long-term average conditions and in dry and critical dry years due to reduced use of groundwater, as summarized in Tables 12.34 and 12.35.

Table 12.34 Changes in Sacramento Valley Agricultural Production over the Long-term Average Conditions under Alternative 3 as compared to the No Action Alternative

Crops	Alternative 3 ($ millions)	No Action Alternative ($ millions)	Changes ($ millions)
Grain Crops	149	150	-0.7
Rice	1,115	1,114	0.6
Field Crops	77	77	-0.1
Forage Crops	246	246	0.5
Vegetables and Truck Crops	967	967	0.0
Orchards and Vineyards	3,192	3,192	0.9
Total	5,746	5,745	1.2

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Table 12.35 Changes in Sacramento Valley Agricultural Production in Dry and Critical Dry Years under Alternative 3 as compared to the No Action Alternative

Crops	Alternative 3 ($ millions)	No Action Alternative ($ millions)	Changes ($ millions)
Grain Crops	150	150	0.2
Rice	1,112	1,107	5.8
Field Crops	77	77	0.1
Forage Crops	244	243	0.8
Vegetables and Truck Crops	967	967	0.1
Orchards and Vineyards	3,193	3,191	2.2
Total	5,744	5,735	9.2

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

San Joaquin Valley

Results of the SWAP analysis indicated that irrigated acreage in the San Joaquin Valley, including the Tulare Lake area, would be similar under Alternative 3 as compared to the No Action Alternative over long-term average conditions and in dry and critical dry years, as summarized in Tables 12.36 and 12.37.

Table 12.36 Changes in San Joaquin Valley Irrigated Acreage over the Long-term Average Conditions under Alternative 3 as compared to the No Action Alternative

Crops	Alternative 3 (1000s acres)	No Action Alternative (1000s acres)	Changes (1000s acres)
Grain Crops	1,024	1,024	0
Rice	17	17	0
Field Crops	828	828	0
Forage Crops	735	735	0
Vegetables and Truck Crops	633	633	0
Orchards and Vineyards	2,156	2,156	0
Total	5,392	5,392	0

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Table 12.37 Changes in San Joaquin Valley Irrigated Acreage in Dry and Critical Dry Years under Alternative 3 as compared to the No Action Alternative

Crops	Alternative 3 (1000s acres)	No Action Alternative (1000s acres)	Changes (1000s acres)
Grain Crops	1,021	1,010	11
Rice	17	17	0
Field Crops	828	827	0
Forage Crops	735	735	0
Vegetables and Truck Crops	633	633	0
Orchards and Vineyards	2,154	2,154	0
Total	5,387	5,375	12

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Agricultural production in the San Joaquin Valley would be similar under Alternative 3 as compared to the No Action Alternative over long-term average conditions and in dry and critical dry years due to reduced use of groundwater, as summarized in Tables 12.38 and 12.39.

Table 12.38 Changes in San Joaquin Valley Agricultural Production over the Long-term Average Conditions under Alternative 3 as compared to the No Action Alternative

Crops	Alternative 3 ($ millions)	No Action Alternative ($ millions)	Changes ($ millions)
Grain Crops	1,373	1,373	0.1
Rice	31	31	0.0
Field Crops	1,437	1,436	0.3
Forage Crops	1,426	1,426	0.1
Vegetables and Truck Crops	4,623	4,623	-0.1
Orchards and Vineyards	16,547	16,547	-0.1
Total	25,437	25,437	0.3

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Table 12.39 Changes in San Joaquin Valley Agricultural Production in Dry and Critical Dry Years under Alternative 3 as compared to the No Action Alternative

Crops	Alternative 3 ($ millions)	No Action Alternative ($ millions)	Changes ($ millions)
Grain Crops	1,370	1,359	11.5
Rice	31	31	0.0
Field Crops	1,436	1,436	0.4
Forage Crops	1,426	1,426	-0.1
Vegetables and Truck Crops	4,623	4,623	0.0
Orchards and Vineyards	16,542	16,542	-0.3
Total	25,428	25,417	11.4

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Effects Related to Water Transfers

Potential effects to agricultural resources could be similar to those identified in a recent environmental analysis conducted by Reclamation for long-term water transfers from the Sacramento to San Joaquin valleys (Reclamation 2014c) as described above under the No Action Alternative compared to the Second Basis of Comparison. For the purposes of this EIS, it is anticipated that similar conditions would occur during implementation of cross Delta water transfers under Alternative 3 and the No Action Alternative, and that impacts on agricultural resources would not be substantial in the seller's service area due to implementation requirements of the transfer programs.

Under Alternative 3, water could be transferred throughout the year without an annual volumetric limit. Under the No Action Alternative, the timing of cross Delta water transfers would be limited to July through September and include annual volumetric limits, in accordance with the 2008 USFWS BO and 2009 NMFS BO. Overall, the potential for cross Delta water transfers would be increased under Alternative 3 as compared to the No Action Alternative.

San Francisco Bay Area, Central Coast, and Southern California Regions

Potential Changes in Irrigated Agricultural

It is anticipated that reductions in CVP and SWP water supplies within the San Francisco Bay Area, Central Coast, and Southern California regions would not result in reductions in irrigated acreage or land use changes due to the use of other water supplies in the same manner that is projected to occur in the Central Valley Region.

12.4.3.4.2 Alternative 3 Compared to the Second Basis of Comparison

Trinity River Region

Potential Changes in Irrigated Agricultural

There are no agricultural lands irrigated with CVP and SWP water supplies in the Trinity River Region. Therefore, there would be no changes in irrigated lands under Alternative 3 as compared to the Second Basis of Comparison.

Central Valley Region

Potential Changes in Irrigated Agricultural

Sacramento Valley

Results of the SWAP analysis indicated that agricultural crop patterns in the Sacramento Valley would be similar under Alternative 3 as compared to the Second Basis of Comparison over long-term average conditions and in dry and critical dry years, as summarized in Tables 12.40 and 12.41.

