Chapter 20
Economic Analyses

20.1 Introduction

As described in Chapter 1, *Introduction,* the purpose of this recirculated substitute environmental document (SED) is to present the State Water Resources Control Board's (State Water Board) analysis for potential changes to the Lower San Joaquin River (LSJR) flow and southern Delta water quality (SDWQ) objectives, as well as updates to the program of implementation included in the 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta Estuary (2006 Bay-Delta Plan). This SED, although not an environmental impact report (EIR), fulfills the requirements of the California Environmental Quality Act (CEQA) to analyze the environmental effects of a proposed regulatory activity and its alternatives. The State Water Board must also comply with Section 13141 and Section 13241 of the Porter-Cologne Act when developing and adopting new water quality objectives.

Project-related social or economic effects are not, as a general rule, required to be analyzed in CEQA documents; however, a lead agency may decide to include an assessment of economic or social effects in an EIR (or, by extension, an SED), particularly if these effects are perceived as being important or substantial. As discussed in Section 15131 of the State CEQA Guidelines, economic or social information may be included in an EIR in whatever form a lead agency desires. The State CEQA Guidelines also indicate that social and economic issues may be discussed in an EIR when they are linked to physical change. (§ 15131, subd. (a).) The intermediate economic or social changes that cause the physical change, however, need not be analyzed in any detail greater than necessary to trace the chain of cause and effect. The focus of the analysis should be on the physical changes. If, for example, a construction project would severely limit access to a business area, and the resultant loss of taxes would reduce an agency's ability to maintain infrastructure and public services, then the fiscal (economic) impacts should be discussed. California courts have held that potential economic and social consequences of a program or project that would cause urban decay or blight (e.g., effects on downtown businesses from developing a suburban shopping center) should be discussed in an EIR (e.g., *Bakersfield Citizens for Local Control v. City of Bakersfield*).

Under the California Water Code, the need for economic analysis associated with State Water Board actions is required by two sections. Water Code Section 13141 states:

> . . . prior to implementation of any agricultural water quality control program, an estimate of the total cost of such a program, together with an identification of potential sources of financing, shall be indicated in any regional water quality control plan.

Water Code Section 13241 states that "economic considerations" should be considered in establishing water quality objectives. In practice, compliance with these statutory provisions typically involves quantifying the costs to affected parties (e.g., farmers and water districts), and assessing potential impacts on local and regional economies affected by changes in economic activity. Evaluation of other potential economic effects, such as water quality benefits, typically is conducted more qualitatively.

To address the dual objectives of the proposed plan amendments,[1] this chapter is separated into the following two geographic parts: Section 20.3, *Lower San Joaquin River and Tributaries*, and Section 20.4, *Southern Delta*.

The resources addressed in the *Lower San Joaquin River and Tributaries* section are as follows:

- 20.3.1, *Changes in Hydrologic Conditions*
- 20.3.2, *Agricultural Production and Related Effects on Economic and Local Fiscal Conditions*
- 20.3.3, *Effects on Municipal and Industrial Water Supplies and Affected Regional Economies*
- 20.3.4, *Effects on Hydropower Generation, Revenues and the Regional Economy*
- 20.3.5, *Effects on Fisheries and Associated Regional Economies*
- 20.3.6, *Effects on Recreational Opportunities, Activity, and the Regional Economy*

In addition to evaluating the economic effects on these resources, Section 20.3.7, *Non-Flow Measures,* identifies the costs associated with other potential compliance actions that could be taken to inform the body of scientific literature and assist with adaptive implementation.

Section 20.4, *Southern Delta*, evaluates the potential costs of complying with salinity water quality objectives in the southern Delta, consistent with requirements in Water Code Section 13241. This section presents the potential effects that higher water treatment costs could have on ratepayers and the regional economy.

The geographic locations or study areas discussed in this chapter vary by topic, depending on the resource being evaluated, the temporal and geographic distribution of that resource, and the geographic extent of potential effects on local and regional economies. As such, evaluations may extend beyond the defined plan area described in Chapter 1, *Introduction*. For example, the evaluation of recreation and commercial fisheries includes the Pacific Ocean marine waters and corresponding coastal areas. This is necessary because anadromous fish migrate to the ocean and develop there for usually 3–4 years before they can be harvested in commercial and recreational fisheries as they return to spawn in the freshwater rivers of their origin. The evaluation of recreational activities related to rivers and reservoirs is generally confined to the Stanislaus, Tuolumne, and Merced Rivers and their respective rim reservoirs, New Melones, New Don Pedro, and Lake McClure. Given the spatial variability among topics discussed in the analyses, each subsection in this chapter describes the geography in which the analysis focuses.

Several important considerations need to be noted concerning the analyses contained in this chapter. The purposes of and the analytical framework for these analyses are (1) to compare potential changes in surface water diversion-related economic effects of the LSJR alternatives, and (2) to describe the potential costs of compliance with updated water quality objectives for the southern Delta. Although the analyses conducted to address these two purposes are presented together in this chapter, this should not be interpreted as an attempt to compare relevant costs and benefits of the LSJR alternatives or of the SDWQ alternatives. While the topic-specific analyses include certain analytical components common to each discussion (e.g., evaluation of potential effects on the regional economy), the reader is strongly discouraged from trying to draw conclusions across topics concerning the overall net benefits of a particular alternative. The study areas often differ among the analyses, and information available to conduct the different analyses (such as

[1] These plan amendments are the *project* as defined in State CEQA Guidelines, Section 15378.

estimates of physical impacts on a corresponding resource topic) is highly variable, thereby precluding the conduct of a net benefit-type analysis.

The economic analysis presented in this SED will help inform the State Water Board's consideration of potential changes to the 2006 Bay-Delta Plan related to LSJR flow and southern Delta water quality objectives. Any project-level changes to water rights or other measures that may be needed to implement any approved updates to the 2006 Bay-Delta Plan will be considered in subsequent proceedings and would require project-level analysis, as appropriate. Therefore, the economic analyses presented in this chapter, which also summarize results from resource analyses presented elsewhere in this SED and its appendices, are limited by the programmatic nature of this document.

20.2 Summary of Results

The economic analyses in this chapter assess the potential economic effects of LSJR Alternatives 2, 3, and 4 and SDWQ Alternatives 2 and 3 based on how the use of certain resources may change. The economic analyses mostly rely on impacts presented in corresponding chapters and appendices in this SED.

Under the LSJR alternatives, reductions in diversions would result both in potential cost effects (e.g., from reduced agricultural production) and potential beneficial effects (e.g., from enhanced conditions for salmon and other native fisheries) in the three eastside tributary[2] watersheds and the San Joaquin River (SJR) Basin, relative to baseline conditions. Where appropriate in this chapter, baseline conditions are described using modeled results; in cases where modeled results are not available (e.g., fisheries), historical conditions and general trends are used to establish a point of reference. As described in Chapter 3, *Alternatives Description*, baseline conditions are not representative of the No Project Alternative. The No Project Alternative represents continuation of the existing Bay-Delta Plan, with full implementation of the plan through the State Water Board's Water Right Decision ~~D~~-1641 (revised March 15, 2000) requirements. The anticipated economic effects of LSJR Alternatives 2, 3, and 4, which represent unimpaired flow[3] requirements of 20 percent, 40 percent, and 60 percent, respectively, on the three eastside tributaries, are summarized in Tables 20.2-1 through 20.2-5.

[2] In this document, the term *three eastside tributaries* refers to the Stanislaus, Tuolumne, and Merced Rivers.

[3] *Unimpaired flow* represents the water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds. It differs from natural flow because unimpaired flow is the flow that occurs at a specific location under the current configuration of channels, levees, floodplain, wetlands, deforestation and urbanization.

Table 20.2-1. Summary of Average Annual Cost and Beneficial Effects of LSJR Alternatives 2, 3, and 4, Relative to Baseline Conditions: Agricultural Production and Related Economics [Table 20.2-1 has been replaced to reflect topics raised during the response to comments process and to provide related clarifications.]

	LSJR Alternative 2		LSJR Alternative 3		LSJR Alternative 4	
Category	Change from Baseline Conditions	% Change	Change from Baseline Conditions	% Change	Change from Baseline Conditions	% Change
Agricultural Production						
Irrigated acreage	-5,990	-1.1	-24,905	-4.8	-64,038	-12.3
Crop revenues ($M)	-$10	-0.7	-$39	-2.6	-$108	-7.0
Additional GW pumping cost ($M)	+$1.3	+8.5	+$6.3	+41.2	+$14.7	+96.1
Local Fiscal conditions, as measured by change in tax revenue ($M)	-$0.4	-0.7	-$1.6	-2.6	-$4.3	-7.1
Regional Agriculture-Related Effects						
Total regional output ($M)	-$18	-1	-$69	-3	-$190	-7
Total regional jobs	-123	-1	-458	-2	-1,287	-7

$M = millions of dollars

GW = groundwater

Table 20.2-2. Summary of Average Annual Cost and Beneficial Effects of LSJR Alternatives 2, 3, and 4, Relative to Baseline Conditions: Municipal and Industrial Water Supply and Related Economics

	LSJR Alternative 2		LSJR Alternative 3		LSJR Alternative 4	
Category	Change from Baseline Conditions	% Change	Change from Baseline Conditions	% Change	Change from Baseline Conditions	% Change
M&I Water Supply						
Plan Area	Change in average annual water supply due to reduced diversions would be 2% on the Stanislaus and Tuolumne Rivers and 6% on the Merced River; reduction in deliveries by irrigation and water districts would be district-specific and would depend on consideration of established water rights or contracts, types of planned uses for the water, and district (and other) policies concerning distribution of water supplies		Change in average annual water supply due to reduced diversions would be 12% on the Stanislaus, 14% on the Tuolumne River, and 16% on the Merced River; reductions in deliveries by irrigation and water districts would be district-specific, and would depend on consideration of established water rights or contracts, types of planned uses for the water, and district (and other) policies concerning distribution of water supplies. Costs would be more than under LSJR Alternative 2 because of less surface water supply		Change in average annual water supply due to reduced diversions would be 32% on the Stanislaus, 35% on the Tuolumne River, and 32% on the Merced River; reductions in deliveries by irrigation and water districts would be district-specific, and would depend on consideration of established water rights or contracts, types of planned uses for the water, and district (and other) policies concerning distribution of water supplies. Costs would be more than under LSJR Alternative 3 because of less surface water supply	
SFPUC Service Area: Additional water supply cost ($M)[a]	+$14 to +$35, depending on Fourth Agreement interpretation scenario	+2.9 to +7.2	+$27 to +$119, depending on Fourth Agreement interpretation scenario	+5.6 to +24.6	+$30 to +$208, depending on Fourth Agreement interpretation scenario	+6.2 to +43.1

Category	LSJR Alternative 2		LSJR Alternative 3		LSJR Alternative 4	
	Change from Baseline Conditions	% Change	Change from Baseline Conditions	% Change	Change from Baseline Conditions	% Change
Regional M&I Water Supply-Related Effects						
Plan Area	Regional effects not evaluated specifically but anticipated to be relatively minor.		Regional effects not evaluated specifically but anticipated to be relatively minor.		Regional effects not evaluated specifically but anticipated to be relatively minor.	
SFPUC Service Area: Total Regional Output ($M)[a]	-$16 to -$40, depending on Fourth Agreement interpretation scenario	-0.03 to -0.06	-$31 to -$140, depending on Fourth Agreement interpretation scenario	-0.05 to -0.22	-$35 to -$244, depending on Fourth Agreement interpretation scenario	-0.05 to -0.38
SFPUC Service Area: Total Regional Jobs[a]	-117 to -292, depending on Fourth Agreement interpretation scenario	<-0.01 to -0.01	-226 to -1005, depending on Fourth Agreement interpretation scenario	<-0.01 to -0.03	-254 to -1,756, depending on Fourth Agreement interpretation scenario	<-0.01 to -0.06

M&I = municipal and industrial

SFPUC = San Francisco Public Utilities Commission

$M = millions of dollars

[a] SFPUC Service Area Water Supply Cost, Total Regional Output, and Total Regional Jobs in this table have been calculated on an annual average basis within the most severe 6-year drought period (1987–1992), rather than over the longer-term period of record. Longer-term average costs are shown in Table 20.3.3-9b, Table 20.3.3-14b, and Table 20.3.3-14b, and Table 20.3.3-15b.

Table 20.2-3. Summary of Average Annual Cost and Beneficial Effects of LSJR Alternatives 2, 3, and 4, Relative to Baseline Conditions: Hydropower Generation and Related Economics

	LSJR Alternative 2		LSJR Alternative 3		LSJR Alternative 4	
Category	Change from Baseline Conditions	% Change	Change from Baseline Conditions	% Change	Change from Baseline Conditions	% Change
Hydropower Production						
Generation (GWh)	+29	+2	-4	0	-87	-5
Hydropower revenue ($M)	+$1.68	+2	-$0.67	-1	-$6.55	-7
Regional Hydropower-Related Effects	Regional effects not quantified but would be very minimal		Regional effects not quantified but would be minimal but greater than LSJR Alternative 2		Regional effects not quantified but would be minimal but greater than LSJR Alternative 3	

GWh = gigawatt hour

$M= millions of dollars

Table 20.2-4. Summary of Average Annual Cost and Beneficial Effects of LSJR Alternatives 2, 3, and 4, Relative to Baseline Conditions: Fisheries and Related Economics

	LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Category	Change from Baseline Conditions	Change from Baseline Conditions	Change from Baseline Conditions
Fisheries			
Commercial and Sport Harvest	Effects cannot be quantified but would be expected to be beneficial; extent depends on program success, primarily concerning restoration of salmon populations available for harvest. During closures of the ocean commercial and sport fisheries in 2008 and 2009, the annual value of both the commercial and sport salmon fisheries in marine waters in California was estimated at between $255 and $290 million, and supported an estimated 1,823 to 2,263 jobs annually	Effects cannot be quantified but would be expected to be beneficial; extent depends on program success, primarily concerning restoration of salmon populations available for harvest. The value of the commercial and sport salmon fisheries in California marine water would be similar to that described under LSJR Alternative 2, but these effects would be more probable to occur than under LSJR Alternative 2.	Effects cannot be quantified but would be expected to be beneficial; extent depends on program success, primarily concerning restoration of salmon populations available for harvest. The value of the commercial and sport salmon fisheries in California marine water would be similar to that described under LSJR Alternative 2, but these effects would be more probable to occur than under LSJR Alternative 3.
Non-Use Values Associated with Salmon Restoration	Effects cannot be reliably quantified but would be expected to be beneficial and substantial (based on study results from the literature); extent depends on program success, primarily concerning restoration of salmon populations	Effects cannot be reliably quantified but would be expected to be beneficial and substantial (based on study results from the literature); extent depends on program success, primarily concerning restoration of salmon populations, but these effects would be more probable to occur than under LSJR Alternative 2.	Effects cannot be reliably quantified but would be expected to be beneficial and substantial (based on study results from the literature); extent depends on program success, primarily concerning restoration of salmon populations, but these effects would be more probable to occur than under LSJR Alternative 3.

Category	LSJR Alternative 2 Change from Baseline Conditions	LSJR Alternative 3 Change from Baseline Conditions	LSJR Alternative 4 Change from Baseline Conditions
Regional Fisheries-Related Effects			
Commercial & Sport	Regional effects not quantified but would be beneficial; extent depends on program success, primarily concerning restoration of salmon populations	Regional effects not quantified but would be beneficial; extent depends on program success, primarily concerning restoration of salmon populations, but these effects would be more probable to occur than under LSJR Alternative 2.	Regional effects not quantified but would be beneficial; extent depends on program success, primarily concerning restoration of salmon populations but these effects would be more probable to occur than under LSJR Alternative 3.

Table 20.2-5. Summary of Average Annual Cost and Beneficial Effects of LSJR Alternatives 2, 3, and 4, Relative to Baseline Conditions: Recreation Activity-Related Economics

	LSJR Alternative 2 Change from Baseline Conditions	LSJR Alternative 3 Change from Baseline Conditions	LSJR Alternative 4 Change from Baseline Conditions
Recreation: Tributary Rivers	Effects on river activity not quantified but expected to be generally unchanged	Effects on river activity not quantified but expected to be minor or even unchanged	Effects on river activity not quantified but expected to be minor
Recreation: Reservoirs	Effects on reservoir activity not quantified but expected to be generally unchanged	Effects on reservoir activity not quantified but expected to be minor or even unchanged	Effects on reservoir activity not quantified but expected to be minor
Regional Recreation-Related Effects	Not quantified but would be minor	Not quantified but would be minor, and slightly greater than LSJR Alternative 2	Not quantified but would be minor, and slightly greater than LSJR Alternative 3

As described in Chapter 3, *Alternatives Description*, LSJR Alternatives 2, 3, and 4 include adaptive implementation. Four different methods of adaptive implementation are analyzed under each LSJR alternative. These are described in detail in Chapter 3 (Section 3.3.3, *Adaptive Implementation*) and allow instream flow requirements under LSJR Alternatives 2, 3, and 4 to be adjusted. In general, the methods are as follows.

- Method 1, increasing or decreasing the percent of unimpaired flow required by up to 10 percent depending on the LSJR alternative selected
- Method 2, adjusting the timing of the unimpaired flow releases within the period of February–June
- Method 3, allowing some of the required unimpaired flow volume to be shifted outside of February–June, depending on the LSJR alternative selected
- Method 4, maintaining a certain base flow in the SJR at Vernalis.

The operational changes made using the adaptive implementation methods above may take place on either a short-term (e.g., monthly or annually) or a longer-term basis. Where appropriate, this chapter presents a qualitative discussion of adaptive implementation for each of the LSJR alternatives.

The SDWQ alternatives would establish a revised salinity objective to protect the beneficial uses of agriculture in the southern Delta. Revising the objective could involve costs to dischargers complying with a new National Pollution Discharge Elimination System (NPDES) discharge permit, new waste discharge requirements, or complying with a new total maximum daily load (TMDL) that is established for protecting agricultural beneficial uses. New or updated requirements would be established through subsequent actions of the Central Valley Regional Water Quality Control Board (Central Valley Water Board). Potential compliance costs would be expected mostly from increased wastewater treatment costs in various wastewater treatment districts, although costs also could be incurred by agricultural operators for return flow salinity controls. Potential ratepayer effects and regional economic effects resulting from higher treatment costs would also be possible. Because the actual methods of compliance that would ultimately be used are necessarily site- and discharge-specific, only general costs of compliance for agencies could be developed, as described below.

- **Reduce salinity discharges by developing new, higher-quality water supplies.** Based on purchases (i.e., water transfers) of substantial quantities of water in the southern Delta between 1997 and 2005, a reasonable cost for a long-term transfer would be about $310 per acre-foot (AF), whereas the purchase cost for a permanent transfer would have been about $1,716 per AF based on environmental water account (EWA) contract sales between 2002 and 2004. (Note that these are examples of unit costs ($/AF) for developing new water supplies and do not represent potential total costs if all water purveyors in the southern Delta portion of the plan area decide to develop new, higher-quality water supplies.) These cost estimates are based solely on the estimated cost of surface water and do not include capital costs (e.g., conveyance of water from source to point of use), administrative, engineering, or legal costs related to securing the water supply and building the infrastructure. Because water supply, demand, and price conditions have changed substantially since the late 1990s and early 2000s, when these unit cost estimates were developed, further research should be conducted to determine the appropriateness of these unit costs for representing current costs.

Based on examples of more recent and comprehensive cost information for relatively large-scale water supply projects, water supply costs could range from $235 to $337 million to develop between 33,600 and 45,000 AF per year (AF/y) of new surface water resources (see Table 16-24). Higher quality water would be used by water purveyors to reduce reliance on groundwater, which is typically more saline than surface water supplies.

- **Implement salinity pretreatment programs.** A wastewater treatment agency could implement a program that involves, for example, replacing 2,000 salt-regenerating water softeners over 5 years. Under such a program, the wastewater treatment agency could reasonably be expected to pay between $929,000 and $9,000,000 over the life of the program ($185,700 to $1,803,100 per year). In the case when a commercial, industrial, or institutional discharger decides to install a desalination device, costs vary based on what is being discharged, the volume, and the desired water quality entering the wastewater collection system. Costs can range considerably; relatively small systems can cost as little as $1,000 to install and $200 per year to operate, whereas larger systems can cost millions of dollars to install and tens of thousands of dollars to operate annually.
- **Develop desalination processes at the wastewater treatment plant.** Assuming a 10 million gallons per day (mgd) discharger, a wastewater treatment agency could be expected to pay between $5 million and $22 million to construct a reverse osmosis (RO) system at a wastewater treatment plant (WWTP).
- **Implement agricultural return flow salinity controls.** Control options include real-time management (e.g., changing the timing of the release of agricultural discharge to receiving waters). Assuming 11 real-time management systems to effectively cover the major water users in the plan area, estimated construction costs could total $4.7 million, with an operations and maintenance budget of $1.1 million per year (excluding costs to construct and operate temporary detention ponds).
- **Continue operating the South Delta Temporary Barriers Program.** Implementation for the SDWQ alternatives requires the continued operation (construction and removal) of the temporary barriers in the southern Delta. A recent DWR contract was awarded to build and then remove the temporary rock barriers for approximately $7.5 million, which accounts for other related construction activities but no environmental studies.
- **Provide additional low lift pumping stations at existing south Delta temporary barriers.** Assuming a two-pumping site alternative with 1,000 cubic feet per second (cfs) pumping capacity and combined pumping at Middle and Old River barriers, estimated construction costs could range from $55.5 to $540.7 million, with annual operating costs ranging from $4.5 to $62.7 million.

Under the SDWQ alternatives, costs for complying with salinity objectives could result in rate increases for ratepayers in wastewater treatment districts that do not currently meet salinity objectives set by the alternatives. Assessing how sewer utility rates could be affected by complying with salinity objectives under the SDWQ alternatives is complicated because of several uncertainties that make it infeasible to estimate rate effects as part of this SED's program-level assessment. However, the following wastewater treatment agencies could face increased compliance costs, potentially resulting in higher costs for ratepayers to offset compliance-related expenditures for development and operation of programs and/or facilities.

- No Project Alternative (LSJR Alternative 1 and SDWQ Alternative 1)— none, or the City of Tracy, City of Stockton, City of Manteca, and Mountain House Community Services District (CSD) depending on the status of NPDES permits.
- SDWQ Alternative 2: 1.0 dS/m salinity—City of Tracy, the City of Stockton, and Mountain House CSD.
- SDWQ Alternative 3: 1.4 dS/m salinity—none.

From the perspective of the regional economy in the southern Delta area, rate increases could shift a portion of the spending by residential, commercial, and industrial ratepayers from consumer goods and services, business employee wages, and business supplies and services to monthly sewer utility bills. This shift, although somewhat speculative, would not be anticipated to affect a large percentage of overall consumer and business spending in the region, but could cause relatively small reduction in sales, employment, and income in several sectors of the regional economy. To some extent, these adverse regional economic effects would be offset by increased spending by wastewater treatment agencies to construct and operate new and expanded facilities and establish and operate programs to achieve updated salinity objectives established by their NPDES permits.

20.3 Lower San Joaquin River and Tributaries

This section describes the potential economic effects of LSJR Alternatives 2, 3, and 4 based on modeling results from the State Water Board's Water Supply Effects (WSE) model and the interpretation of those results. Potential economic effects of adaptive implementation are also addressed. The LSJR alternatives represent new instream flow requirements on the eastside tributaries to the LSJR (Stanislaus, Tuolumne, and Merced Rivers) that are defined as a percent of each rivers unimpaired flow from February–June. Specific requirements of the LSJR alternatives are presented in Chapter 3, *Alternatives Description*. Changes in flows would result both in potential costs (e.g., reduction in agricultural production due to reduced diversions) and potential benefits (e.g., improved fisheries and the enhancement of river recreation opportunities); however, the analyses in this section focus on presenting the pertinent economic effects of LSJR Alternatives 2, 3, and 4 without attempting to sum values across resource topics. The dollar values reported in each subsection that follows, with the exception of certain costs reported in Section 20.3.3, *Effects on Municipal and Industrial Water Supplies and Affected Regional Economies*, are presented in constant 2008 dollars.

20.3.1 Changes in Hydrologic Conditions

As discussed in Appendix G, *Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results*, allowable monthly diversions under LSJR Alternatives 2, 3, and 4 were estimated using the WSE model. The WSE model is a monthly water balance spreadsheet model that estimates allowable surface water diversions and reservoir operations needed to achieve the target flow requirements of LSJR Alternatives 2, 3, and 4 on the three eastside tributaries. For the purposes of this analysis, the monthly diversions were added together for a given year and presented as annual allowable diversions in thousand-acre-foot (TAF) increments. The annual diversion estimates were then used to inform the economic analysis of agricultural production effects, municipal and industrial water supply effects, hydropower generation effects, and recreation effects presented later in this chapter. The CALSIM II model run that was used as a source of information for the WSE model is the CALSIM II "Current Conditions" case used in the California Department of Water Resources (DWR) *2009 Delivery Reliability Report* (DWR 2010).

Table 20.3.1-1 summarizes how the LSJR alternatives may impact surface water diversions on the three eastside tributaries and the plan area as a whole. This table presents the average annual allowable surface water diversions under baseline conditions and the potential change of those diversions for each of the LSJR alternative, in total TAF values and as a percent of baseline diversions. Table 20.3.1-1 also includes results for adaptive implementation method 1 under each of the LSJR alternatives for illustrative purposes. Although the adaptive implementation conditions are not quantitatively analyzed for each economic resource topic addressed in this chapter, these adaptive implementation conditions are considered in assessing the likely direction and/or magnitude of impacts associated with a particular LSJR alternative.

As shown in Table 20.3.1-1, the annual average reductions in surface water diversions for the LSJR alternative without adaptive implementation ranges from 2 to 32 percent on the Stanislaus River, 2 to 35 percent on the Tuolumne River, and 6 to 32 percent on the Merced River. For the entire plan area the annual average reduction in surface water diversions for the LSJR alternatives ranges from 3 to 33 percent. In general, average annual diversions are reduced more, relative to baseline, as the unimpaired flow requirement increases (i.e., the least reduction occurs in LSJR Alternative 2 and the greatest reduction occurs in LSJR Alternative 4, both without adaptive implementation.)

The values presented in Table 20.3.1-1 are averaged over the 82-year time period of modeling results for simple reporting. However, because water supplies and related conditions in the watersheds of the Stanislaus, Tuolumne, and Merced Rivers are highly variable over time, diversion reductions could be higher or lower for a specific year than the value reported in the table, depending on the hydrologic conditions. Diversions would likely receive greater cuts in drier years, while diversions may not be reduced at all in wet years, even under LSJR Alternative 4.

Table 20.3.1-1. Average Annual Baseline Water Supply and Differences from Baseline (Changes in Diversions) in the Eastside Tributaries and Plan Area for LSJR Alternatives 2, 3, and 4 (1922–2003)

	Stanislaus (TAF)/(%)	Tuolumne (TAF)/(%)	Merced (TAF)/(%)	Plan Area (TAF)/(%)
Baseline	637/100%	851/100%	580/100%	2,068/100%
LSJR Alternative 2				
Without Adaptive Implementation	-12/-2	-20/-2	-33/-6	-65/-3
With Adaptive Implementation (30%)[a]	-33/-5	-56/-7	-60/-10	-149/-7
LSJR Alternative 3				
Without Adaptive Implementation	-79/-12	-119 /-14	-95/-16	-293/-14
With Adaptive Implementation (30%)[a]	-33/-5	-56/-7	-60/-10	-149/-7
With Adaptive Implementation (50%)[a]	-136 / -21	-193/-23	-136/ -23	-465/-23

	Stanislaus (TAF)/(%)	Tuolumne (TAF)/(%)	Merced (TAF)/(%)	Plan Area (TAF)/(%)
Baseline	637/100%	851/100%	580/100%	2,068/100%
LSJR Alternative 4				
Without Adaptive Implementation	-206/-32	-298/-35	-185/-32	-689/-33
With Adaptive Implementation (50%)[a]	-136 /-21	-193/-23	-136/-23	-465/-23

TAF = thousand acre-feet

TAF/y = thousand acre-feet per year

[a] LSJR Alternatives 2, 3, and 4 include adaptive implementation. The four methods of adaptive implementation are described in Chapter 3, *Alternatives Description*. Results are presented here for method 1, which could result in an increase or decrease of up to 10 percent of the unimpaired flow, depending on the LSJR alternative. The adaptive implementation conditions are not quantitatively analyzed for each economic resource topic addressed in this chapter; however, reference is made to these adaptive implementation conditions in assessing the likely direction and/or magnitude of impacts associated with a particular LSJR alternative.

20.3.2 Agricultural Production and Related Effects on Economic and Local Fiscal Conditions

20.3.2.1 Introduction

The analysis in this section focuses on the potential economic effects that could result from changes in agricultural production caused by reduced surface water diversions under the LSJR alternatives. The economic variables examined include agricultural production and revenues, including groundwater pumping costs, regional economic output, regional economic jobs, and local fiscal conditions. Agricultural production in the tributary watersheds is dependent on irrigation water supply from various sources, including surface water diversions from the three tributaries and~~,~~ groundwater pumping~~, and deliveries from the State Water Project (SWP) and the federal Central Valley Project (CVP)~~. Implementation of LSJR Alternatives 2, 3, and 4 is expected to affect the amount of allowable surface water diversions and, therefore, the agricultural production dependent on those diversions.

The study area for this evaluation includes the San Joaquin, Stanislaus, and Merced Counties (three-county region). Within the three-county region, there are multiple diverters that regularly receive surface water from the Stanislaus, Tuolumne, or Merced Rivers. The primary water providers within this area are collectively referred to as *irrigation districts* and include: South San Joaquin Irrigation District (SSJID), Oakdale Irrigation District (OID), Stockton East Water District (SEWD), Central San Joaquin Water Conservation District (CSJWCD), Turlock Irrigation District (TID), Modesto Irrigation District (MID), and Merced Irrigation District (Merced ID). SEWD and CSJWCD are also sometimes referred to as *CVP contractors*. Many residents and businesses also rely on water from one of the four groundwater subbasins that underlie the three-county region: the Eastern San Joaquin, Modesto, Turlock, and Merced Subbasins[4]. Irrigation district boundaries, counties in which the districts are located, and key municipalities in this region are identified in Figures ES-2 of the *Executive Summary*, Figures 2-1a, 2-1b, and 2-4 of Chapter 2, *Water Resources*, and Figure G.1-1 of Appendix G, *Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results*.

[4] As described in Chapter 9, *Groundwater Resources*, the Merced Subbasin was extended for the analysis to include a part of the Chowchilla Subbasin.

As described in Sections G.2, G.4, and G.5 in Appendix G, the analysis of agricultural production and related economic effects follows three primary steps. First, total agricultural applied water for the irrigation districts is estimated based on the allowable surface water diversions calculated by the WSE model and the available groundwater pumping capacities of the irrigation districts. Second, the Statewide Agricultural Production (SWAP) model is used to estimate how changes in applied water directly affect agricultural production and associated revenues. Finally, the Impact Analysis for Planning (IMPLAN) input-output model is used to estimate how changes in agricultural production revenues, predicted by SWAP for the study area, could impact regional economic output and jobs. The IMPLAN analysis considers the effects on all interconnected sectors of the regional economy to estimate the total economic effect, including direct, indirect, and induced effects.

If surface water supplies are reduced, diverters would likely increase groundwater pumping to help mitigate shortage and to meet their demands. Therefore, implementation of LSJR Alternatives 2, 3, and 4 also would be expected to affect the need for and costs of additional groundwater pumping by farm operators. Appendix G describes the groundwater pumping cost calculations in section G.4.4, Groundwater Pumping Costs, ~~G.2.1, *Inputs from the WSE Model*, and G.2.2, *Methodology for Calculating Applied Water*,~~ and summarizes the groundwater pumping cost results ~~in Tables G.3-3 and~~ G.4-11. Potential economic impacts related to the costs of additional groundwater pumping are summarized below.

This section focuses on three related topics: agricultural production and revenues, including the potential impacts of additional groundwater pumping on farm operators, regional economic effects (total economic output and jobs) in the study area, and effects on local fiscal conditions. For each topic, the modeled baseline conditions are compared to modeled results for LSJR Alternatives 2, 3, and 4 to determine the economic effects.

Baseline Agricultural Production and Revenues and Potential Farmer Effects

Assessment Methods

This section describes application of the SWAP model, including a description of the model inputs. The SWAP model is a widely used agricultural production model for estimating the response of agricultural production and associated revenues to changes in water supply. SWAP uses estimates of the relative applied water delivery ~~(described in Appendix G, Section G.2.4, *Estimates of Total Applied Water*)~~ along with crop distribution information (described in Appendix G, Section G.4.2, *Crop Distribution and Applied Water for SWAP*) for each irrigation district to estimate agricultural production and associated revenues under baseline conditions and for LSJR Alternatives 2, 3, and 4. For more detailed description of the SWAP model, see Appendix G, Section G.4.1, *Description of the Statewide Agricultural Production Model.*

The SWAP model optimizes available land and water such that net returns to farmers are maximized. As water becomes more scarce, the crops most affected, in general, are Pasture, Alfalfa, Rice, and Other Field Crops. These crops are affected more because they require relatively high water use and/or generate lower net revenue per acre when compared to annual crops, such as Almonds and Pistachios. In this analysis, the lower net-revenue crops cover large portions of the study area; consequently, the acreages of these crop groups are substantially reduced as a result of the LSJR alternatives, particularly for LSJR Alternative 4.