Table 12.40 Changes in Sacramento Valley Irrigated Acreage over the Long-term Average Conditions under Alternative 3 as compared to the Second Basis of Comparison

Crops	Alternative 3 (1000s acres)	Second Basis of Comparison (1000s acres)	Changes (1000s acres)
Grain Crops	154	154	0
Rice	548	548	0
Field Crops	59	59	0
Forage Crops	200	200	0
Vegetables and Truck Crops	119	119	0
Orchards and Vineyards	457	457	0
Total	1,537	1,537	0

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Table 12.41 Changes in Sacramento Valley Irrigated Acreage in Dry and Critical Dry Years under Alternative 3 as compared to the Second Basis of Comparison

Crops	Alternative 3 (1000s acres)	Second Basis of Comparison (1000s acres)	Changes (1000s acres)
Grain Crops	155	155	0
Rice	547	548	-1
Field Crops	59	59	0
Forage Crops	197	198	-1
Vegetables and Truck Crops	119	119	0
Orchards and Vineyards	456	457	-1
Total	1,533	1,536	-3

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

The agricultural production value under long-term average conditions and dry and critical dry conditions would be similar under Alternative 3 and Second Basis of Comparison, as summarized in Tables 12.42 and 12.43, primarily due to a decrease in groundwater pumping.

Table 12.42 Changes in Sacramento Valley Agricultural Production over the Long-term Average Conditions under Alternative 3 as compared to the Second Basis of Comparison

Crops	Alternative 3 ($ millions)	Second Basis of Comparison ($ millions)	Changes ($ millions)
Grain Crops	149	149	0.1
Rice	1,115	1,115	-0.3
Field Crops	77	77	0.0
Forage Crops	246	246	-0.1
Vegetables and Truck Crops	967	967	0.0
Orchards and Vineyards	3,192	3,193	-0.1
Total	5,746	5,747	-0.3

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Table 12.43 Changes in Sacramento Valley Agricultural Production in Dry and Critical Dry Years under Alternative 3 as compared to the Second Basis of Comparison

Crops	Alternative 3 ($ millions)	Second Basis of Comparison ($ millions)	Changes ($ millions)
Grain Crops	150	150	-0.3
Rice	1,112	1,114	-1.5
Field Crops	77	77	0.0
Forage Crops	244	245	-0.6
Vegetables and Truck Crops	967	967	-0.1
Orchards and Vineyards	3,193	3,193	0.4
Total	5,744	5,746	-2.1

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

San Joaquin Valley

Results of the SWAP analysis indicated that irrigated acreage in the San Joaquin Valley, including the Tulare Lake area, would be similar under Alternative 3 as compared to the Second Basis of Comparison over long-term average conditions and in dry and critical dry years, as summarized in Tables 12.44 and 12.45.

Table 12.44 Changes in San Joaquin Valley Irrigated Acreage over the Long-term Average Conditions under Alternative 3 as compared to the Second Basis of Comparison

Crops	Alternative 3 (1000s acres)	Second Basis of Comparison (1000s acres)	Changes (1000s acres)
Grain Crops	1,024	1,024	0
Rice	17	17	0
Field Crops	828	828	0
Forage Crops	735	735	0
Vegetables and Truck Crops	633	633	0
Orchards and Vineyards	2,156	2,156	0
Total	5,392	5,392	0

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Table 12.45 Changes in San Joaquin Valley Irrigated Acreage in Dry and Critical Dry Years under Alternative 3 as compared to the Second Basis of Comparison

Crops	Alternative 3 (1000s acres)	Second Basis of Comparison (1000s acres)	Changes (1000s acres)
Grain Crops	1,021	1,024	-3
Rice	17	17	0
Field Crops	828	828	0
Forage Crops	735	735	-1
Vegetables and Truck Crops	633	633	0
Orchards and Vineyards	2,154	2,156	-2
Total	5,387	5,392	-5

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

The agricultural production value under long-term average conditions would be similar under Alternative 3 and the Second Basis of Comparison, as summarized in Tables 12.46 and 12.47, primarily due to an increase in groundwater pumping.

Table 12.46 Changes in San Joaquin Valley Agricultural Production over the Long-term Average Conditions under Alternative 3 as compared to the Second Basis of Comparison

Crops	Alternative 3 ($ millions)	Second Basis of Comparison ($ millions)	Changes ($ millions)
Grain Crops	1,373	1,373	-0.1
Rice	31	31	0.0
Field Crops	1,437	1,437	-0.1
Forage Crops	1,426	1,426	0.0
Vegetables and Truck Crops	4,623	4,623	0.0
Orchards and Vineyards	16,547	16,547	-0.1
Total	25,437	25,438	-0.3

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Table 12.47 Changes in San Joaquin Valley Agricultural Production in Dry and Critical Dry Years under Alternative 3 as compared to the Second Basis of Comparison

Crops	Alternative 3 ($ millions)	Second Basis of Comparison ($ millions)	Changes ($ millions)
Grain Crops	1,370	1,373	-2.9
Rice	31	31	0.0
Field Crops	1,436	1,437	-0.6
Forage Crops	1,426	1,426	-0.5
Vegetables and Truck Crops	4,623	4,623	-0.2
Orchards and Vineyards	16,542	16,547	-4.7
Total	25,428	25,437	-8.9

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Effects Related to Water Transfers

It is anticipated that water would be transferred between subbasins in the same manner under Alternative 3 as compared to the Second Basis of Comparison. If the water to be transferred is made available through crop idling, there would be a reduction in irrigated acreage. If the water is used to reduce crop idling in dry and critical dry years, there would be an increase in irrigated acreage. Therefore, the changes in agricultural resources would need to be determined for each water transfer program.

Potential effects to agricultural resources could be similar to those identified in a recent environmental analysis conducted by Reclamation for long-term water transfers from the Sacramento to San Joaquin valleys (Reclamation 2014c) as described above under the No Action Alternative compared to the Second Basis of Comparison. For the purposes of this EIS, it is anticipated that similar conditions would occur during implementation of cross Delta water transfers under Alternative 3 as compared to the Second Basis of Comparison, and that impacts on agricultural resources would not be substantial in the seller's service area due to implementation requirements of the transfer programs.

Under Alternative 3 and the Second Basis of Comparison, water could be transferred throughout the year without an annual volumetric limit. Overall, the potential for cross Delta water transfers would be similar under Alternative 3 as compared to the Second Basis of Comparison.

San Francisco Bay Area, Central Coast, and Southern California Regions

Potential Changes in Irrigated Agricultural

It is anticipated that reductions in CVP and SWP water supplies within the San Francisco Bay Area, Central Coast, and Southern California regions would not result in reductions in irrigated acreage or land use changes due to the use of other water supplies in the same manner that is projected to occur in the Central Valley Region.

12.4.3.5 Alternative 4

The agricultural resources under Alternative 4 would be identical to the conditions under the Second Basis of Comparison; therefore, Alternative 4 is only compared to the No Action Alternative.