Agricultural Production and Revenues

Table 20.3.2-1 presents the average annual acreage of irrigated crops under baseline conditions and the average difference (in acres and percent) between LSJR Alternatives 2, 3, and 4 and these baseline conditions, by crop group. As shown, total acreage is reduced by about 6,000~~6,100~~ acres (1.2 percent of the total acreage) under LSJR Alternative 2, by about 24,900~~23,700~~ acres (4.8~~4.6~~ percent of the total acreage) under LSJR Alternative 3, and by about 64,000~~70,600~~ acres (12.4~~13.8~~ percent of the total acreage) under LSJR Alternative 4.

Table 20.3.2-1. Average Annual Acreage of Irrigated Crops for Baseline and Average Difference (in Acres and Percent) between LSJR Alternatives 2, 3, and 4 and Baseline, by Crop Group [Table 20.3.2-1 has been replaced to reflect topics raised during the response to comments process and to provide related clarifications.]

	Baseline	LSJR Alternative 2		LSJR Alternative 3		LSJR Alternative 4	
Crop Group	Acreage	Change	% Change	Change	% Change	Change	% Change
Alfalfa	34,005	-1,004	3.0	-3,551	10.4	-9,757	28.7
Almonds/Pistachios	115,839	-191	0.2	-674	0.6	-1,884	1.6
Corn	106,365	-850	0.8	-2,424	2.3	-8,926	8.4
Cotton	2,597	-2	0.1	-19	0.7	-63	2.4
Cucurbits	2,678	-37	1.4	-95	3.6	-291	10.9
Dry Bean	2,441	-74	3.1	-212	8.7	-664	27.2
Grain	14,417	-21	0.1	-65	0.5	-194	1.3
Onion and Garlic	781	-1	0.1	-2	0.2	-5	0.6
Orchards	78,606	-63	0.1	-219	0.3	-615	0.8
Other Field Crops	51,917	-2,120	4.1	-9,063	17.5	-21,606	41.6
Other Truck Crops	28,669	-174	0.6	-569	2.0	-2,358	8.2
Pasture	33,156	-1,128	3.4	-6,931	20.9	-14,768	44.5
Rice	6,152	-266	4.3	-887	14.4	-2,395	38.9
Safflower	158	-9	5.7	-25	15.9	-67	42.5
Subtropical	1,988	-7	0.3	-27	1.4	-58	2.9
Sugarbeet	291	0	0.0	-1	0.2	-2	0.8
Tomato (fresh)	10,418	-2	0.0	-8	0.1	-23	0.2
Tomato (processing)	1,900	-25	1.3	-72	3.8	-202	10.6
Vine	22,946	-16	0.1	-58	0.3	-161	0.7
TOTAL	515,325	-5,990	1.2	-24,902	4.8	-64,038	12.4

Source: Derived from Appendix G, *Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results*, Table G.4-6a to Table G.4-6f.

As discussed in Appendix G, *Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results,* the SWAP modeling predicts that pasture and field crops could be nearly eliminated from production in some years of extreme drought, particularly under LSJR Alternatives 3 and 4. On the other hand, higher-value crops, such as Vines, remain unaffected under LSJR Alternatives 2 and 3. The modeling results predict that higher-value crops, such as Tomatoes, are less affected by reduced surface water diversion than lower-value crops because farmers would be expected to fallow lower-value crops first. Perennial crops such as Vines, Almonds, Pistachios, and Sub-Tropical crop groups, are predicted to experience decreases in production only during prolonged extreme droughts, such as occurred in the early 1990s.

Similar to changes in crop acreages, when compared to baseline conditions, average annual crop revenues generated across all irrigation districts are predicted to slightly decrease under LSJR Alternative 2 and to decline more substantially as irrigation water becomes less available under LSJR Alternatives 3 and 4. As shown in Table 20.3.2-2, total average annual crop revenues in the entire region would decrease by an estimated $10~~9~~ million, or about 0.7~~0.3~~ percent, under LSJR Alternative 2, as compared to baseline revenues. Under LSJR Alternatives 3 and 4, crop production revenues are estimated to decline by $39~~36~~ million (2.6~~2.4~~ percent) and $108~~117~~ million (7.1~~7.9~~ percent), respectively, as compared to baseline revenues.

Table 20.3.2-2. Estimates of Annual Average Agricultural Revenues under Baseline Conditions and the Change in Revenues for LSJR Alternatives 2, 3, and 4, by Irrigation District [Table 20.3.2-2 has been replaced to reflect topics raised during the response to comments process and to provide related clarifications.]

Irrigation District	Baseline	LSJR Alternative 2 Difference from Baseline		LSJR Alternative 3 Difference from Baseline		LSJR Alternative 4 Difference from Baseline	
	$Million/y, 2008	$Million/y, 2008	% Change	$Million/y, 2008	% Change	$ Million/y, 2008	% Change
SSJID	221	-2	-1.1	-6	-2.9	-17	-7.6
OID	134	-2	-1.4	-5	-3.9	-15	-11.1
SEWD/CSJWCD	335	0	0.0	0	0.0	0	0.0
MID	178	-2	-1.2	-9	-4.9	-22	-12.5
TID	333	-4	-1.1	-17	-5.2	-48	-14.5
Merced ID	320	0	<1.0	-2	<1.0	-6	-1.8
TOTAL	1,521	-10	<1.0	-39	-2.6	-108	-7.1

Source: Appendix G, *Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results,* Table G.4-9.

Because water supplies and other conditions important to agricultural production are highly variable over time, effects associated with LSJR Alternatives 2, 3, and 4 on crop revenues also vary. These trends are characterized in Appendix G (Figure G.4-1) by an exceedance plot that shows the magnitude and variability of estimated revenues across the 82 years of model simulation (1922–2003) for LSJR Alternatives 2, 3, and 4 and baseline.

Groundwater Pumping Costs and Potential Impacts on Farmers

As discussed in Appendix G, *Agricultural Economic Effects of the Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results*, additional groundwater pumping needed to offset the loss of surface water supplies could affect the profitability of farming operations. These potential impacts, which are discussed in detail in Appendix G, are summarized below.

Factors affecting the costs of drilling and operating new groundwater wells, or to increase the production of existing wells, include pump efficiency, depth of the well, cost of electricity, volumetric flow, cost of materials for maintenance (lubrication, replacement parts, etc.), proximity to water distribution system, and the staff needed to maintain equipment and facilities. For this analysis, an average energy price of $0.189/kilowatt hour (kWh) over the entire irrigation season was assumed based on information contained in the SWAP model (CH2M Hill 2012). The cost effects of additional groundwater pumping on farming operations are presented in Table 20.3.2-3. The average price used for this analysis is considered a conservative assumption because some of the affected irrigation districts have hydropower projects and/or receive discounted power that would be less expensive than this average price,

The estimated increase in groundwater pumping costs would range from $1.3 million per year under LSJR Alternative 2 to $~~12~~14.7 million per year under LSJR Alternative 4, when compared to baseline conditions (Table 20.3.2-3). In addition to estimating the cost of additional groundwater pumping on farming operations, an IMPLAN-based analysis of the induced effects on proprietary income (presented in Table 20.3.2-3 as Induced Economic Impact) from additional groundwater pumping are estimated to range from about $1 million per year (LSJR Alternative 2) to about $~~9~~11.~~8~~ 4 million per year (LSJR Alternative 4). Loss in proprietor income also may result in some reductions in employment in the study area, ranging from 7.5 jobs in in LSJR Alternative 2 to about ~~74~~ 85 per year in LSJR Alternative 4, when compared to baseline conditions.

One of the effects of increased pumping costs would be to transfer income from farming to mostly power utilities. Because operations of the power utility entities that serve the area are mostly located outside the plan area, most of the benefits in employment and economic output from this transfer would be expected to occur outside the study area.

Adaptive Implementation

Adaptive implementation would take place based on required evaluation of current scientific information and would need to be approved as described in Appendix K, *Revised Water Quality Control Plan.* Accordingly, the frequency and duration for any use of adaptive implementation methods 1, 2, 3, and 4 cannot be determined at this time. Adaptive implementation method 1 potentially has the greatest likelihood to change economic effects as it would allow the unimpaired flow requirement to be increased or decreased by up to 10 percent from the objective unimpaired flow (with a minimum requirement of 20 percent and a maximum of 60 percent unimpaired flow). For LSJR Alternative 2 an increase from 20 percent to 30 percent of the unimpaired flow would likely result in different effects as compared to those shown above for LSJR Alternative 2, depending upon flow conditions and frequency of the adjustment. As such, under LSJR Alternatives 2 or 3, if the percentage of unimpaired flow is increased with adaptive implementation method 1, crop production would likely shift more toward higher-value crops and away from lower value crops (e.g., Pasture, Row Crops) than is predicted without adaptive implementation. On the other hand, under LSJR Alternatives 3 and 4, if the percent of unimpaired flow is reduced with adaptive implementation method 1, the shift toward higher value crops would not be as great and revenue losses for lower value crops would be smaller than those predicted without adaptive implementation.

Baseline Regional Economic Conditions and Potential Regional Effects

This section addresses potential regional economic effects associated with changes in agricultural production and revenues. Estimates of the total economic output and total employment within the three-county region under baseline conditions and under LSJR Alternatives 2, 3, and 4 are presented. As discussed in Appendix G, *Agricultural Economic Effects of the Lower San Joaquin River*

Flow Alternatives: Methodology and Modeling Results, IMPLAN-derived multipliers were applied to the estimated changes in crop production revenues as predicted by SWAP to determine these effects.

Table 20.3.2-3. The Average Annual Cost of Groundwater Pumping in the Irrigation Districts, and its Associated Induced Effects on Total Economic Output and Employment under Baseline Conditions and for LSJR Alternatives 2, 3, and 4 [Table 20.3.2-3 has been replaced to reflect topics raised during the response to comments process and to provide related clarifications.]

			Change from Baseline		
		Baseline[a]	LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Average Annual GW Pumping	TAF/y	258	21	105	249
Average Annual Cost of GW Pumping	$Millions/y, 2008	15.3	1.3	6.3	14.7
Induced Economic Effect	$ Millions/y, 2008	-11.9	-1.0	-4.8	-11.4
Induced Employment Effect	Jobs/y	-89	-7.5	-36	-85

Source: Appendix G, *Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results,* Table G.4-11.

GW = groundwater

TAF/y = thousand acre-feet per year

$Millions, 2008/y = millions of $ per year (in 2008 $)

[a] The baseline induced effects are approximated using marginal impact multipliers, so these values likely differ to some extent from the actual values.

Assessment Methods

To estimate the regional economic effects of agricultural production under baseline conditions and for LSJR Alternatives 2, 3, and 4, this assessment used multipliers developed from the 2010 IMPLAN database. The IMPLAN model relies on a snapshot of the interrelationships among sectors and institutions in a regional economy; it is widely used to assess the regional economic effects resulting from changes in the availability and use of resources.

For the IMPLAN analysis, direct agricultural revenues from the SWAP model, described above, were "mapped" from the SWAP categories to different IMPLAN crop groups. The economic effect of each LSJR alternative was then estimated in terms of the total annual economic output less estimates of the direct annual revenues under baseline conditions. As described in Appendix G, the majority of the irrigation district areas modeled using IMPLAN is contained within San Joaquin, Merced, and Stanislaus Counties.

Potential effects on economic activity can extend beyond the three-county region used to analyze predicted changes in agricultural production. These changes could affect residents and businesses throughout the state, and beyond. In general, even when a change in agricultural production occurs in a particular region, change in economic activity (sales and purchases) typically extends beyond that area, both directly and indirectly. For example, agricultural inputs, such as seed, fertilizer, insurance services, and fuel and transportation, often originate outside the region where they are used. After accounting for direct sales and purchases, the indirect and induced transactions that result from income changes and secondary effects broaden the boundaries of the originally-affected area.

These potential effects outside of the three-county region, however, are not quantified for this analysis; the analysis focuses on the three-county region where the irrigation districts are located and where the direct effects on agricultural production and associated revenues would occur. Effects on areas outside of this region would be more dispersed, thereby incurring an increasingly smaller effect.

Results

Overview of Regional Economic Effects

Under LSJR Alternatives 2, 3, and 4, reductions in water deliveries to agricultural users would affect several sectors of the economy, in addition to agriculture. When farm production decreases as a result of reduced water availability, farmers often would hire fewer seasonal workers and may lay off some year-round workers. Without jobs, household spending by these workers is likely to decrease, affecting retailers and other businesses in the area. In addition, farmers would likely reduce purchases of equipment, materials, and services from local businesses, reducing jobs and income for these suppliers. The total regional economic effect is the sum of the direct effects on agriculture and the associated indirect and induced effects.

Effects on Total Economic Output in the Study Area

Table 20.3.2-4, presents estimates of average annual effects on total economic output (including direct, indirect, and induced effects) related to agricultural production in the irrigation districts under baseline conditions. Table 20.3.2-4 also presents differences from baseline conditions, both in dollars and as a percent, for each LSJR alternative. The table splits the total sector output into direct effects and indirect and induced effects. As shown, as the unimpaired flow for an LSJR alternative increases, the effect on economic output also increases.

Table 20.3.2-4. Estimates of Total Economic Output Related to Agricultural Production in the Irrigation Districts under Baseline Conditions and Associated with Changes in Agricultural Production under LSJR Alternatives 2, 3, and 4 [Table 20.3.2-4 has been replaced to reflect topics raised during the response to comments process and to provide related clarifications.]

Economic Output Effects	Baseline Total Economic Output ($ Millions, 2008)[a]	Change from Baseline ($ Millions, 2008)		
		LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Direct Economic Output	1,521	-10	-39	-108
Indirect and Induced Economic Output	1,144	-8	-30	-82
Total Economic Output	2,665	-$18	-$69	-190
% of Baseline Total Economic Output	100	-0.7	-2.6	-7.1

Source: Appendix G, *Agricultural Economic Effects of the Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results*, Table G-5.4.

[a] The baseline economic output is approximated using marginal impact multipliers, so these values likely differ to some extent from the actual values.

Effects on Total Employment in the Study Area

Table 20.3.2-5 presents estimates of the number of jobs associated with crop production and affected economic activity in other sectors of the economy under baseline conditions. The table also presents differences from baseline conditions, both in total jobs and as a percent, for each LSJR alternative.

The total effect on jobs associated with the LSJR alternatives are relatively similar to the effects on economic output. The number of jobs within the crop production sector (direct effects) and those within other affected sectors (indirect and induced) are presented.

Table 20.3.2-5. Estimates of Total Employment Related to Agricultural Production in the Irrigation Districts under Baseline Conditions and the Change for LSJR Alternatives 2, 3, and 4 [Table 20.3.2-5 has been replaced to reflect topics raised during the response to comments process and to provide related clarifications.]

Employment Effects	Baseline Total Employment (# of Jobs)[a]	Change from Baseline (# of Jobs)		
		LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Direct Employment	8,422	-54	-193	-561
Indirect and Induced Employment	10,805	-68	-265	-725
Total Employment	19,227	-123	-458	-1,287
% of Baseline Total Employment	100	-0.6	-2.4	-6.7

Source: Appendix G, *Agricultural Economic Effects of the Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results*, Table G-5.6.

[a] The baseline employment is approximated using marginal impact multipliers, so these values likely differ to some extent from the actual values.

Other Regional Considerations

As described in Appendix L, *City and County of San Francisco Analyses*, and summarized in Section 20.3.3, *Effects on Municipal and Industrial Water Supplies and Affected Regional Economies*, the analysis of potential economic effects on water districts and ratepayers in the San Francisco Public Utilities Commission (SFPUC) service area assumes that water districts and farm operators in the plan area would be willing to sell water to the SFPUC for $1,000 per AF and that existing Tuolumne River water supply infrastructure would be used to transfer this water to the San Francisco Bay Area. These assumed agreements would result in a stream of income from the SFPUC to the willing irrigation districts. As shown in Tables 20.3.3-9a and 20.3.3-9b (Section 20.3.3, *Effects on Municipal and Industrial Water Supplies and Affected Regional Economies*), the income that would be paid in severe drought years to the irrigation districts is estimated to be $14 million or $25 million under LSJR Alternative 2, $27 million or $119 million under LSJR Alternative 3, and $30 million or $208 million under LSJR Alternative 4, depending on which scenario under the Fourth Agreement between CCSF and the irrigation districts is agreed upon. (For more information regarding the Fourth Agreement, see Section 20.3.3.4, *M&I Water Supply Conditions in the SFPUC Service Area and Potential Effects*.) This income would be expected to offset, to some extent, the economic effects in the three-county region caused by reduced agricultural production.

Adaptive Implementation

Adaptive implementation would take place based on required evaluation of current scientific information and would need to be approved as described in Appendix K, *Revised Water Quality Control Plan.* Accordingly, the frequency and duration for any use of adaptive implementation methods 1, 2, 3, and 4 cannot be determined at this time. Adaptive implementation method 1 potentially has the greatest likelihood of changing economic effects as it would allow the unimpaired flow requirements to be increased or decreased by up to 10 percent from the objective unimpaired flow (with a minimum requirement of 20 percent and a maximum of 60 percent unimpaired flow). For LSJR Alternative 2, an increase from 20 percent to 30 percent of the unimpaired flow would likely result in different effects as compared to those shown above for LSJR Alternative 2, depending upon flow conditions and frequency of the adjustment. As such, under LSJR Alternatives 2 or 3, if the percentage of unimpaired flow is increased with adaptive implementation method 1, the regional economic and employment effects could be greater than those predicted without adaptive implementation. On the other hand, under LSJR Alternatives 3 and 4, if the percent of unimpaired flow is reduced with adaptive implementation method 1, the regional economic and employment effects could be less than those predicted without adaptive implementation.

Baseline Local Fiscal Conditions and Potential Fiscal Effects

This section describes how changes in agricultural production could affect local fiscal conditions in the three-county study region. Agricultural production encourages economic activity throughout local economies, generating millions of dollars in revenue for farmers and related industries. Federal, state, and local governments also collect a portion of this income by imposing various taxes. Potential fiscal effects at the state and federal level are described in Appendix G, *Agricultural Economic Effects of the Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results*, along with details of the following assessment on local fiscal conditions.

Overview

Because the amount of tax revenue generated by a community depends on its levels of economic activity, reductions in agricultural production may have fiscal impacts on tax revenue for cities, counties, the state, and the federal government. There could be direct impacts on sales tax revenue associated with the reduction in agricultural production because there is less crop product to sell. Property taxes may decrease slightly as property values decline from fallowing of farmland and reduced economic activity in the area. Tax revenue generated from other industries also could decrease in response to the indirect and induced effects caused by changes in crop production. A significant decline in tax revenue from reduced agricultural production could in turn impact the delivery of public services. Although vital services, such as health and safety, would likely maintain funding by tapping into other available sources of revenue, less critical services, such as public transportation and road systems, could be forced to operate with smaller budgets.

Table 20.3.2-6 presents estimates of total tax revenue received by local governments for each county within the three-county region during 2010, and the contribution of crop farming related production and import tax revenues to each county's total. Taxes on production and imports represent sales tax, property tax, and other miscellaneous taxes (severance, motor vehicle license); it does not include income or corporate taxes, which primarily go to the state and federal governments. Of the three counties in the study area, the agricultural sector makes the greatest percent contribution in Merced County where it generates about 4.5 percent of the tax revenue. Overall, San Joaquin and Stanislaus Counties receive more tax revenue than Merced County, primarily because they have larger urban populations, but agriculture contributes a smaller percent of the total tax revenue.

Table 20.3.2-6. Estimates of Local Government Tax Revenue and Crop Farming Contribution from IMPLAN

	Total Annual Tax Revenue to Local Governments[a]	Total Annual Tax Revenue from Crop Farming to Local Governments[b]	Crop Farming Contribution as % of Total Tax Revenue
County	($ Millions, 2010)	($ Millions, 2010)	(%)
San Joaquin	983	18	1.9
Stanislaus	736	11	1.4
Merced	283	13	4.5

Source: Appendix G, *Agricultural Economic Effects of the Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results*, Table G-5.9.

$ Million, 2010 = millions of 2010 dollars.

[a] Local government includes the governments of both the county and cities within the county.

[b] Only includes taxes on production and imports, not personal taxes.

Assessment Methods

Multipliers derived from the IMPLAN input-output model are used to estimate potential local tax revenue effects under LSJR Alternatives 2, 3, and 4. These multipliers are developed for a three-county study region of San Joaquin, Stanislaus, and Merced Counties, and also for each of the three counties individually. Table 20.3.2-7 presents the impact and the fiscal impact multipliers associated with an agricultural revenue loss of $1 million in each county. For example, a 1 million dollar loss in agricultural revenue in San Joaquin County would have a direct loss of $15,691 in tax revenue for local governments. Accounting for the indirect and induced effects of the 1 million dollar loss would increase the tax revenue losses to $44,731. To create fiscal impact multipliers for the different levels of government, the total loss at each level of government is divided by $1 million. In other words, the total federal tax impact is 15.4 percent of the agricultural revenue loss, the total state tax impact is 6.1 percent of the loss, and the total local tax impact is 4.5 percent of the loss.

The county fiscal impact multipliers in Table 20.3.2-7 are used with the SWAP results for crop revenue as described in Appendix G, Section G.4.3, *SWAP Modeling Results,* to estimate the tax revenue losses. Before applying the multipliers, SWAP results for crop revenue in each of the irrigation districts are first totaled by county. For OID and TID, which each overlap portions of two counties, the revenue is divided between the counties based on the relative area of the irrigation districts in each county. According the OID AWMP (2012) 20 percent of OID falls in San Joaquin County and 80 percent falls in Stanislaus County. TID is estimated to have 74 percent of its area in Stanislaus County and 26 percent of it area in Merced County, based on GIS analysis.

Table 20.3.2-7. Fiscal Impacts by County of a Hypothetical $1 Million Crop Revenue Loss

Level of Government	Tax Revenue Impact ($ Million, 2010)		Fiscal Impact Multipliers	
	Direct	Total[a]	Direct	Total
San Joaquin				
Federal	-75,482	-154,003	0.075	0.154
State	-27,156	-61,415	0.027	0.061
Local	-15,691	-44,731	0.016	0.045
Stanislaus				
Federal	-83,268	-153,658	0.083	0.154
State	-28,707	-60,647	0.029	0.061
Local	-15,998	-40,519	0.016	0.041
Merced				
Federal	-70,966	-108,684	0.071	0.109
State	-26,757	-47,082	0.027	0.047
Local	-15,404	-32,610	0.015	0.033

Source: Appendix G, *Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results,* Table G-5.12.

$ Million, 2010 = millions of 2010 dollars.

[a] Includes direct, indirect, and induced effects of a $1 million (in 2010 dollars) loss in agricultural revenue.

Results

This section focuses on potential effects for local tax revenues under each of the LSJR alternatives, although results for state and federal tax revenues also are addressed. Table 20.3.2-8 shows the annual average tax revenue related to changes (decreases) in agricultural production for each level of government in the three counties individually and in the three-county region as a whole. Under baseline, the federal government receives about $216~~210~~ million and the state receives about $87~~85~~ million in tax revenue from agricultural production over all three counties, which is only 0.01

percent and 0.09 percent of their total tax revenue for 2010 (Table G.5-8 of Appendix G), respectively. Both federal and state tax revenues from agricultural production in the three counties decrease by an estimated 0.7 percent under LSJR Alternative 2, up to about 7.3~~8.1~~ percent under LSJR Alternative 4; however, these changes are minor compared to the total revenue for 2010.

Table 20.3.2-8. Estimated Change in Tax Revenue Associated with Predicted Changes in Annual Agricultural Production for LSJR Alternatives 2, 3, and 4 Relative to Baseline Conditions [Table 20.3.2-8 has been replaced to reflect topics raised during the response to comments process and to provide related clarifications.]

		Tax Revenue Effects of Agricultural Production			
		Baseline	Change Relative to Baseline ($ Millions, 2008)		
County	Level of Government	($ Millions, 2008)[a]	LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
San Joaquin	Federal	90	-0.42	-1.14	-3.04
	State	36	-0.17	-0.46	-1.21
	Local	26	-0.12	-0.33	-0.88
Stanislaus	Federal	82	-0.97	-3.95	-10.74
	State	32	-0.38	-1.56	-4.24
	Local	22	-0.25	-1.04	-2.83
Merced	Federal	44	-0.12	-0.68	-2.00
	State	19	-0.05	-0.30	-0.86
	Local	13	-0.04	-0.21	-0.60
Total, All Counties	Federal	216	-1.51	-5.78	-15.77
	State	87	-0.60	-2.31	-6.31
	Local	61	-0.42	-1.58	-4.31

Source: Appendix G, *Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results,* Table G-5.13.

$ Millions, 2008 = millions of 2008 dollars.

[a] The baseline tax revenue is approximated using marginal impact multipliers, so these values likely differ to some extent from the actual values.

Table 20.3.2-9 summarizes the effect of the LSJR alternatives on local governments and how it compares to the total annual tax revenue from Table 20.3.2-6. Under baseline, local governments in San Joaquin, Stanislaus, and Merced Counties receive an estimated $26, $22~~20~~, and $13 million in tax revenue from annual agricultural production, respectively. These revenues represent about 2.7 to 4.8~~4.5~~ percent of the total annual tax revenue for local governments in each of the three counties (Table 20.3.2-9). For the LSJR alternatives, the resulting impact on tax revenue is small compared to the total annual tax revenue. Stanislaus County has the largest reduction in tax revenue of the three counties, but its losses would not exceed an estimated 0.4 percent of the total annual tax revenue under any of the LSJR alternatives.

Table 20.3.2-9. Estimates of Local Tax Revenue Associated with Predicted Changes in Annual Agricultural Production, as a Percent of Total Tax Revenue [Table 20.3.2-9 has been replaced to reflect topics raised during the response to comments process and to provide related clarifications.]

		Tax Revenue Related to Predicted Annual Agricultural Production, by County			
			Change Relative to Baseline as % of Estimated Total Annual Tax Revenue		
County	Estimates of Total Annual Tax Revenue to Local Governments[a,b] ($ Millions, 2008)	Baseline Value as % of Estimated Total Annual Tax Revenue[c]	LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
San Joaquin	963	2.7	<0.01	<0.01	-0.1
Stanislaus	722	3.0	<0.01	-0.1	-0.4
Merced	278	4.8	<0.01	-0.1	-0.2

Source: Appendix G, *Agricultural Economic Effects of Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results,* Table G-5.14.

$ Million, 2008 = millions of 2008 dollars.

[a] Local government includes the governments of both the county and cities within the county.

[b] Dollar values from IMPLAN are in $2010 and had to be converted to $2008 with a conversion factor of 0.980 derived from BEA data (BEA 2016).

[c] The baseline tax revenue is approximated using marginal impact multipliers, so these values likely differ to some extent from the actual values.

Given the results presented above (and in Appendix G), LSJR Alternatives 2, 3, and 4 would have a minor effect on tax revenue for all levels of government relative to the total tax revenue collected by each level of government. Tax revenue from agricultural production is a larger percentage of income for local governments than for the federal or state government, but it is still relatively small compared to tax revenue from other sources. Although the three counties in the study area account for some of the largest agricultural producing counties in the state[5], the contribution to tax revenue from agriculture is relatively small for most local governments. A recent report similarly concluded that lost agricultural production over the drought from 2012–2014 did not substantially impact the finances of most local governments (MIS 2014). While there could be localized impacts on small towns that primarily rely on agriculture, most cities within the three-county region would not be expected to experience substantial budgetary changes or impacts on public services.

Adaptive Implementation

Adaptive implementation would take place based on required evaluation of current scientific information and would need to be approved as described in Appendix K, *Revised Water Quality Control Plan.* Accordingly, the frequency and duration for any use of adaptive implementation methods 1, 2, 3, and 4 cannot be determined at this time. Adaptive implementation method 1 potentially has the greatest likelihood of changing fiscal effects as it would allow the unimpaired flow requirements to be increased or decreased by up to 10 percent from the objective unimpaired flow (with a minimum requirement of 20 percent and a maximum of 60 percent unimpaired flow). For LSJR Alternative 2, an increase from 20 percent to 30 percent of the unimpaired flow would

[5] See information in the 2012 Census of Agriculture for California – county data. Can be accessed at: https://www.nass.usda.gov/Statistics_by_State/California/Publications/

likely result in different effects as compared to those shown above for LSJR Alternative 2, depending upon flow conditions and frequency of the adjustment. As such, under LSJR Alternatives 2 or 3, if the percentage of unimpaired flow is increased with adaptive implementation method 1, tax revenue related to agricultural production would likely decrease slightly more than is predicted without adaptive implementation. On the other hand, under LSJR Alternatives 3 and 4, if the percent of unimpaired flow is reduced with adaptive implementation method 1, tax revenue related to agricultural production would be slightly larger than predicted without adaptive implementation. Overall, given the very small estimated changes in agricultural-related tax revenue, it is not expected that adaptive implementation would substantially change the effects presented above.

20.3.3 Effects on Municipal and Industrial Water Supplies and Affected Regional Economies

Implementation of LSJR Alternatives 2, 3, and 4 could result in surface and groundwater water supply reductions to municipal and industrial (M&I) service providers in the plan area, as described in Chapter 13, *Service Providers*, and Chapter 22*, Integrated Discussion of Potential Municipal and Domestic Water Supply Management Options*. Specifically, M&I service providers that rely on surface water contracts with irrigation districts within the plan area or rely solely on groundwater from the four primary groundwater subbasins under the plan area could be particularly affected if they do not have ready access to alternative supplies (Tables 13-3a and 13-3b).

This section discusses potential costs to municipal and industrial service providers, identified in Chapter 13, concerning different activities they may undertake to secure reliable water supplies.

Potential effects on ratepayers in affected irrigation districts within the plan area also are evaluated. In addition to potential effects within the plan area, implementation of the LSJR alternatives under drought conditions could result in water supply reductions within the SFPUC retail service area, and within the service areas of the 27 agencies in Alameda, San Mateo, and Santa Clara Counties that purchase wholesale water from SFPUC. The analysis presented in this section (and described in greater detail in Appendix L, *City and County of San Francisco Analyses*) assumes that under LSJR Alternatives 2, 3, and 4, during drought periods, SFPUC could meet its potential water supply shortage by buying water from MID and TID. However, due to the uncertainties of this type of water transfer (i.e., price of water, quantity of water available, willingness of parties to enter into an agreement), other actions that SFPUC might undertake to ensure a reliable supply of water for its service area also are considered (primarily in Chapter 16, *Evaluation of Other Indirect and Additional Actions*, and summarized in Appendix L).

This section first describes M&I water supply conditions in the plan area and addresses potential effects that the LSJR alternatives may have on these water districts and their ratepayers. The section then describes M&I water supply conditions in the SFPUC service area and assesses potential indirect effects of the LSJR alternatives on water supply costs and the regional economy within that service area. Additional details of the assessment for potential M&I water supply effects in the SFPUC service area are included in Appendix L.

M&I Water Supply Conditions in the Plan Area and Potential Water District and Ratepayer Effects

This section addresses potential economic effects of reduced surface water diversions on affected water districts and ratepayers within the plan area under LSJR Alternatives 2, 3, and 4. The following assessment uses three of the service providers in the plan area as examples: SSJID, SEWD, and MID. The discussion first presents information on water usage, types of uses served, rate structures, and facility improvement plans for each district, followed by a qualitative assessment of the potential economic effects on these and other districts (and ratepayers) in the plan area using information presented in Chapter 13, *Service Providers*, and Chapter 16, *Evaluation of Other Indirect and Additional Actions*. These districts exhibit certain characteristics that are important to assessing potential economic effects, as they rely on surface water to meet some or all of their demand and they have agreements to either provide surface water to other water users or receive surface water.

Affected Water Districts

Water service providers in the plan area obtain their water supplies by either diverting surface water from one or more of the three eastside tributaries (see Table 13-2) or by pumping groundwater from aquifers (see Tables 13-3a and 13-3b). ~~Some irrigation districts also have contracts or agreements to obtain water supplies from other water users, including water districts or conservation districts.~~ Irrigation districts within the plan area obtain most of their water supply from surface water diversions; other water users primarily rely on groundwater, or a combination of groundwater and surface water, for their water (see Tables 13-3a and 13-3b). As identified in Chapter 13, *Service Providers* (see Table 13-2), five irrigation districts receive surface water from the Stanislaus, Tuolumne, and Merced Rivers, and 13 other water users, including water districts and conservation districts, obtain some of ~~its~~ their water from one of the ~~primary surface water diverters~~five irrigation districts.

South San Joaquin Irrigation District

SSJID, together with OID, holds contract rights with the U.S. Bureau of Reclamation (USBR) to divert 600 thousand acre-feet (TAF) of water from the Stanislaus River. Water usage by type of use within the SSJID is identified in Table 20.3.3-1.

Table 20.3.3-1. South San Joaquin Irrigation District Water Usage by Type of Use

Type of Use	Usage (acre-feet)
Treated Water for Cities of Lathrop, Manteca, and Tracy	19,263 (2014)
Groundwater Recharge from Distribution Seepage and Applied Irrigation Water	132,513 (2014)
SSJID Water Transfers	325 (40,150 to San Luis & Delta-Mendota Water Authority in 2013)
Supplemental Water to Improve Flow for Chinook Salmon	(Average of 3,529 from 2000–2010)

Source: SSJID 2015a.