12.4.3.5.1 Alternative 4 Compared to the No Action Alternative

The CVP and SWP operations under Alternative 4 are identical to the CVP and SWP operations under the Second Basis of Comparison and Alternative 1. Therefore, changes in agricultural resources under Alternative 4 as compared to the No Action Alternative would be the same as the impacts described in Section 12.4.3.2.1, Alternative 1 Compared to the No Action Alternative.

12.4.3.6 Alternative 5

The CVP and SWP operations under Alternative 5 are similar to the No Action Alternative with modified Old and Middle River flow criteria and New Melones Reservoir operations.

12.4.3.6.1 Alternative 5 Compared to the No Action Alternative

Trinity River Region

Potential Changes in Irrigated Agricultural

There are no agricultural lands irrigated with CVP and SWP water supplies in the Trinity River Region. Therefore, there would be no changes in irrigated lands under Alternative 5 as compared to the No Action Alternative.

Central Valley Region

Potential Changes in Irrigated Agricultural

Sacramento Valley

Results of the SWAP analysis indicated that agricultural crop patterns in the Sacramento Valley would be similar under Alternative 5 as compared to the No Action Alternative over long-term average conditions and in dry and critical dry years, as summarized in Tables 12.48 and 12.49.

Table 12.48 Changes in Sacramento Valley Irrigated Acreage over the Long-term Average Conditions under Alternative 5 as compared to the No Action Alternative

Crops	Alternative 5 (1000s acres)	No Action Alternative (1000s acres)	Changes (1000s acres)
Grain Crops	155	155	0
Rice	548	548	0
Field Crops	59	59	0
Forage Crops	199	199	0
Vegetables and Truck Crops	119	119	0
Orchards and Vineyards	456	456	0
Total	1,537	1,537	0

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Table 12.49 Changes in Sacramento Valley Irrigated Acreage in Dry and Critical Dry Years under Alternative 5 as compared to the No Action Alternative

Crops	Alternative 5 (1000s acres)	No Action Alternative (1000s acres)	Changes (1000s acres)
Grain Crops	155	155	0
Rice	544	544	0
Field Crops	59	59	0
Forage Crops	197	197	0
Vegetables and Truck Crops	119	119	0
Orchards and Vineyards	456	456	0
Total	1,529	1,529	0

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

The agricultural production value under long-term average conditions and dry and critical dry conditions would be similar under Alternative 5 and the No Action Alternative, as summarized in Tables 12.50 and 12.51.

Table 12.50 Changes in Sacramento Valley Agricultural Production over the Long-term Average Conditions under Alternative 5 as compared to the No Action Alternative

Crops	Alternative 5 ($ millions)	No Action Alternative ($ millions)	Changes ($ millions)
Grain Crops	150	150	0.0
Rice	1,114	1,114	0.1
Field Crops	77	77	0.0
Forage Crops	246	246	0.0
Vegetables and Truck Crops	967	967	0.0
Orchards and Vineyards	3,192	3,192	0.1
Total	5,745	5,745	0.1

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Table 12.51 Changes in Sacramento Valley Agricultural Production in Dry and Critical Dry Years under Alternative 5 as compared to the No Action Alternative

Crops	Alternative 5 ($ millions)	No Action Alternative ($ millions)	Changes ($ millions)
Grain Crops	150	150	-0.1
Rice	1,107	1,107	0.2
Field Crops	77	77	0.0
Forage Crops	243	243	0.1
Vegetables and Truck Crops	967	967	0.0
Orchards and Vineyards	3,192	3,191	0.7
Total	5,736	5,735	0.8

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

San Joaquin Valley

Results of the SWAP analysis indicated that irrigated acreage in the San Joaquin Valley, including the Tulare Lake area, would be similar under Alternative 5 as compared to the No Action Alternative over long-term average conditions and dry and critical dry years, as summarized in Tables 12.52 and 12.53.

Table 12.52 Changes in San Joaquin Valley Irrigated Acreage over the Long-term Average Conditions under Alternative 5 as compared to the No Action Alternative

Crops	Alternative 5 (1000s acres)	No Action Alternative (1000s acres)	Changes (1000s acres)
Grain Crops	1,024	1,024	0
Rice	17	17	0
Field Crops	828	828	0
Forage Crops	735	735	0
Vegetables and Truck Crops	633	633	0
Orchards and Vineyards	2,156	2,156	0
Total	5,392	5,392	0

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Table 12.53 Changes in San Joaquin Valley Irrigated Acreage in Dry and Critical Dry Years under Alternative 5 as compared to the No Action Alternative

Crops	Alternative 5 (1000s acres)	No Action Alternative (1000s acres)	Changes (1000s acres)
Grain Crops	1,010	1,010	0
Rice	17	17	0
Field Crops	827	827	0
Forage Crops	734	735	0
Vegetables and Truck Crops	633	633	0
Orchards and Vineyards	2,153	2,154	-1
Total	5,374	5,375	-1

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

The agricultural production value under long-term average conditions and dry and critical dry year conditions would be similar under Alternative 5 and the No Action Alternative, as summarized in Tables 12.54 and 12.55.

Table 12.54 Changes in San Joaquin Valley Agricultural Production over the Long-term Average Conditions under Alternative 5 as compared to the No Action Alternative

Crops	Alternative 5 ($ millions)	No Action Alternative ($ millions)	Changes ($ millions)
Grain Crops	1,373	1,373	0.0
Rice	31	31	0.0
Field Crops	1,436	1,436	0.0
Forage Crops	1,426	1,426	0.0
Vegetables and Truck Crops	4,623	4,623	0.0
Orchards and Vineyards	16,547	16,547	-0.1
Total	25,437	25,437	-0.1

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Table 12.55 Changes in San Joaquin Valley Agricultural Production in Dry and Critical Dry Years under Alternative 5 as compared to the No Action Alternative

Crops	Alternative 5 ($ millions)	No Action Alternative ($ millions)	Changes ($ millions)
Grain Crops	1,359	1,359	-0.1
Rice	31	31	0.0
Field Crops	1,435	1,436	-0.2
Forage Crops	1,426	1,426	-0.1
Vegetables and Truck Crops	4,622	4,623	-0.2
Orchards and Vineyards	16,540	16,542	-2.0
Total	25,414	25,417	-2.7

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Effects Related to Water Transfers

Potential effects to agricultural resources could be similar to those identified in a recent environmental analysis conducted by Reclamation for long-term water transfers from the Sacramento to San Joaquin valleys (Reclamation 2014c) as described above under the No Action Alternative compared to the Second Basis of Comparison. For the purposes of this EIS, it is anticipated that similar conditions would occur during implementation of cross Delta water transfers under Alternative 5 and the No Action Alternative, and that impacts on agricultural resources would not be substantial in the seller's service area due to implementation requirements of the transfer programs.