SSJID charges a flat rate of $24 per acre for water service to each parcel performing irrigation, with a $50 minimum charge. In addition, SSJID charges a groundwater recharge fee of $12 per acre for parcels of more than 10 acres with a $25 minimum charge, as long as the parcel is subject to an Irrigation Service Abandonment Agreement (ISAA). In 2013, the district enacted a $3 per AF volumetric charge for water. However, starting in 2016, the district plans to have a two-tier volumetric charge, where it increases to $10 per AF if water use exceeds 48 inches per year (Table

20.3.3-2). Finally, since 2010, the district also has imposed a pressurized water charge of $30/AF for the first 3 AF/y and $40/AF in excess of 3 AF/y for customers served with pressurized water by the District's Irrigation System Improvement Project

Table 20.3.3-2. South San Joaquin Irrigation District2016 Water Rate Structure

Category of Charge	Cost in $/Acre (AC) or $/Acre-Foot (AF)
Fixed Charge	None
Flat Rate	$24/AC (with a $50 minimum)
Groundwater Recharge Fee (for parcels of 10+ acres, subject to an ISAA)	$12/AC (with a $25 minimum)
Volumetric—Tier 1 (water use ≤ 48"/y)	$3/AF
Volumetric—Tier 2 (water use > 58"/y)	$10/AF
Pressurized Water Charge (first 3 AF/y)	$30/AF
Pressurized Water Charge (above 3 AF/y)	$40/AF

Source: SSJID 2015b.

Although the district does not have a fixed capital cost fee, it is allowed by district law to levy assessments for maintenance projects. The district may also collect charges for any services furnished. The second tier volumetric charges (Table 20.3.3-2) were recently enacted to pay for the increased costs of ongoing maintenance and other pipeline costs.

The SSJID's 2011 capital improvement plan includes the following highlights.

- Expanding the Nick C. DeGroot Water Treatment Plant to increase the total output of the plant to 43,000 AF/y of water, which would provide sufficient capacity to supply Escalon with treated water.
- Constructing a new pipeline to Escalon.
- Constructing a 10-mile-long pressurized water delivery system to areas west of Ripon.
- Using newly installed electronic controllers on district groundwater pumps to measure groundwater salinity.
- Implementing a 2011 plan to provide drinking water to Ripon, which requires constructing a new pipeline.
- Supplying a new 80-acre annexation area with irrigation water from existing irrigation facilities.

Stockton East Water District

SEWD provides water to the CalWater Services Company, the Stockton Municipal Utility District, and very small amounts of water to the County of San Joaquin. District surface water is diverted from the Stanislaus River and the Calaveras River. Surface water is stored in two reservoirs and treated at the Dr. Joe Waidhofer water treatment plant. The district provides about 12,400 AF/y of water for urban uses, and about 117,400 AF/y for agricultural uses (SEWD 2014).

As of January 2015, SEWD's rate structure for water included both fixed charges and volumetric charges (Table 20.3.3-3). Also included is a base monthly charge that allocates costs of the

Treatment Plant Budget (SEWD 2014). Groundwater production costs are estimated during each update of the water management plan.

Table 20.3.3-3. Stockton East Water District Rate Structure and Units Billed, by Type of Use

Charges	Charge Units	Units Billed During Year	Collected
Fixed Charges			
Urban			
Domestic Groundwater	$37.50/Well	5,042 Wells	$218, 549
Agricultural			
Surface water	$20/AF	4,150 AF	$83,008
Agricultural Groundwater	$4.58/AF	117,434 AF	$537,806
Volumetric Charges			
Urban			
Municipal Groundwater	$164.31/AF	16,122 AF	$2,506,012
Agricultural			
Metered Surface Water	$20/AF	18,965 AF	$379,304

Source: SEWD 2014.
AF = acre-feet

According to the 2014 SEWD Water Management Plan, no new treatment facilities or reservoirs are planned; however, the district has expressed interest in securing additional supplemental supplies from the Calaveras River (SEWD 2014).

Modesto Irrigation District

Water usage by type of use within the MID service area is shown in Table 20.3.3-4. As shown, irrigation water from surface water diversion accounts for the largest share (65 percent) of the total water usage in the district.

Table 20.3.3-4. Modesto Irrigation District Water Usage in 2012, by Type of Use

Type of Use	Usage (2012) (acre-feet)
Surface Water—Irrigation	278,800
M&I Treated Surface Water	32,661
Groundwater Pumping—Irrigation (agency wells)	17,300
Groundwater Pumping—M&I (agency wells)	28,700
Groundwater Pumping—Irrigation (private wells)	81,200

Source: MID 2015a.

As of March 2015, MID's water rate structure included both a fixed charge and a four-tier volumetric charge (Table 20.3.3-5). If a customer takes no surface water, the landowner is charged a facilities maintenance fee that is half of the fixed charge, or $20 per acre. Provisions of the Amended and Restated Treatment and Delivery Agreement (ARTDA) reached between MID and the City of Modesto in 2005 allow MID the option to pass higher costs on to water customers, including the City of Modesto, if the state of California levies fees or other charges on MID.

Table 20.3.3-5. Modesto Irrigation District Water Rate Structure

Category	Cost $/Acre (AC) or $/Acre Foot (AF)
Fixed Charge	$40.00/AC
Volumetric—Tier 1 (water use ≤ 24"/y)	$1.00/AF
Volumetric —Tier 2 (24"/y < water use ≤ 36"/y)	$2.00/AF
Volumetric—Tier 3 (36"/y < water use ≤ 42"/y)	$3.00/AF
Volumetric—Tier 4 (42"/y < water use)	$10.00/AF

Source: MID 2015b.

MID is presently moving forward on Phase Two of its Modesto Regional Wastewater Treatment Plant (MRWTP) project, which would expand water treatment capacity to 67,000 AF. As part of the project, new storage tanks and pipelines are expected to be built. During Phase One, MID and the City of Modesto developed a long-term water management plan, which included combining well water with surface water supplies from the Tuolumne River. In addition to water supply, MID also operates an extensive power grid, and the capital costs associated with the power grid are allocated jointly with the water infrastructure costs as part of the Capital Infrastructure Budget (MID 2013).

Potential Effects of the LSJR Alternatives

The LSJR alternatives are expected to result in reduced surface water diversions on the Stanislaus, Tuolumne, and Merced Rivers. The reduced surface water diversion could increase the cost of operations for irrigation and water districts in the plan area. This effect, in turn, could also indirectly affect the customers of the affected water service providers. This section presents an evaluation of these potential effects, including a qualitative assessment on how affected service providers can recover the investment costs of securing other reliable water supplies.

Potential Changes in Water Supply Costs

As discussed in Chapter 13, *Service Providers*, the extent of reduced surface water diversions on the amount of water in the eastside tributaries would vary by alternative. The average percent reduction in water supply on the Stanislaus, Tuolumne, and Merced Rivers is between 2 and 6 percent for LSJR Alternative 2, between 12 and 16 percent for LSJR Alternative 3, and between 32 and 35 percent for LSJR Alternative 4. The extent to which these reductions in surface water diversions would affect water supplies delivered by irrigation and water districts in the plan area would, however, be largely determined based on a number of factors that underlie how each affected service provider obtains its respective water supplies. These factors include a district's established water rights or contracts, the types of uses that water service providers supply, existing (district and others) policies affecting the distribution of water supplies, and local and state regulations. As described in Chapter 13 some water supply contracts include provisions that dictate when and how much surface water can be received by other water users from irrigation districts.

Other important considerations in assessing the extent of potential effects of reduced surface water supplies include a district's ability to expand water production, as needed, from current water sources (e.g., groundwater), its ability to potentially develop alternative water supplies, and the effectiveness of implementing demand-side management measures. As an example, service providers that currently rely on groundwater as their primary source of water (e.g., Central San Joaquin Water Conservation District, Manteca, Ripon, and Escalon) could potentially expand use of groundwater, assuming that additional pumping of groundwater is economically feasible. This situation would be expected to minimize potential cost effects of LSJR Alternatives 2, 3, and 4. Service providers that rely substantially on surface water diversions from the eastside tributaries (e.g., Cities of Modesto and Tracy), however, could experience more substantial cost effects, depending on the factors identified above.

As indicated in Chapter 13, some service providers that cannot expand production from current water sources may need to construct new water supply infrastructure or modify existing infrastructure to obtain water supplies from other sources. Alternatively, water conservation efforts may be effective in offsetting some of the cost effects associated with developing new supplies. According to information recently published by the State Water Board (2016), statewide cumulative water conservation savings in response to Executive Order (EO) B-29-15, State of Emergency Due to Severe Drought Conditions, totaled 23.9 percent between June 2015 and February 2016, compared with the same months in 2013. Ultimately, affected water districts would need to consider the capital and operating costs of acquiring alternative water supplies, including conservation actions, and how these costs could affect the structure of water rates. Estimated costs of developing some presumably feasible alternative water supplies, which are discussed in Chapter 16, *Evaluation of Other Indirect and Additional Actions*, are summarized in Table 20.3.3-6.

Table 20.3.3-6. Cost Estimates for Developing Alternative Water Supplies

Source	Cost Estimate
Water Transfers	$1,716 per AF for an Environmental Water Account contract sale or $310 per AF for a long-term transfer[a]
Substitution of Surface Water with Groundwater	$57–$76 per AF for groundwater pumping electrical costs; $102–$153 per AF annually for total operations and maintenance cost of a groundwater project; $1,938 per AF based on entire operating budget and total groundwater production
Aquifer Storage and Recovery	$158–$238 per AF annually (20-year amortized cost)
Recycled Water Sources:	$400–$2,100/AF for landscape and agricultural irrigation (including capital, operations, and maintenance); $700–$1,200/AF for direct potable reuse (including capital, operations, and maintenance)

Source: Chapter 16, *Evaluation of Other Indirect and Additional Actions*, Section 16.2.

AF = acre-foot

[a] The section below titled *M&I Water Supply Conditions in the SFPUC Service Area and Potential Cost, Ratepayer, and Regional Economic Effects* of the LSJR alternatives discusses the costs associated with a water transfer specific to SFPUC.

Potential Ratepayer Effects

Ratepayers in districts that substantially rely on surface water diversions from the eastside tributaries, and where current rates do not account for unexpected capital costs, would likely be the service providers most affected by the additional costs of replacing lost surface water supplies. Over the long term, most districts would be expected to recover most, if not all, capital costs through rate adjustments. Certain water service provider may consider temporarily halting construction for new treatment facilities, as a project could become less economically viable as a result of reduced surface water diversions; however, over time, districts would be expected to re-spread the fixed costs of its projects, whether completed or not, among their ratepayers to achieve the revenue needed to remain economically viable. The potential impacts of reduced surface water supplies could be largely offset if cost-effective alternative supplies are available, similar to those described in Table 20.3.3-6.

A recent economic analysis of implementing EO B-29-15 (M-Cubed et al. 2015) provides additional insight on the potential economic effects from LSJR Alternatives 2, 3, and 4. Although there are fundamental differences in the actions being taken under the plan amendments and EO B-29-15 (implementation of the EO would result in a substantial reduction in the demand for water by essentially restricting water use, whereas the LSJR alternatives would result in reduced surface water supplies), both actions would not only affect water service providers, but also their ratepayers. Over the long term, any additional net costs to affected water service providers would likely be passed on to the ratepayers, unless specific provisions restrict this action. As presented in the M-Cubed economic impact analysis of EO B-29-15, impacts of restricted water use would principally consist of reduced net revenue for urban water districts and lost benefits for businesses and ratepayers who could have used the water productively. Both types of costs ultimately would be borne by water users, since water utilities would have to adjust their service charges and rates over time to recover the forgone net revenue from ratepayers. Similar actions and ratepayer consequences would be expected from implementing LSJR Alternatives 2, 3, and 4. However, these impacts are expected to vary significantly by district as a result of water use differences, established institutional/legal measures, water rates, and opportunities for obtaining water supplies from other sources.

As highlighted by the differences in sources of water, types of uses and water rates for the three example water providers characterized above, each service provider in the plan area has its own unique set of circumstances (e.g., institutional constraints affected by user types, rate structures, need for new facilities) within which it can react to reduced surface water supplies. As established by state law, the intent of regularly updating water management plans is to provide districts with an opportunity to consider how changes in supply and demand conditions potentially affect each district and its ratepayers. Although water service providers (both primary diverters and other water users) that rely less on surface water would appear to be less vulnerable than other service providers, this is not necessarily the case given the many factors that must be considered. However, service providers with cost effective opportunities to tap alternative sources of water, such as groundwater or water transfers, would be best positioned to minimize potential costs effects of a reduced surface water supply.

Adaptive Implementation

Adaptive implementation would take place based on required evaluation of current scientific information and would need to be approved as described in Appendix K, *Revised Water Quality Control Plan.* Accordingly, the frequency and duration for any use of adaptive implementation methods 1, 2, 3, and 4 cannot be determined at this time. Adaptive implementation method 1 potentially has the greatest likelihood to change economic effects as it would allow the unimpaired flow requirement to be increased or decreased by up to 10 percent from the objective unimpaired flow (with a minimum requirement of 20 percent and a maximum of 60 percent unimpaired flow). For LSJR Alternative 2 an increase from 20 percent to 30 percent of the unimpaired flow would likely result in different effects as compared to those shown above for LSJR Alternative 2, depending upon flow conditions and frequency of the adjustment. As such, under LSJR Alternatives 2 or 3, if the percentage of unimpaired flow is increased with adaptive implementation method 1, water supply costs to affected water districts also would likely increase as these districts would need to develop more costly sources of water supply than those developed without adaptive implementation. On the other hand, under LSJR Alternatives 3 and 4, if the percent of unimpaired flow is reduced with adaptive implementation method 1, water supply costs to affected water districts would be expected to be somewhat less than without adaptive implementation.

M&I Water Supply Conditions in the SFPUC Service Area and Potential Cost, Ratepayer, and Regional Economic Effects

Introduction

SFPUC is a department of CCSF that provides retail drinking water and wastewater services to San Francisco, wholesale water to three Bay Area counties, and green hydroelectric and solar power to San Francisco's municipal departments. The amount of water SFPUC delivers to its service area is largely dependent on water delivered from the Tuolumne River Watershed. LSJR Alternatives 2, 3, and 4 may affect the amount of surface water diversions to the SFPUC service area.

This discussion presents background information on SFPUC's service area and ratepayers. It is followed by an analysis of how the LSJR alternatives could potentially affect water supply costs, the regional economy, and ratepayers in the service area. In addition, the potential economic effects of purchasing water (i.e., water transfers) by SFPUC from willing sellers in the Central Valley are analyzed. Cost information for other actions that SFPUC could take instead of purchasing water can be found in Chapter 16, *Evaluation of Other Indirect and Additional Actions* and summarized in Appendix L, *City and County of San Francisco Analyses*. Where appropriate, sections, tables, and figures from Chapter 16 and Appendix L are cited in this discussion.

Service Area Conditions

CCSF, through the SFPUC, owns and operates a regional water system that provides retail water directly to customers in San Francisco and wholesale water to 27 water agencies and water companies in three Bay Area counties, including those serving parts of Alameda, San Mateo, and Santa Clara Counties. CCSF also delivers water to a small number of isolated retail and wholesale customers along the water system, including customers in Tuolumne County. In 2010, the SFPUC retail and wholesale service areas included service to about 2.6 million residents.

The SFPUC water system has the capacity to deliver about 265 mgd (296,800 AF/y) on average, of which about 85 percent is from the Tuolumne River Watershed through SFPUC's Hetch Hetchy Project, and about 15 percent is from the combined Alameda and Peninsula Watersheds. During drought periods, the water provided by the Hetch Hetchy Project can amount to more than 93 percent of the total water delivered within SFPUC's retail and wholesale service areas.

As Table 20.3.3-7 shows, individual water agencies rely on SFPUC supplies to varying extents. Based on fiscal year 2010–2011 water demands and deliveries, SFPUC provided at least 90 percent of the water used by 19 of the 27 wholesale agencies it served that year. An additional five agencies received at least half their water supply from SFPUC. Water use by customer class also varies widely among the wholesale agencies, as shown in Table 20.3.3-8. Across the entire wholesale service area, about 59 percent was delivered to residential customers, 21 percent to commercial and industrial customers, 11 percent to government and other users, and 9 percent to dedicated irrigation users.

Table 20.3.3-7. SFPUC Water Deliveries to Retail and Wholesale Agencies and Reliance of Agencies on San Francisco Public Utilities Commission Water, 2010

County/Agency	SFPUC Water Deliveries (mgd)	Percent of Total SFPUC Water Deliveries	Percent of Total Demand Met by SFPUC Regional Water System[a]
Retail Agency			
San Francisco City/County San Francisco Retail Area	76.50[b]	33.9	100.0
Wholesale Agencies			
Alameda County			
Alameda County Water District	10.81	4.8	18.3
City of Hayward	17.25	7.6	100.0
County subtotal	28.06	12.4	41.5
San Mateo County			
City of Brisbane/Guadalupe Valley Municipal Improvement District[c]	0.58	0.3	100.0
City of Burlingame	3.93	1.7	93.1
California Water Service Company[d]	32.57	14.4	95.1
Coastside County Water District	1.82	0.8	90.2
Cordilleras Mutual Water Association	0.01	0.0	100.0
City of Daly City	3.21	1.4	69.2
City of East Palo Alto	1.81	0.8	100.0
Estero Municipal Improvement District	4.90	2.2	100.0
Town of Hillsborough	2.97	1.3	100.0
City of Menlo Park	3.04	1.3	100.0
Mid-Peninsula Water District	2.87	1.3	100.0
City of Millbrae	2.24	1.0	99.1
North Coast County Water District	3.02	1.3	100.0
City of Redwood City	9.61	4.3	94.3
City of San Bruno	1.46	0.6	42.7
Westborough Water District	0.84	0.4	100.0
County subtotal	74.88	33.1	92.4
Santa Clara County			
City of Milpitas	6.28	2.8	61.0
City of Mountain View	8.95	4.0	82.8
City of Palo Alto	10.99	4.9	93.6
Purissima Hills Water District	1.75	0.8	100.0
City of San Jose (north)	4.13	1.8	90.8
City of Santa Clara	2.35	1.0	10.3

County/Agency	SFPUC Water Deliveries (mgd)	Percent of Total SFPUC Water Deliveries	Percent of Total Demand Met by SFPUC Regional Water System[a]
Stanford University	2.14	0.9	66.5
City of Sunnyvale	9.92	4.4	44.3
County subtotal	46.51	20.6	54.4
TOTAL RETAIL & WHOLESALE	**225.95**	**100.0**	**73.6**

Sources: SFPUC 2011a; Bay Area Water Supply and Conservation Agency 2012; Appendix L, *City and County of San Francisco Analyses,* Table L.3-1.

mgd = million gallons per day (1 mgd equals 1,120.147 acre-feet of water).

[a] Based on water production and purchases during fiscal year 2010–2011.

[b] Includes water delivered to Lawrence Livermore Lab and the Groveland Community Services Districts. Excludes groundwater used for City of San Francisco irrigation uses and groundwater delivered to Castlewood and Sunol golf courses.

[c] The City of Brisbane and the Guadalupe Valley Municipal Improvement District represent two separate wholesale customers to SFPUC. However, their water demand data is reported together.

[d] CWS provides water to three separate service areas (Bear Gulch, Mid Peninsula, and South San Francisco).

Table 20.3.3-8. Percentage Distribution of San Francisco Public Utilities Commission Water Deliveries by Customer Class, 2010

County/Agency	Residential	Commercial & Industrial	Government & Other[a]	Dedicated Irrigation[b]
Retail Agency				
San Francisco City/County	55.2	32.1	12.7	NA
San Francisco Retail Area[c]				
Wholesale Agencies[d]				
Alameda County				
Alameda County Water District	61.0	14.9	14.5	9.6
City of Hayward	51.6	19.1	18.1	11.2
County subtotal	58.3	16.1	15.5	10.1
San Mateo County				
City of Brisbane/Guadalupe Valley Municipal Improvement District[c]	38.3	27.6	5.4	28.7
City of Burlingame	55.0	23.2	16.7	5.1
California Water Service Company[d]	67.5	22.2	10.3	0.0
Coastside County Water District	60.8	24.1	6.2	8.9
Cordilleras Mutual Water Association	100.0	0.0	0.0	0.0
City of Daly City	79.6	12.1	6.3	2.0
City of East Palo Alto	76.7	17.8	5.5	0.0
Estero Municipal Improvement District	61.4	11.0	4.1	23.5

County/Agency	Residential	Commercial & Industrial	Government & Other[a]	Dedicated Irrigation[b]
Town of Hillsborough	94.7	0.2	3.7	1.4
City of Menlo Park	44.3	33.8	11.3	10.6
Mid-Peninsula Water District	60.7	14.8	24.5	0.0
City of Millbrae	66.4	16.1	10.1	7.4
North Coast County Water District	82.8	7.4	7.6	2.2
City of Redwood City	64.8	17.2	5.7	12.3
City of San Bruno	68.2	18.2	13.6	0.0
Westborough Water District	68.8	16.7	3.7	10.8
County subtotal	67.5	18.6	9.4	4.5
Santa Clara County				
City of Milpitas	43.0	24.5	13.6	18.9
City of Mountain View	53.2	18.8	4.2	23.8
City of Palo Alto	53.9	19.8	19.1	7.2
Purissima Hills Water District	93.6	0.0	5.8	0.6
City of San Jose (north)	22.9	43.2	4.5	29.4
City of Santa Clara	43.4	40.6	9.7	6.3
Stanford University	29.1	18.3	19.0	33.6
City of Sunnyvale	61.6	19.9	7.6	10.9
County subtotal	49.6	26.5	10.4	13.5
TOTAL WHOLESALE	**58.5**	**20.8**	**11.4**	**9.3**

Sources: SFPUC 2011a; Bay Area Water Supply and Conservation Agency 2012; Appendix L, *City and County of San Francisco Analyses*, Table L.3-2.

NA = not available.

[a] Includes government uses, recycled water uses, unaccounted-for uses, meter under-registration loses, and other system losses.

[b] Includes dedicated irrigation uses for both private and government customers.

[c] Based on 2010 demands. Does not included city irrigation uses and golf course uses served by groundwater.

[d] Based on fiscal year 2010–2011 demands.

Baseline Ratepayer Conditions

SFPUC funds its water system through two separate budgets, its Hetch Hetchy Water and Power Budget and its Water Enterprise Budget. The Hetch Hetchy Water and Power Budget operates the collection and conveyance of approximately 85 percent of SFPUC's total water supply, employing a system of reservoirs, hydroelectric power plants, aqueducts, pipelines, and transmission lines that carry water and power from Hetch Hetchy to customers in San Francisco and to SFPUC's wholesale customers elsewhere in the Bay Area. The Water Enterprise is responsible for collecting, treating, and distributing SFPUC's water supply to its retail and wholesale customers, as well as operating and maintaining pipelines in San Francisco and throughout the region, 27 pump stations, 28 dams and reservoirs, 9 water tanks, and 3 water treatment plants. An overview of recent budget expenditures under the Water Enterprise Budget and the water portion of the Hetch Hetchy Water and Power Budget are shown in Table L.3-3 in Appendix L, *City and County of San Francisco Analyses*.

SFPUC sets its retail water rates based on an independent rate study conducted at least once every 5 years. Retail water rates consist of a monthly service charge based on meter size and a commodity charge based on usage volumes. Annual rate increases for retail customers are set to meet project costs and debt coverage requirements. SFPUC's water rates for its 27 wholesale customers are based on the Water Supply Agreement established in 2009. In general, costs are apportioned to wholesale customers based on proportionate water use, and rates are reset annually to cover costs as mandated by the Water Supply Agreement. See Table L.3-4 for actual retail and wholesale water rates between 2008 and 2014.

Effects on M&I Water Supply in the SFPUC Service Area

This section addresses how the LSJR alternatives could potentially affect water supply costs, the regional economy, and ratepayers in the SFPUC service area. Regional economic effects are presented within each county in the four-county Bay Area region in which the SFPUC serves retail and wholesale customers. Additional details of the methods and assumptions can be found in Appendix L, *City and County of San Francisco Analyses*.

Potential Change in Water Supply Costs

As discussed in Section L.6 of Appendix L, *City and County of San Francisco Analyses,* LSJR Alternatives 2, 3, and 4 may affect the ability of SFPUC to supply water to its retail and wholesale customers under drought conditions. The magnitude of the effect under drought conditions depends on how the parties involved interpret the Fourth Agreement between CCSF and MID and TID, which currently governs the New Don Pedro Reservoir water bank account on the Tuolumne River. There are two possible scenarios,[6] which are described in Table 20.3.3-9a and referred to throughout the remainder of this evaluation. To assess the effects of additional water supply costs on the four-county Bay Area regional economy, it is assumed that the SFPUC would meet its water demands during severe drought periods (such as within the 6-year drought 1987–1992) by purchasing water from MID and TID. Under this assumption, water costs for SFPUC are estimated based on the predicted annual average water shortage during severe drought years under each of the LSJR alternatives, relative to baseline conditions. The annual average cost for SFPUC to replace lost surface water supplies was then calculated based on the following assumptions.

- During severe drought periods, SFPUC would replace reductions in water supplies by purchasing water at $1,000 per AF.
- No other costs to SFPUC would be required to wheel, treat, or distribute the purchased water beyond existing costs for Hetch Hetchy water. (Note that if the transferred water comes from Cherry or Eleanor Reservoirs instead of passing through Hetch Hetchy Reservoir, the water would need to be filtered, potentially resulting in additional cost.)
- SFPUC operations and maintenance costs to provide water from the Hetch Hetchy water system do not vary based on the amount of water annually delivered by the system. As a result, SFPUC

[6] It cannot be predicted whether and how CCSF and the irrigation districts would agree to apportion responsiblity for meeting future flow requirements. In the past, the parties have agreed to either an allocation of storage credits or payments. Nonetheless, Appendix L, *City and County of San Francisco Analyses*, analyzes the potential water supply effects associated with the allocation of responsibility under paragraph (b) of Article 8 of the Fourth Agreement. Under Scenario 1, storage credits would be reallocated only if CCSF has a positive credit balance in the water bank account. Under Scenario 2, storage credits would be reallocated even if CCSF has a negative balance in the water bank account. See Appendix L for more information.

water-production costs do not appreciably decline when less water is delivered during drought conditions. (System facilities still need to be operated and maintained regardless of the amount of water delivered through the system.) As a result, 100 percent of the $1,000 per AF purchase price for water transfers would be added to overall SFPUC costs to provide water from the Hetch Hetchy system.

Based on these assumptions, average annual water-shortage replacement costs for SFPUC are estimated in Table 20.3.3-9a. For the LSJR alternatives, SFPUC's annual severe-drought-period (1987–1992) water transfer costs are estimated to range from about $14 million to $30 million under Scenario 1 and from about $35 million to $208 million under Scenario 2.

Table 20.3.3-9a. Estimated San Francisco Public Utilities Commission Replacement Water Purchase Costs in Severe Drought Years (1987–1992) under the LSJR Alternatives

	Scenario 1[a]		Scenario 2[b]	
Alternative	Required Water Transfer (TAF)	Estimated Purchase Cost	Required Water Transfer (TAF)	Estimated Purchase Cost
LSJR Alternative 2	14	$14,000,000	35	$35,000,000
LSJR Alternative 3	27	$27,000,000	119	$119,000,000
LSJR Alternative 4	30	$30,000,000	208	$208,000,000

Source: Appendix L, *City and County of San Francisco Analyses,* Table L.6-1a.

TAF = thousand acre-feet.

[a] Scenario 1 is defined in Appendix L as: storage credits would be reallocated only if CCSF has a positive credit balance in the water bank account.

[b] Scenario 2 is defined in Appendix L as: storage credits would be reallocated even if CCSF has a negative balance in the water bank account.

Assuming a "worst-case" return period of one severe 6-year drought every 21 years, the mean annual costs to purchase water in drought years shown in Table 20.3.3-9a would be spread over 21 years, instead of over only 6 drought years. The mean annual reduction in water supply compared to baseline would range from 4–9 TAF per year under scenario 1 to 10–71 TAF per year under scenario 2 (Table 20.3.3-9b). The distributed costs would be similarly reduced—long-term annual average costs for the LSJR alternatives are estimated to range from about $4–$9 million under Scenario 1 and from about $10–$71 million under scenario 2.

It should be noted, however, that these estimated costs to be incurred by SFPUC and its wholesale agencies due to a water supply reduction during a severe drought would not be expected to occur evenly over a defined period, either 6 years or 21 years, as suggested by the calculation of an average annual value, based either on the example 1987–1992 drought or on the available 21-year period of record used for assessing water bank deficits. Consequently, while the calculation of an average annual cost is useful for evaluating potential effects (both cost and regional economic effects) relative to ongoing budgetary conditions, the temporal accuracy of calculating an average annual cost is somewhat uncertain. Appendix L, *City and County of San Francisco Analyses*, briefly provides additional consideration of the return interval of such a severe drought.

Table 20.3.3-9b. Estimated Mean Annual (1983–2003) San Francisco Public Utilities Commission Replacement Water Purchase Costs in Severe Drought Years under the LSJR Alternatives

	Scenario 1[a]		Scenario 2[b]	
Alternative	Required Water Transfer (TAF)	Estimated Purchase Cost	Required Water Transfer (TAF)	Estimated Purchase Cost
LSJR Alternative 2	4	$4,000,000	10	$10,000,000
LSJR Alternative 3	8	$8,000,000	34	$34,000,000
LSJR Alternative 4	9	$9,000,000	71	$71,000,000

Source: Appendix L, *City and County of San Francisco Analyses,* Table L.6-1b.

TAF = thousand acre-feet.

[a] Scenario 1 is defined in Appendix L as: storage credits would be reallocated only if CCSF has a positive credit balance in the water bank account.

[b] Scenario 2 is defined in Appendix L as: storage credits would be reallocated even if CCSF has a negative balance in the water bank account.

For assessing regional economic effects of the water supply impacts, the costs in Tables 20.3.3-9a and 20.3.3-9b are distributed to SFPUC water users by agency and user category. The assumptions underlying this distribution are described in Appendix L. After distributing the water replacement cost among SFPUC's different customers, it is totaled by county under each of the LSJR alternatives for scenarios 1 and 2.

It is assumed that SFPUC would purchase and transfer additional water supplies from the Tuolumne River Watershed to offset water shortages during drought periods. This would result in substantially lower estimates of regional impacts than if it is assumed that SFPUC would cut back its water deliveries (i.e., impose shortages) to its retail and wholesale customers, particularly in assessing impacts for commercial and industrial water users. See Sunding 2014 for an assessment of how assumed water shortages, as opposed to the water replacement approach used in this analysis, within the Hetch Hetchy Regional Water System Service Area could impact SFPUC.

Assessment Methods for Potential Effects on the Regional Economy

SFPUC could purchase water to offset water shortages during drought periods (described above) and, in turn, could pass the additional cost on to its retail customers in the form of a temporary rate surcharge and to its wholesale customers in the form of higher wholesale water rates. Wholesale customers could then pass the higher costs to their own retail customers through a temporary rate surcharge. As higher water costs filter through the four-county Bay Area region, less discretionary income would be available for water customers to spend on goods and services, resulting in a reduction of economic output (sales) and employment throughout the region.

The IMPLAN input-output economic model was used to analyze the effects on the regional economy. IMPLAN is widely used for assessing regional economic effects of regulatory and policy actions, despite some limitations in evaluating cost-related impacts. The model was used to estimate the indirect and induced economic activity associated with direct changes in water costs for customers within SFPUC's retail and wholesale service areas. Using 2010 IMPLAN county-level data files, individual IMPLAN models were constructed for Alameda, San Francisco, San Mateo, and Santa Clara Counties.

The regional economic effects of rate surcharges would largely be determined by the reactions of end-use customers to temporarily higher water rates, which includes actions taken by residential customers, commercial and industrial customers, government water users, and dedicated irrigation water users. Predicting how the various classes of water customers would react to temporarily higher water rates is complex. Faced with higher water costs during drought years, residential customers could decrease their water use or they could decrease their spending on other goods and services to compensate for higher water utility bills. If rate increases are relatively small, however, households may not change their spending habits at all by reducing savings and/or investments, by charging purchases using credit cards, or by borrowing money. Commercial and industrial water customers could account for the additional cost of water by reducing profits, purchasing less water and/or decreasing production levels, raising product/service prices, or changing their mix of production inputs to reduce non-water-related costs. For institutional water users responding to temporarily higher water costs, government agencies could lay off staff or reduce spending on other operational inputs. However, the need for agencies to maintain staffing and service levels set through agency budgeting suggests that temporary economic effects of higher water costs would be limited. For the SFPUC retail service area, dedicated city irrigation demands are met using groundwater supplies, which have been excluded from this assessment.

Several assumptions are made to simplify the modeling approach for assessing the regional economic effects of the LSJR alternatives. These assumptions are presented in Appendix L, *City and County of San Francisco Analyses*.