Under Alternative 5 and the No Action Alternative, the timing of cross Delta water transfers would be limited to July through September and include annual volumetric limits, in accordance with the 2008 USFWS BO and 2009 NMFS BO. Overall, the potential for cross Delta water transfers would be similar under Alternative 5 and the No Action Alternative.

San Francisco Bay Area, Central Coast, and Southern California Regions

Potential Changes in Irrigated Agricultural

It is anticipated that reductions in CVP and SWP water supplies within the San Francisco Bay Area, Central Coast, and Southern California regions would not result in reductions in irrigated acreage or land use changes due to the use of other water supplies in the same manner that is projected to occur in the Central Valley Region.

12.4.3.6.2 Alternative 5 Compared to the Second Basis of Comparison

Trinity River Region

Potential Changes in Irrigated Agricultural

There are no agricultural lands irrigated with CVP and SWP water supplies in the Trinity River Region. Therefore, there would be no changes in irrigated lands under Alternative 5 as compared to the Second Basis of Comparison.

Central Valley Region

Potential Changes in Irrigated Agricultural

Sacramento Valley

Results of the SWAP analysis indicated that agricultural crop patterns in the Sacramento Valley would be similar under Alternative 5 as compared to the Second Basis of Comparison over long-term average conditions and in dry and critical dry years, as summarized in Tables 12.56 and 12.57.

Table 12.56 Changes in Sacramento Valley Irrigated Acreage over the Long-term Average Conditions under Alternative 5 as compared to the Second Basis of Comparison

Crops	Alternative 5 (1000s acres)	Second Basis of Comparison (1000s acres)	Changes (1000s acres)
Grain Crops	155	154	1
Rice	548	549	0
Field Crops	59	59	0
Forage Crops	199	200	-1
Vegetables and Truck Crops	119	119	0
Orchards and Vineyards	456	457	0
Total	1,537	1,537	0

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Table 12.57 Changes in Sacramento Valley Irrigated Acreage in Dry and Critical Dry Years under Alternative 5 as compared to the Second Basis of Comparison

Crops	Alternative 5 (1000s acres)	Second Basis of Comparison (1000s acres)	Changes (1000s acres)
Grain Crops	155	155	-1
Rice	544	548	-4
Field Crops	59	59	0
Forage Crops	197	198	-1
Vegetables and Truck Crops	119	119	0
Orchards and Vineyards	456	457	-1
Total	1,529	1,536	-7

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

The agricultural production value under long-term average conditions and in dry and critical dry conditions would be similar under Alternative 5 and Second Basis of Comparison, as summarized in Tables 12.58 and 12.59.

Table 12.58 Changes in Sacramento Valley Agricultural Production over the Long-term Average Conditions under Alternative 5 as compared to the Second Basis of Comparison

Crops	Alternative 5 ($ millions)	Second Basis of Comparison ($ millions)	Changes ($ millions)
Grain Crops	150	149	0.8
Rice	1,114	1,115	-0.8
Field Crops	77	77	0.1
Forage Crops	246	246	-0.6
Vegetables and Truck Crops	967	967	0.0
Orchards and Vineyards	3,192	3,193	-0.9
Total	5,745	5,747	-1.5

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Table 12.59 Changes in Sacramento Valley Agricultural Production in Dry and Critical Dry Years under Alternative 5 as compared to the Second Basis of Comparison

Crops	Alternative 5 ($ millions)	Second Basis of Comparison ($ millions)	Changes ($ millions)
Grain Crops	150	150	-0.6
Rice	1,107	1,114	-7.1
Field Crops	77	77	-0.1
Forage Crops	243	245	-1.3
Vegetables and Truck Crops	967	967	-0.3
Orchards and Vineyards	3,192	3,193	-1.1
Total	5,736	5,746	-10.5

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

San Joaquin Valley

Results of the SWAP analysis indicated that irrigated acreage in the San Joaquin Valley, including the Tulare Lake area, would be similar under Alternative 5 as compared to the Second Basis of Comparison over long-term average conditions and in dry and critical dry years, as summarized in Tables 12.60 and 12.61.

Table 12.60 Changes in San Joaquin Valley Irrigated Acreage over the Long-term Average Conditions under Alternative 5 as compared to the Second Basis of Comparison

Crops	Alternative 5 (1000s acres)	Second Basis of Comparison (1000s acres)	Changes (1000s acres)
Grain Crops	1,024	1,024	0
Rice	17	17	0
Field Crops	828	828	0
Forage Crops	735	735	0
Vegetables and Truck Crops	633	633	0
Orchards and Vineyards	2,156	2,156	0
Total	5,392	5,392	-1

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

Table 12.61 Changes in San Joaquin Valley Irrigated Acreage in Dry and Critical Dry Years under Alternative 5 as compared to the Second Basis of Comparison

Crops	Alternative 5 (1000s acres)	Second Basis of Comparison (1000s acres)	Changes (1000s acres)
Grain Crops	1,010	1,024	-14
Rice	17	17	0
Field Crops	827	828	0
Forage Crops	734	735	-1
Vegetables and Truck Crops	633	633	0
Orchards and Vineyards	2,153	2,156	-3
Total	5,374	5,392	-18

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.

The agricultural production value under long-term average conditions and in dry and critical dry conditions would be similar, as summarized in Tables 12.62 and 12.63, primarily due to an increase in groundwater pumping.