Results for Potential Effects on the Regional Economy

Under Scenario 1 (storage credits would be reallocated only if CCSF has a positive credit balance in the water bank account), decreased spending on goods and services resulting from increased water costs for residential, commercial, industrial, and institutional water users could cause industrial output to decline throughout the Bay Area region during drought periods. The reduction in economic output is estimated to range from $16.2 million under LSJR Alternative 2 to $35.3 million under LSJR Alternative 4 (Table 20.3.3-10). While large, these reductions during severe drought periods (e.g., 1987–1992) would be relatively small in the context of the regional economy, ranging from 0.03 to 0.05 percent of total output.

Table 20.3.3-10. Estimated Average Annual Water Supply Effects (Direct, Indirect, and Induced) during Severe Drought Years on Economic Output in the Bay Area Region Associated with LSJR Alternatives 2, 3, and 4: Scenario 1[a]

Economic Effects (2010 Dollars)	2010 Baseline	Change from Baseline by LSJR Alternative		
		LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Alameda County				
Total County Output ($ Millions)	143,450.6	-2.8	-5.5	-6.2
% of Output	100	-0.02	-0.04	-0.04
San Francisco County				
Total County Output ($ Millions)	124,678.1	-5.6	-10.9	-12.2
% of Output	100	-0.04	-0.09	-0.10
San Mateo County				
Total County Output ($ Millions)	99,088.3	-4.4	-8.5	-9.5
% of Output	100	-0.04	-0.09	-0.10
Santa Clara County				
Total County Output ($ Millions)	278,082.8	-3.4	-6.6	-7.4
% of Output	100	-0.01	-0.02	-0.03
Bay Area Region				
Total Region Output ($ Millions)	645,299.8	-16.2	-31.4	-35.3
% of Output	100	-0.03	-0.05	-0.05

Sources: 2010 IMPLAN county data files and IMPLAN model runs for LSJR alternatives; Appendix L, *City and County of San Francisco Analyses,* Table L.6-2.

[a] Scenario 1 is defined in Appendix L as: storage credits would be reallocated only if CCSF has a positive credit balance in the water bank account.

The total regional effects of the LSJR alternatives on employment under Scenario 1 are similar, in relative terms, to the effects on economic output. During drought periods, the average annual number of jobs within the region are predicted to decrease by 117 (0.01 percent) under LSJR Alternative 2, 226 (0.01 percent) under LSJR Alternative 3, 254 (0.01 percent) under LSJR Alternative 4 (Table 20.3.3-11). Job losses under LSJR Alternative 4 are predicted to be largest in San Francisco County (84 jobs) and San Mateo County (71 jobs).

Table 20.3.3-11. Estimated Average Annual Water Supply Effects (Direct, Indirect, and Induced) during Severe Drought Years on Jobs in the Bay Area Region Associated with LSJR Alternatives 2, 3, and 4: Scenario 1[a]

Economic Effects	2010 Baseline	Change from Baseline by LSJR Alternative		
		LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Alameda County				
Total County Jobs	872,636	-21	-41	-46
% of Jobs	100	<-0.01	<-0.01	-0.01
San Francisco County				
Total County Jobs	734,063	-39	-75	-84
% of Jobs	100	-0.01	-0.01	-0.01
San Mateo County				
Total County Jobs	464,194	-33	-64	-71
% of Jobs	100	-0.01	-0.01	-0.02
Santa Clara County				
Total County Jobs	1,112,308	-24	-47	-53
% of Jobs	100	<-0.01	<-0.01	<-0.01
Bay Area Region				
Total Region Jobs	3,183,201	-117	-226	-254
% of Jobs	100	<-0.01	<-0.01	<-0.01

Sources: 2010 IMPLAN county data file, and IMPLAN model runs for LSJR alternatives; Appendix L, *City and County of San Francisco Analyses,* Table L.6-3.

[a] Scenario 1 is defined in Appendix L as: storage credits would be reallocated only if CCSF has a positive credit balance in the water bank account.

Under Scenario 2 (storage credits would be reallocated even if CCSF has a negative balance in the water bank account) output and job losses during drought periods are predicted to be substantially higher than under Scenario 1 because replacement water needs and related costs to customers would be much larger. Annual output reductions in the Bay Area region are estimated to range from $40.5 million to $243.6 million under LSJR Alternatives 2, 3, and 4 (Table 20.3.3-12). In the context of the overall Bay Area region economy, these reductions would represent 0.06 and 0.38 percent of total output, respectively. Similarly, job losses would be relatively small, ranging from 292 to 1,756 jobs across LSJR Alternatives 2, 3, and 4, which represent 0.01 and 0.06 percent of all regional jobs, respectively (Table 20.3.3-13).

Table 20.3.3-12. Estimated Average Annual Water Supply Effects (Direct, Indirect, and Induced) during Severe Drought Years on Economic Output in the Bay Area Region Associated with the LSJR Alternatives 2, 3, and 4: Scenario 2[a]

		Change from Baseline by LSJR Alternative		
Economic Effects (2010 Dollars)	2010 Baseline	LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Alameda County				
Total County Output ($ Millions)	143,450.6	-7.1	-24.5	-43.0
% of Output	100	-0.05	-0.17	-0.30
San Francisco County				
Total County Output ($ Millions)	124,678.1	-14.0	-48.2	-84.2
% of Output	100	-0.11	-0.39	-0.68
San Mateo County				
Total County Output ($ Millions)	99,088.3	-10.9	-37.6	-65.5
% of Output	100	-0.11	-0.38	-0.66
Santa Clara County				
Total County Output ($ Millions)	278,082.8	-8.5	-29.2	-51.0
% of Output	100	-0.03	-0.11	-0.18
Bay Area Region				
Total Region Output ($ Millions)	645,299.8	-40.5	-139.5	-243.6
% of Output	100	-0.06	-0.22	-0.38

Sources: 2010 IMPLAN county data files and IMPLAN model runs for LSJR alternatives; Appendix L, *City and County of San Francisco Analyses,* Table L.6-4.

[a] Scenario 2 is defined in Appendix L as: storage credits would be reallocated even if CCSF has a negative balance in the water bank account.

Table 20.3.3-13. Estimated Average Annual Water Supply Effects (Direct, Indirect, and Induced) during Severe Drought Years on Jobs in the Bay Area Region Associated with LSJR Alternatives 2, 3, and 4: Scenario 2[a]

Economic Effects	2010 Baseline	Change from Baseline by LSJR Alternative		
		LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Alameda County				
Total County Jobs	872,636	-53	-181	-318
% of Jobs	100	-0.01	-0.02	-0.04
San Francisco County				
Total County Jobs	734,063	-97	-334	-583
% of Jobs	100	-0.01	-0.05	-0.08
San Mateo County				
Total County Jobs	464,194	-82	-282	-491
% of Jobs	100	-0.02	-0.06	-0.11
Santa Clara County				
Total County Jobs	1,112,308	-61	-209	-364
% of Jobs	100	-0.01	-0.02	-0.03
Bay Area Region				
Total Region Jobs	3,183,201	-292	-1,005	-1,756
% of Jobs	100	-0.01	-0.03	-0.06

Sources: 2010 IMPLAN county data files and IMPLAN model runs for LSJR alternatives; Appendix L, *City and County of San Francisco Analyses,* Table L.6-5.

[a] Scenario 2 is defined in Appendix L as: storage credits would be reallocated even if CCSF has a negative balance in the water bank account.

Assessment Methods for Potential Ratepayer Effects

Effects of SFPUC water purchases on water rates are evaluated based on the relative increase in overall SFPUC budget costs attributable to replacement water purchases under each alternative. Existing water rates that are annually established for both the retail and wholesale service areas reflect operating costs, debt service costs, capital costs, programmatic project costs, and reserve considerations. This ratepayer assessment uses the total SFPUC Water Enterprise and Hetch Hetchy Water budgets for fiscal year 2013–2014 as baselines for the assessment. The adopted fiscal year 2013–2014 budgets totaled $483.2 million, as shown in Appendix L, *City and County of San Francisco Analyses,* (Table L.3-3). These budgets account for the cost of producing, conveying, filtering, treating, and distributing water within the SFPUC service areas, as well as to defray the costs of past, current, and future projects. Existing water rates for SFPUC's retail and wholesale customers, which are largely driven by these budget costs, also are shown in Appendix L (Table L.3-4). For purposes of evaluating ratepayer effects, budgetary cost increases for SFPUC to replace water during drought conditions are assumed to result in proportional rate increases in SFPUC's retail and wholesale water rates, relative to the existing rates.

Results for Potential Ratepayer Effects

The budget effects of purchasing replacement water during severe drought periods (e.g. 1987–1992) under the LSJR alternatives are shown in Tables 20.3.3-14a and 20.3.3-14b and 20.3.3-15a and 20.3.3-15b. Compared to adopted fiscal year 2013–2014 SFPUC budget costs of $483.12million, water replacement costs in severe drought years under Scenario 1 would represent an increase in overall costs ranging from about 3 to 6 percent (Table 20.3.3-14a). These additional drought-period costs would presumably result in rate surcharges within the retail and wholesale service areas of about the same percentages, relative to existing water rates. For example, the drought-period rate surcharge in the SFPUC retail service area could cause existing rates for a single-family residential customer to rise by about 3 percent under LSJR Alternative 2, and by about 6 percent under LSJR Alternatives 3 and 4. Existing rates charged by SFPUC to its wholesale customers could increase by similar percentages.

Table 20.3.3-14a. Estimated SFPUC Budget Effects of Purchasing Replacement Water Supplies during Severe Drought Periods Associated with LSJR Alternatives 2, 3, and 4: Scenario 1[a]

	Baseline[b]	LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Average Annual Water Replacement Costs ($ Millions)	--	14	27	30
Water Budget with Replacement Costs ($ Millions)	483.2	497.2	510.2	513.2
Percentage Change in Water Budget Expenditures	--	2.9%	5.6%	6.2%

Source: Appendix L, *City and County of San Francisco Analyses,* Table L.6-6.

[a] Scenario 1 is defined in Appendix L as: storage credits would be reallocated only if CCSF has a positive credit balance in the water bank account.

[b] Represents combined Adopted Water Enterprise and Hetch Hetchy Water budgets for fiscal year 2013–2014.

Using a longer-term period of record (1983 to 2003), the annual average water replacement costs (as derived in Table 20.3.3-9b) are much less than the costs within the severe drought period (1987 to 1992) described above. Under Scenario 1, estimated longer-term increases in budget expenditures range from 0.8 to 1.9 percent (Table 20.3.3-14b).

Table 20.3.3-14b. Estimated Longer-Term SFPUC Budget Effects of Purchasing Replacement Water Supplies during Severe Drought Periods Associated with LSJR Alternatives 2, 3, and 4: Scenario 1[a]

	Baseline[b]	LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Average Annual Water Replacement Costs ($ Millions)	--	4	8	9
Water Budget with Replacement Costs ($ Millions)	483.2	487.2	491.2	492.2
Percentage Change in Water Budget Expenditures	--	0.8%	1.7%	1.9%

Source: Appendix L, *City and County of San Francisco Analyses,* Table L.6-8.

[a] Scenario 1 is defined in Appendix L as: storage credits would be reallocated only if CCSF has a positive credit balance in the water bank account.

[b] Represents combined Adopted Water Enterprise and Hetch Hetchy Water budgets for fiscal year 2013–2014.

For Scenario 2, the additional expenditures to purchase and transfer water during severe drought periods (e.g. 1987–1992) under the LSJR alternatives would be much higher than in Scenario 1, with cost increases ranging from about 7 to 43 percent of the baseline water budget (Table 20.3.3-15a). As a result, water rate increases during drought periods would be substantially higher than under Scenario 1. Drought-period rate surcharges in the SFPUC retail service area could raise existing rates for a single-family residential customers by about 7 percent under LSJR Alternative 2, by about 25 percent under LSJR Alternative 3, and by about 43 percent under LSJR Alternative 4. Existing rates charged by SFPUC to its wholesale customers could increase by similar percentages. Under Scenario 2, estimated longer-term increases in budget expenditures range from 2.1 to 14.7 percent (Table 20.3.3-15b).

Table 20.3.3-15a. Estimated SFPUC Budget Effects of Purchasing Replacement Water Supplies during Severe Drought Periods Associated with LSJR Alternatives 2, 3, and 4: Scenario 2[a]

	Baseline[b]	LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Average Annual Water Replacement Costs ($ Millions)	--	35	119	208
Water Budget with Replacement Costs ($ Millions)	483.2	518.2	602.2	691.2
Percentage Change in Water Budget Expenditures	--	7.2%	24.6%	43.1%

Source: Appendix L, *City and County of San Francisco Analyses,* Table L.6-7.

[a] Scenario 2 is defined in Appendix L as: storage credits would be reallocated even if CCSF has a negative balance in the water bank account.

[b] Represents combined Adopted Water Enterprise and Hetch Hetchy Water budgets for fiscal year 2013–2014.

Table 20.3.3-15b. Estimated Longer-term SFPUC Budget Effects of Purchasing Replacement Water Supplies during Severe Drought Periods Associated with LSJR Alternatives 2, 3, and 4: Scenario 2[a]

	Baseline[b]	LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Average Annual Water Replacement Costs ($ Millions)	--	10	34	71
Water Budget with Replacement Costs ($ Millions)	483.2	493.2	517.2	554.2
Percentage Change in Water Budget Expenditures	--	2.1%	7.0%	14.7%

Source: Appendix L, *City and County of San Francisco Analyses,* Table L.6-9.

[a] Scenario 2 is defined in Appendix L as: storage credits would be reallocated even if CCSF has a negative balance in the water bank account.

[b] Represents combined Adopted Water Enterprise and Hetch Hetchy Water budgets for fiscal year 2013–2014.

For the 27 individual water agencies that purchase wholesale water from SFPUC, the actual drought surcharges levied on their retail water customers (e.g., residential, commercial and industrial) would vary depending on the percentage of each district's overall water demand met by purchases from SFPUC. As identified in Appendix L, *City and County of San Francisco Analyses* (Table L.3-1), 19 of the water agencies served by SFPUC purchased at least 90 percent of their total water supply from SFPUC in 2010. Within the service areas of those agencies (e.g., the Cities of Hayward, East Palo Alto, Menlo Park), percentage increases in drought-period rates would likely be similar to increases in wholesale water rates under the LSJR alternatives. For water agencies that rely less on SFPUC water deliveries (e.g., the Cities of Santa Clara, Sunnyvale, and San Bruno), the rate surcharges attributable to the LSJR alternatives would presumably be lower. Additionally, rate increases for customer classifications within each agency would vary based on the rate-setting policies of each agency.

Sensitivity Analysis

In the results described above, the cost of water purchases from the irrigation districts (i.e., MID and TID) is assumed to be $1000 per AF. This assumed price is key to the analysis, and is derived based on a review of recent water purchases involving both MID and TID, as well as by other agricultural districts in California. Although this assumption is considered reasonable for the analysis, an argument also can be made for assuming either a higher or lower average cost per AF, given the many site- and time-specific factors that affect water transaction prices.

A limited review of relevant information concerning the cost of water in recent water purchases suggests that a reasonable cost range for agricultural-to-urban water transfers is $500 to $2000 per AF. Although many factors influence the relationship between the price of water and the extent of associated regional economic effects, assuming that this relationship is linear provides an order-of-magnitude approximation for the potential effects under different average water prices. In other words, the resulting economic effects assuming a water transfer price of $500 per AF could approximately halve the impacts discussed above, while a price of $2000 per AF could approximately double the impacts. Approximate impacts on total economic output and employment in the four-county Bay Area region (San Francisco, Alameda, San Mateo, and Santa Clara Counties) using water transfer prices of $500, $1000, and $2000 per AF are shown in Tables 20.3.3-16 and 20.3.3-17 under Scenarios 1 and 2 for the LSJR alternatives.

Table 20.3.3-16. Estimated Average Annual Water Supply Effects on Economic Output in the Four-County Bay Area Region during Severe Drought Years under LSJR Alternatives 2, 3, and 4 for Different Water Transfer Prices

		Total Region Output ($ Millions)[c]			
			Change from Baseline under LSJR Alternative		
Scenario	Water Transfer Price ($/AF)	2010 Baseline	LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Scenario 1[a]	500	645,300	-8.1	-15.7	-17.7
	1000	645,300	-16.2	-31.4	-35.3
	2000	645,300	-32.4	-62.8	-70.6
Scenario 2[b]	500	645,300	-20.3	-69.8	-121.8
	1000	645,300	-40.5	-139.5	-243.6
	2000	645,300	-81	-279	-487.2

Source: 2010 IMPLAN county data files and IMPLAN model runs for LSJR alternatives; Appendix L, *City and County of San Francisco Analyses,* Table L.6-2 and L.6-4.

$/AF = dollars per acre-foot.