Table 12.62 Changes in San Joaquin Valley Agricultural Production over the Long-term Average Conditions under Alternative 5 as compared to the Second Basis of Comparison

Crops	Alternative 5 ($ millions)	Second Basis of Comparison ($ millions)	Changes ($ millions)
Grain Crops	1,373	1,373	-0.2
Rice	31	31	0.0
Field Crops	1,436	1,437	-0.5
Forage Crops	1,426	1,426	-0.1
Vegetables and Truck Crops	4,623	4,623	0.2
Orchards and Vineyards	16,547	16,547	-0.1
Total	25,437	25,438	-0.7

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Table 12.63 Changes in San Joaquin Valley Agricultural Production in Dry and Critical Dry Years under Alternative 5 as compared to the Second Basis of Comparison

Crops	Alternative 5 ($ millions)	Second Basis of Comparison ($ millions)	Changes ($ millions)
Grain Crops	1,359	1,373	-14.5
Rice	31	31	0.0
Field Crops	1,435	1,437	-1.2
Forage Crops	1,426	1,426	-0.5
Vegetables and Truck Crops	4,622	4,623	-0.5
Orchards and Vineyards	16,540	16,547	-6.4
Total	25,414	25,437	-22.9

Notes:
Grain crops include corn, dry beans, and grain.
Field crops include cotton, grass, hay, safflower, and sugar beets.
Forage crops include alfalfa and pasture.
All values of production are in 2012 dollar equivalent values.

Effects Related to Water Transfers

Potential effects to agricultural resources could be similar to those identified in a recent environmental analysis conducted by Reclamation for long-term water transfers from the Sacramento to San Joaquin valleys (Reclamation 2014c) as described above under the No Action Alternative compared to the Second Basis of Comparison. For the purposes of this EIS, it is anticipated that similar conditions would occur during implementation of cross Delta water transfers under Alternative 5 and the Second Basis of Comparison, and that impacts on agricultural resources would not be substantial in the seller's service area due to implementation requirements of the transfer programs.

Under Alternative 5, the timing of cross Delta water transfers would be limited to July through September and include annual volumetric limits, in accordance with the 2008 USFWS BO and 2009 NMFS BO. Under Second Basis of Comparison, water could be transferred throughout the year without an annual volumetric limit. Overall, the potential for cross Delta water transfers would be reduced under Alternative 5 as compared to the Second Basis of Comparison.

San Francisco Bay Area, Central Coast, and Southern California Regions

Potential Changes in Irrigated Agricultural

It is anticipated that reductions in CVP and SWP water supplies within the San Francisco Bay Area, Central Coast, and Southern California regions would not result in reductions in irrigated acreage or land use changes due to the use of other water supplies in the same manner that is projected to occur in the Central Valley Region.

12.4.3.7 Summary of Environmental Consequences

The results of the environmental consequences of implementation of Alternatives 1 through 5 as compared to the No Action Alternative and the Second Basis of Comparison are presented in Tables 12.64 and 12.65.

Table 12.64 Comparison of Alternatives 1 through 5 to No Action Alternative

Alternative	Potential Change	Consideration for Mitigation Measures
Alternative 1	No effects on agricultural resources.	None needed
Alternative 2	No effects on agricultural resources.	None needed
Alternative 3	No effects on agricultural resources.	None needed
Alternative 4	No effects on agricultural resources.	None needed
Alternative 5	No effects on agricultural resources.	None needed

Table 12.65 Comparison of No Action Alternative and Alternatives 1 through 5 to Second Basis of Comparison

Alternative	Potential Change	Consideration for Mitigation Measures
No Action Alternative	No effects on agricultural resources.	Not considered for this comparison.
Alternative 1	No effects on agricultural resources.	Not considered for this comparison.
Alternative 2	No effects on agricultural resources.	Not considered for this comparison.
Alternative 3	No effects on agricultural resources.	Not considered for this comparison.
Alternative 4	No effects on agricultural resources.	Not considered for this comparison.
Alternative 5	No effects on agricultural resources.	Not considered for this comparison.

12.4.3.8 Potential Mitigation Measures

Changes in CVP and SWP operations under Alternatives 1 through 5 as compared to the No Action Alternative would not result in changes in agricultural resources. Therefore, there would be no adverse impacts to agricultural resources; and no mitigation measures are required.

12.4.3.9 Cumulative Effects Analysis

As described in Chapter 3, the cumulative effects analysis considers projects, programs, and policies that are not speculative; and are based upon known or reasonably foreseeable long-range plans, regulations, operating agreements, or other information that establishes them as reasonably foreseeable.

The No Action Alternative, Alternatives 1 through 5, and Second Basis of Comparison include climate change and sea level rise, implementation of general plans, and completion of ongoing projects and programs (see Chapter 3, Description of Alternatives). The effects of these items were analyzed quantitatively and qualitatively, as described in the Impact Analysis of this chapter. The discussion below focuses on the qualitative effects of the alternatives and other past, present, and reasonably foreseeable future projects identified for consideration of cumulative effects (see Chapter 3, Description of Alternatives).

12.4.3.9.1 No Action Alternative and Alternatives 1 through 5

Continued coordinated long-term operation of the CVP and SWP under the No Action Alternative would result in reduced CVP and SWP water supply availability as compared to recent conditions due to climate change and sea level rise by 2030. These conditions are included in the analysis presented above.

Future water resource management projects considered in cumulative effects analysis could increase water supply availability, as described in Chapter 5, Surface Water Resources and Water Supplies; and change agricultural resources. These projects would result in additional irrigated acreage and/or reduction in groundwater pumping.

There also are several ongoing programs that could result in reductions in CVP and SWP water supply availability due to changes in flow patterns in the Sacramento and San Joaquin rivers watersheds and the Delta that could reduce availability of CVP and SWP water deliveries as well as local and regional water supplies, as described in Chapter 5, Surface Water Resources and Water Supplies. Reduction in available surface water supplies as compared to projected water supplies under the No Action Alternative and Alternatives 1 through 5 could result in reduction of irrigated lands if additional groundwater of appropriate quality is not available.

There would be no adverse agricultural resources impacts associated with implementation of the alternatives as compared to the No Action Alternative or the Second Basis of Comparison. Therefore, Alternatives 1 through 5 would not contribute cumulative impacts to agricultural resources.

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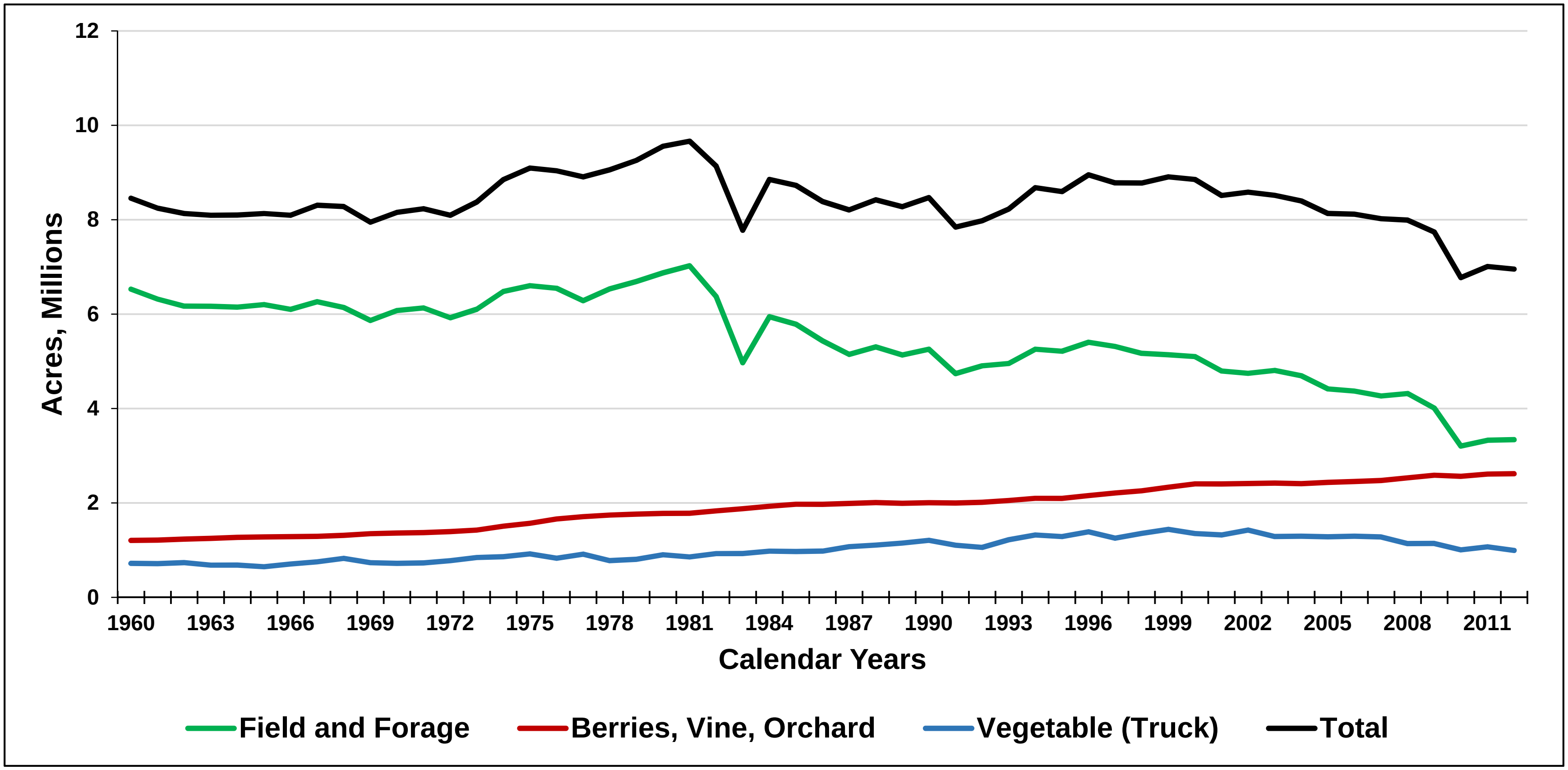

Figure 12.1 California Agricultural Production Acreage, 1960 to 2012

Source: USDA-NASS 2011, 2012a, 2012b, 2013b

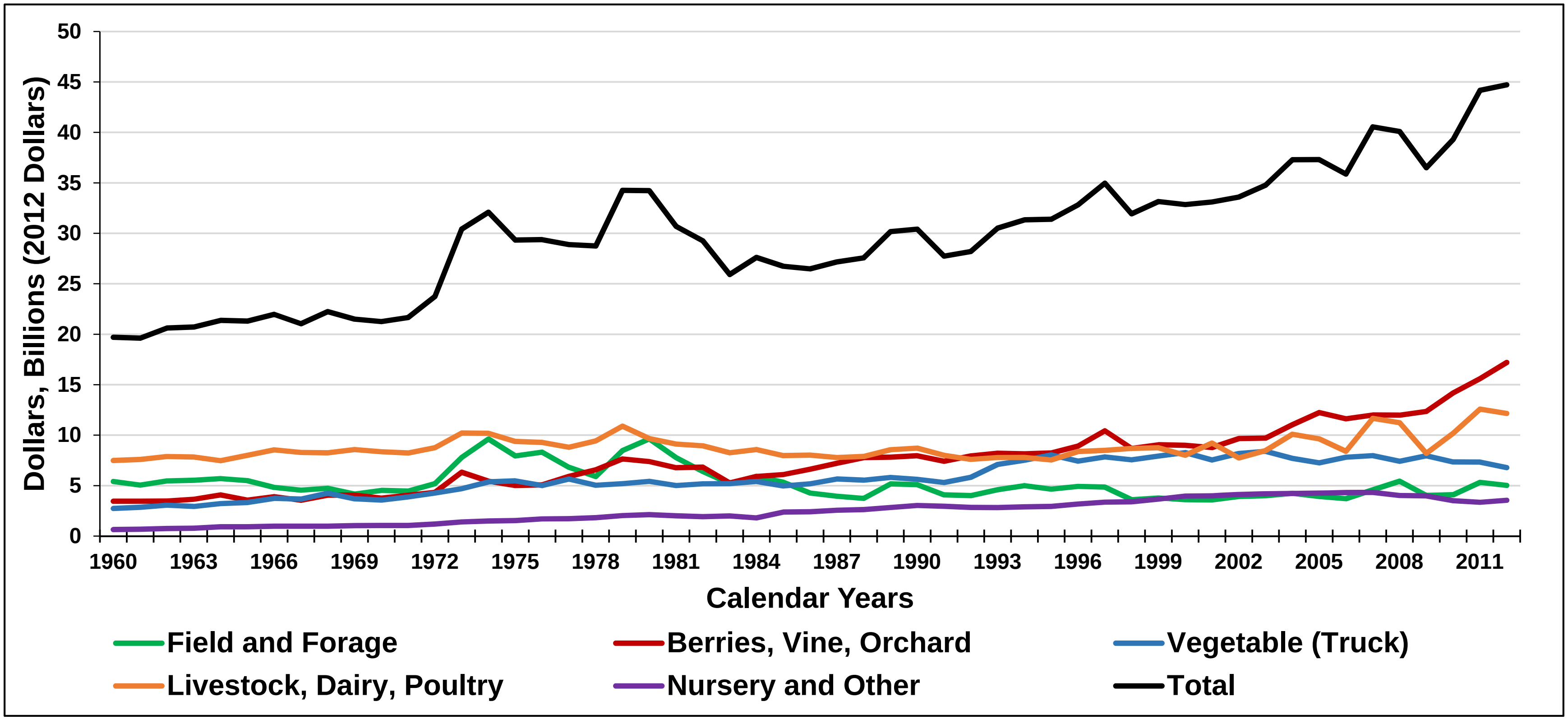

Figure 12.2 Total Value of California Agricultural Production, 1960 to 2012

Source: USDA 2014b; USDA-NASS 2008, 2009, 2010, 2011a, 2011b, 2012a, 2012b, 2013a, 2013b

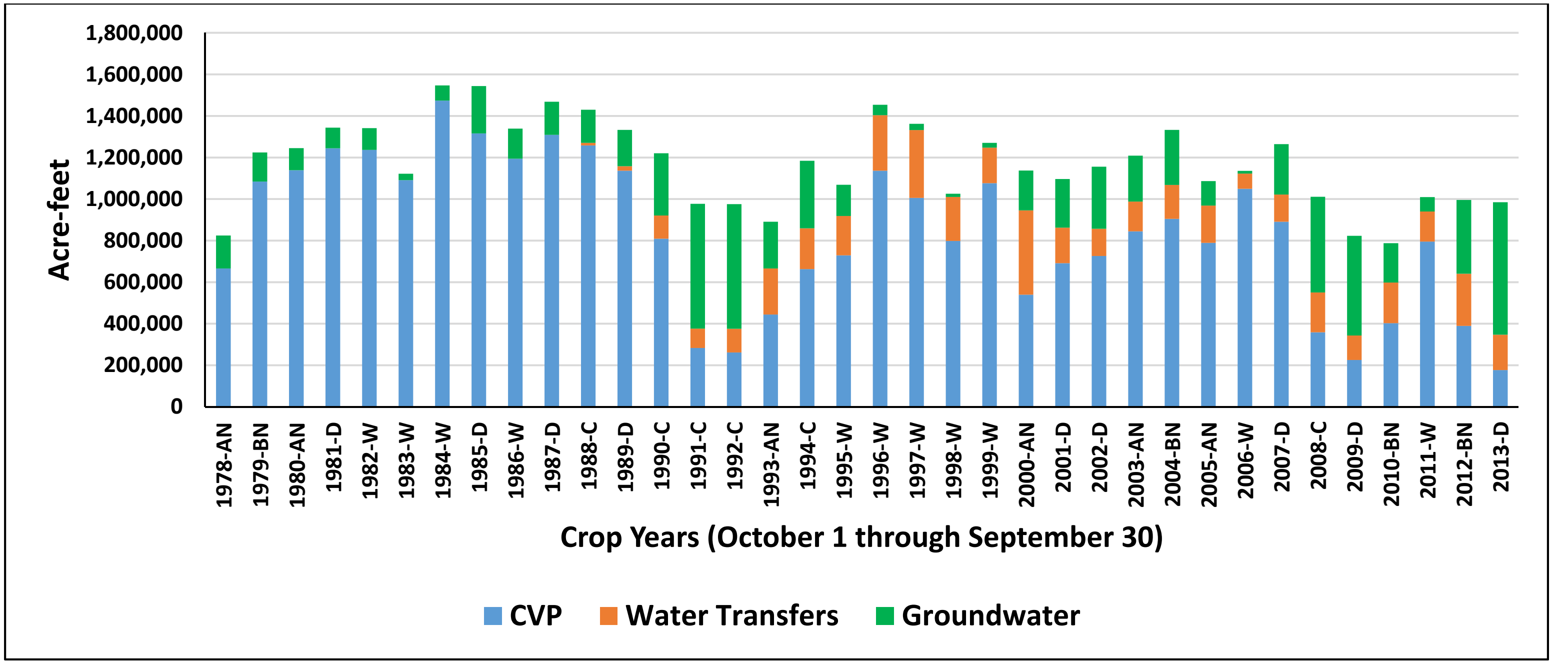

Figure 12.3 Historical Surface Water and Groundwater Supply Sources in Westlands Water District

W = Wet Year; AN= Above Normal Year; BN = Below Normal Year; D = Dry Year; C = Critical Dry Year

Source: WWD 2013a, 2014a

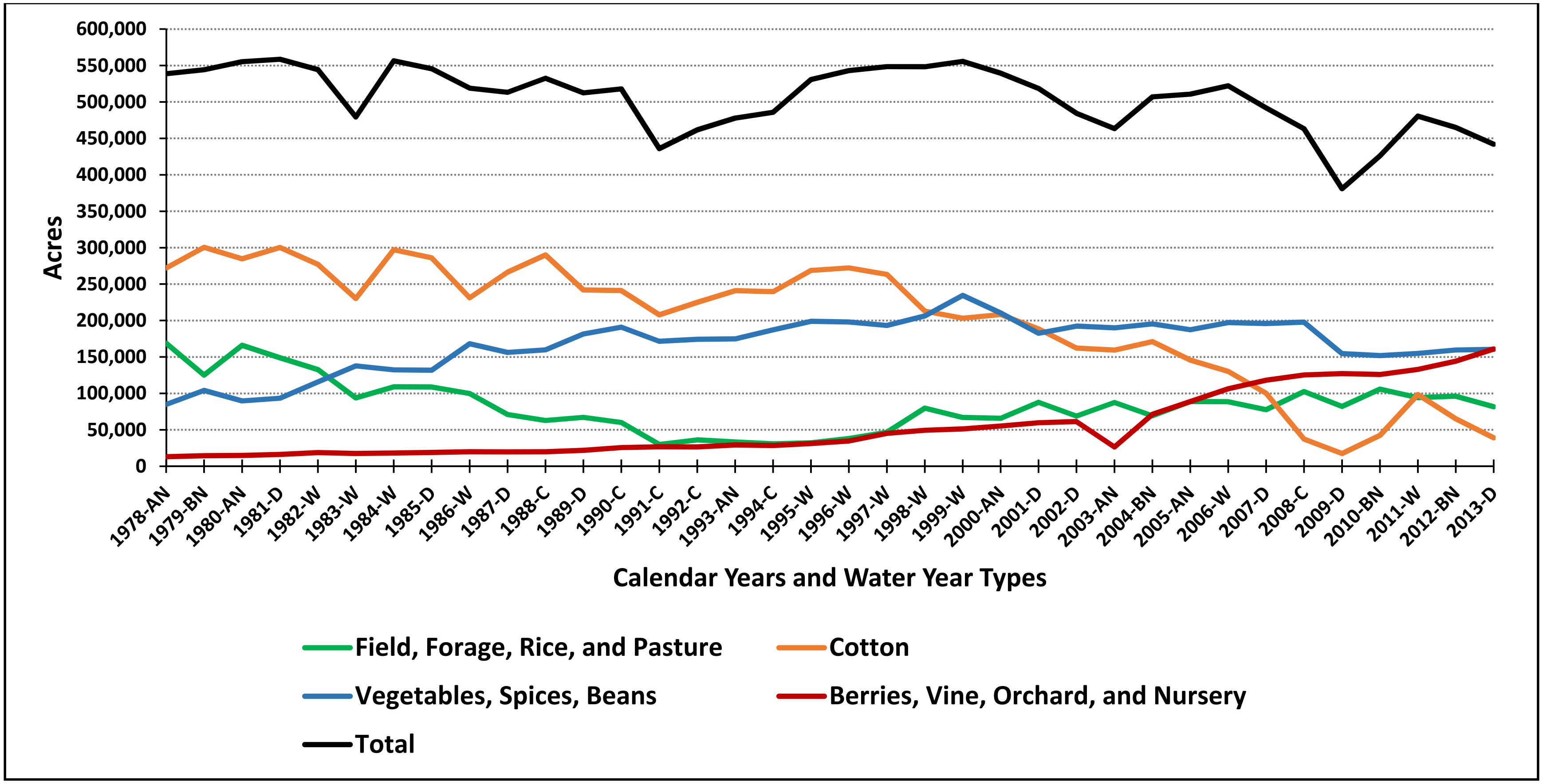

Figure 12.4 Historical Cropping Patterns in Westlands Water District

W = Wet Year; AN= Above Normal Year; BN = Below Normal Year; D = Dry Year; C = Critical Dry Year

Source: WWD 2013a, 2014b, 2014c

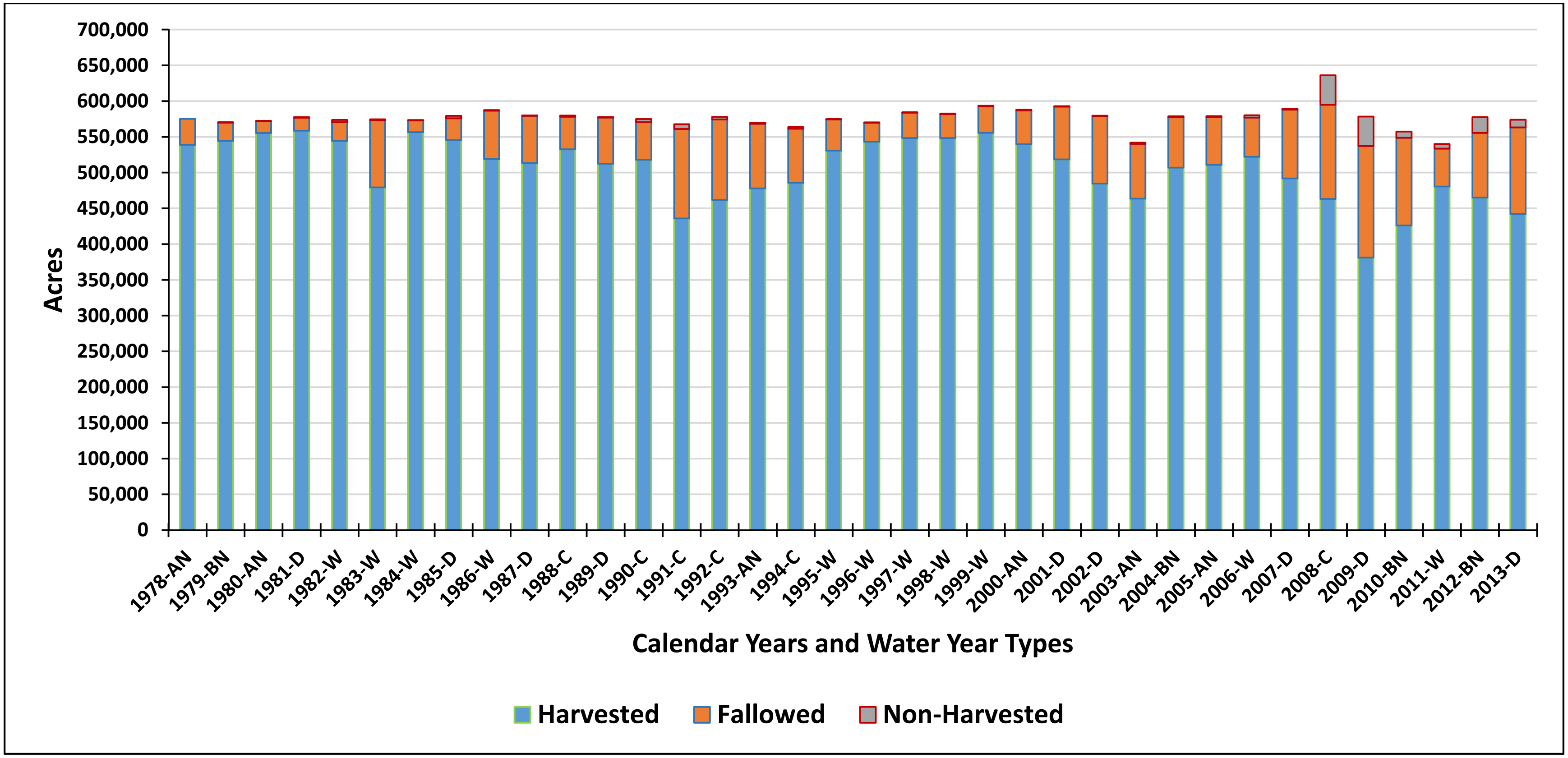

Figure 12.5 Historical Harvested, Fallowed, and Non-Harvested Acreage in Westlands Water District

W = Wet Year; AN= Above Normal Year; BN = Below Normal Year; D = Dry Year; C = Critical Dry Year

Source: WWD 2013a, 2014b, 2014c