[a] Scenario 1 is defined in Appendix L as: storage credits would be reallocated only if CCSF has a positive credit balance in the water bank account.

[b] Scenario 2 is defined in Appendix L as: storage credits would be reallocated even if CCSF has a negative balance in the water bank account.

[c] Region consists of the four Bay Area counties: San Francisco, Alameda, San Mateo, and Santa Clara.

Table 20.3.3-17. Estimated Average Annual Water Supply Effects on Employment in the Four-County Bay Area Region during Severe Drought Years under LSJR Alternatives 2, 3, and 4 for Different Water Transfer Prices

		Total Region Employment (# of Jobs)[c]			
			Change from Baseline under LSJR Alternative		
Scenario	Water Transfer Price ($/AF)	2010 Baseline	LSJR Alternative 2	LSJR Alternative 3	LSJR Alternative 4
Scenario 1[a]	500	3,183,201	-58.5	-113	-127
	1000	3,183,201	-117	-226	-254
	2000	3,183,201	-234	-452	-508
Scenario 2[b]	500	3,183,201	-146	-502.5	-878
	1000	3,183,201	-292	-1005	-1756
	2000	3,183,201	-584	-2010	-3512

Source: 2010 IMPLAN county data files (baseline conditions) and IMPLAN model runs for LSJR alternatives; Appendix L, *City and County of San Francisco Analyses,* Table L.6-3 and L.6-5.

$/AF = dollars per acre-foot.

[a] Scenario 1 is defined in Appendix L as: storage credits would be reallocated only if CCSF has a positive credit balance in the water bank account.

[b] Scenario 2 is defined in Appendix L as: storage credits would be reallocated even if CCSF has a negative balance in the water bank account.

[c] Region consists of the four Bay Area counties: San Francisco, Alameda, San Mateo, and Santa Clara

Adaptive Implementation

Adaptive implementation would take place based on required evaluation of current scientific information and would need to be approved as described in Appendix K, *Revised Water Quality Control Plan.* Accordingly, the frequency and duration for any use of adaptive implementation methods 1, 2, 3, and 4 cannot be determined at this time. Adaptive implementation method 1 potentially has the greatest likelihood to change economic effects as it would allow the unimpaired flow requirement to be increased or decreased by up to 10 percent from the objective unimpaired flow (with a minimum requirement of 20 percent and a maximum of 60 percent unimpaired flow). For LSJR Alternative 2 an increase from 20 percent to 30 percent of the unimpaired flow would likely result in different effects as compared to those shown above for LSJR Alternative 2, depending upon flow conditions and frequency of the adjustment. As such, under LSJR Alternatives 2 or 3, if the percentage of unimpaired flow is increased with adaptive implementation method 1, water supply costs to water districts served by the SFPUC also would likely increase as these districts develop more costly water supply options than those developed without adaptive implementation. On the other hand, under LSJR Alternatives 3 and 4, if the percent of unimpaired flow is reduced with adaptive implementation method 1, water supply costs to SFPUC and affected water districts would be somewhat less than expected without adaptive implementation. Overall, the costs to the SFPUC associated with replacing reduced water supplies from the Tuolumne River Watershed would be expected to increase as the deliveries are reduced.

20.3.4 Effects on Hydropower Generation, Revenues and the Regional Economy

Introduction

The analysis in this section, as explained in Appendix J, *Hydropower and Electric Grid Analysis of Lower San Joaquin River Flow Alternatives*, discusses the potential effects of LSJR Alternatives 2, 3, and 4 for hydropower generation on the three eastside tributaries and the corresponding effects on revenue generation. Implementation of the LSJR alternatives could change reservoir operations, which, in turn, could alter the associated timing of water releases and amount of hydropower generated from hydroelectric facilities on the eastside tributaries. The study area for analyzing hydropower generation includes the three rim dams[7] on the eastside tributaries: New Melones on the Stanislaus River, New Don Pedro on the Tuolumne River, and New Exchequer on the Merced River. The study area also includes areas where connecting transmission systems are located and areas where the balancing authorities for the three hydropower plants—New Melones, New Don Pedro, and New Exchequer—are located, as described in Appendix J, Section J.1 and J.3.

The remaining discussion is organized around a description of baseline conditions and potential effects of each LSJR alternative. The analysis focuses on three related topics: the amount of hydropower generated, generation-related revenues, and effects on regional economic conditions, including ratepayers. Information on hydropower generation and related revenues is presented by tributary area and by hydropower facility. The methods used to assess these related topics are described first.

Assessment Methods

Results from the WSE model provides estimates of the effects of LSJR Alternatives 2, 3, and 4 on reservoir releases and storage (elevations head) and on allowable diversions to off-stream generation facilities; these results are used in this analysis to estimate changes in the generation of monthly and annual amounts of hydropower associated with LSJR Alternatives 2, 3, and 4. It should be noted that changes in hydropower generation at each rim dam differ from changes in total hydropower generation by tributary because other hydroelectric facilities on the tributaries may also contribute to the amount of hydropower generated.

In addition to changes in hydropower generation under LSJR Alternatives 2, 3, and 4, revenues associated with these changes in hydropower generation also are estimated. To derive the effects of LSJR Alternatives 2, 3, and 4 on hydropower revenue, the estimated change in monthly power generated over the 82-year simulation period is multiplied by an assumed monthly price of hydropower.

The monthly price of power used in the assessment is the value at the 80th percentile of average hourly power prices (i.e., the value at which 80 percent of the hourly prices were lower); monthly values available from the California Independent System Operators (ISO) during the 2006 calendar year were used in the assessment. Prices for 2006 were used because, as shown in Figure 20.3.4-1 below, these prices most closely match the median price during years in which price data are

[7] In this document, the term *rim dams* is used when referencing the three major dams and reservoirs on each of the eastside tributaries: New Melones Dam and Reservoir on the Stanislaus River; New Don Pedro Dam and Reservoir on the Tuolumne River; and New Exchequer Dam and Lake McClure on the Merced River.

available (1998 to 2008.) The 2006 monthly prices (Table 20.3.4-1) were adjusted to 2008 dollars using *Engineering News-Record* (*ENR*) Building Cost Indices.[8] Note that the use of monthly power prices at the 80th percentile of hourly prices is considered a conservative approach to estimating hydropower revenue impacts because historical power prices have been generally lower than this 80th percentile value. As a result, the estimated revenue impacts of LSJR Alternatives 2, 3, and 4 likely overstate, to some limited extent, the actual effects on hydropower generation revenue.

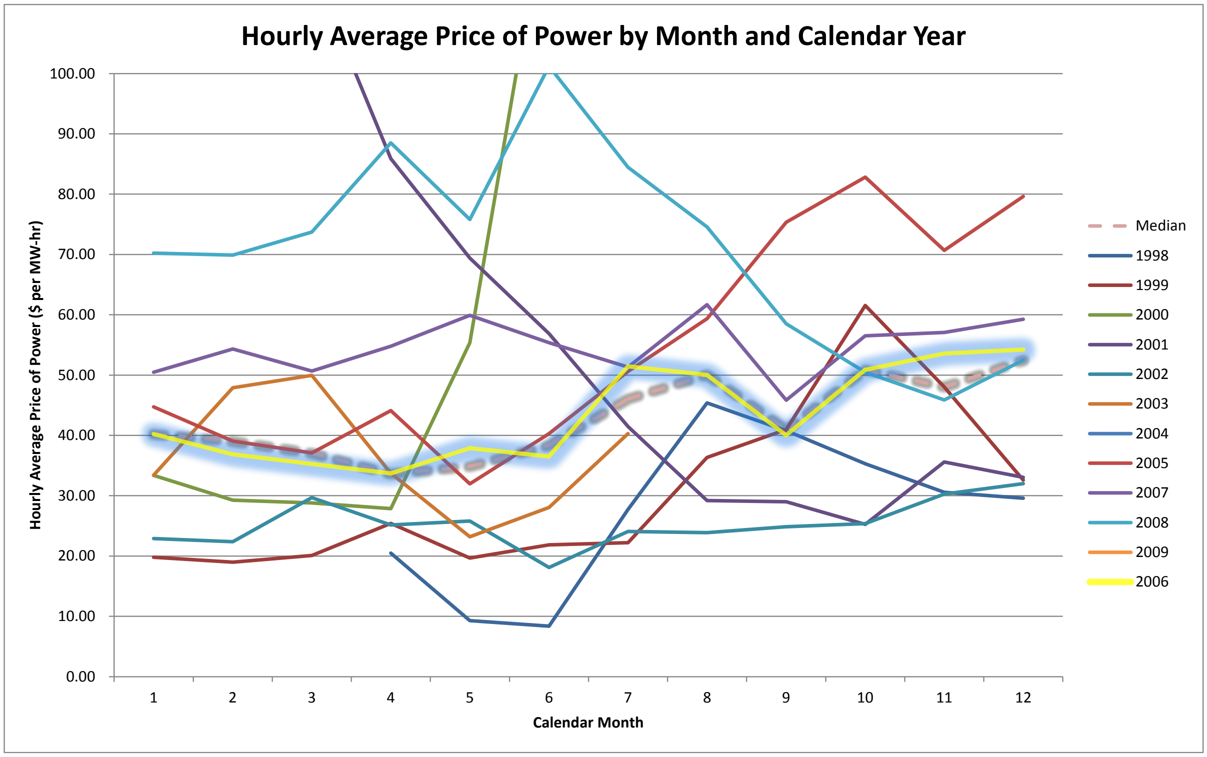

Figure 20.3.4-1. Monthly Average Price and Median Monthly Average Price of Power 1998–2008

[8] The *ENR* Building Cost Index, which has been issued since 1915, is widely used throughout the U.S. construction industry as a benchmark for measuring inflation.

Table 20.3.4-1. Selected 80th Percentile of Hourly Prices from 2006 and Factors used to Escalate to 2008 Dollars

Calendar Month	2006 ISO Power Price $/MWh ($2006)	Building Cost Index Adjustment Factor	ISO Power Price Adjusted by Building Cost Index Factor $/MWh ($2008)
1	56.46	1.0900	61.54
2	47.86	1.0886	52.11
3	43.81	1.0927	47.87
4	47.48	1.0934	51.92
5	51.83	1.0938	56.69
6	54.31	1.0949	59.46
7	61.49	1.0912	67.10
8	61.22	1.0896	66.70
9	51.25	1.0891	55.82
10	58.63	1.0456	61.30
11	63.76	1.0404	66.34
12	64.31	1.0435	67.11

Note: The 2006 ISO power price is the 80th percentile of hourly prices within each month during the 2006 calendar year. The 2006 prices were adjusted to 2008 dollars using the *Engineering News-Record* Building Cost Index.

ISO = Independent System Operators

$/MWh ($2006) = dollars per megawatt hour in 2006 dollars$/MWh ($2008) = dollars per megawatt hour in 2008 dollars

Hydropower Generation

Table 20.3.4-2 shows the average annual hydropower generation on the three eastside tributaries under baseline conditions and the relative change associated with each of the LSJR alternatives. Under baseline conditions, hydropower generation plants on the tributaries are estimated to produce 1,650 gigawatt hours (GWh) of energy per year, with 35 percent from facilities on the Stanislaus River, 40 percent from facilities on the Tuolumne River, and 25 percent from facilities on the Merced River. Under LSJR Alternative 2, energy production increases relative to baseline for all three tributaries, but as the unimpaired flow requirements increase under LSJR Alternatives 3 and 4, the amount of power generated annually is reduced. Relative to baseline, total annual hydropower generation on the tributaries increases by 29 GWh under LSJR Alternative 2, decreases by 4 GWh under LSJR Alternative 3, and decreases by 87 GWh under LSJR Alternative 4.

The analysis presented in Appendix J, *Hydropower and Electric Grid Analysis of Lower San Joaquin River Flow Alternatives*, and summarized here, also estimates the amount of hydropower that would be generated at the major rim dam facilities on each of the three eastside tributaries. Table 20.3.4-3 shows the average annual hydropower generation at each of the three rim dam facilities under baseline conditions and the relative change associated with each of the LSJR alternatives. Under baseline conditions, hydropower facilities at the three rim dams are estimated to produce 1,318 GWH per year. New Don Pedro on the Tuolumne River generates the most energy at about 604 GWh annually (46 percent of the total), while New Melones and New Exchequer generate 419 GWh (32 percent of the total) and 295 GWh (22 percent of the total), respectively. Overall energy production at the three rim dams increases relative to baseline under LSJR Alternatives 2 and 3, but the increase diminishes as the unimpaired flow requirement gets larger under LSJR Alternative 3. Under LSJR Alternative 4, hydropower facilities at the three rim dams generate less total power than under baseline conditions, but facilities at New Melones generate slightly more. Relative to baseline, total annual hydropower generation at the rim dams increases by 38 GWh under LSJR Alternative 2 and by 18 GWh under LSJR Alternative 3, but decreases by 33 GWh under LSJR Alternative 4.

Table 20.3.4-2. Average Annual Baseline Hydropower Generation and Difference from Baseline, by Tributary

Alternative	Stanislaus (GWh)	Tuolumne (GWh)	Merced (GWh)	All Tributaries (GWh)
Baseline	586	656	408	1,650
LSJR Alternative 2	18	2	8	29
LSJR Alternative 3	4	-6	-3	-4
LSJR Alternative 4	-23	-41	-23	-87

Note: Numbers are rounded.
GWh = gigawatt hours

Table 20.3.4-3. Average Annual Baseline Hydropower Generation in New Melones, New Don Pedro, and New Exchequer Hydropower Facilities and Difference from Baseline, by Facility

Alternative	New Melones (GWh)	New Don Pedro (GWh)	New Exchequer (GWh)	Three Facilities (GWh)
Baseline	419	604	295	1,318
LSJR Alternative 2	+22	+2	+13	+38
LSJR Alternative 3	+14	-4	+8	+18
LSJR Alternative 4	+2	-33	-2	-33

Note: Numbers are rounded.
GWh = gigawatt hours

Hydropower Generation-Related Revenue

Table 20.3.4-4 shows the average annual hydropower revenue on each of the three tributaries under baseline conditions and the relative change associated with each of the LSJR alternatives. Under baseline conditions, total revenue from energy production on the three tributaries is estimated to be $97.5 million per year, with 36 percent from facilities on the Stanislaus River, 39 percent from facilities on the Tuolumne River, and 25 percent from facilities on the Merced River. Under the LSJR Alternatives 2, 3, and 4, the change in revenue from hydropower generation on each of the tributaries is proportional to the change in hydropower generation. Relative to baseline, total annual hydropower revenue over all there tributaries increases by $1.7 million under LSJR Alternative 2, decreases by $0.67 million under LSJR Alternative 3, and decreases by $6.5 million under LSJR Alternative 4. Under LSJR Alternative 2, facilities on the Tuolumne River have the smallest revenue increase, whereas the Tuolumne River facilities have the greatest revenue decrease under LSJR Alternatives 3 and 4.

Table 20.3.4-5 shows the average annual hydropower revenue produced by facilities at each of the rim dams on the three tributaries under baseline conditions and the relative change associated with each of the LSJR alternatives. Under baseline conditions the total revenue from energy production by facilities at all three rim dams is estimated to be $77.8 million per year. Facilities at New Don Pedro on the Tuolumne River produce the most revenue, accounting for $35.4 million annually (46 percent of the total), whereas facilities at New Melones and New Exchequer annually contribute $24.8 million (32 percent of the total) and $17.6 million (22 percent of the total), respectively. Overall, revenue from energy production at facilities at the rim dams increases relative to baseline under LSJR Alternatives 2 and 3, but the increase diminishes as the unimpaired flow requirement gets larger under LSJR Alternative 3. Relative to baseline , annual revenues from the sale of hydropower generated at the rim dams is estimated to increase by $2.2 million under LSJR Alternative 2, increase by $0.72 million under LSJR Alternative 3, and decline by $3.2 million under LSJR Alternative 4.

Table 20.3.4-4. Average Annual Baseline Hydropower Revenue and Difference from Baseline, by Tributary

Alternative	Stanislaus ($)	Tuolumne ($)	Merced ($)	All Tributaries ($)
Baseline	34,711,954	38,509,568	24,288,834	97,510,355
LSJR Alternative 2	1,107,615	107,213	464,967	1,679,795
LSJR Alternative 3	139,363	-479,990	-329,987	-670,613
LSJR Alternative 4	-1,866,071	-2,916,944	-1,765,366	-6,548,380

Note: Revenues shown in 2008 dollars.

Table 20.3.4-5. Average Annual Baseline Hydropower Revenue from New Melones, New Don Pedro, and New Exchequer Hydropower Facilities and Difference from Baseline, by Facility

Alternative	New Melones ($)	New Don Pedro ($)	New Exchequer ($)	Three Facilities ($)
Baseline	24,798,903	35,436,787	17,563,111	77,798,801
LSJR Alternative 2	1,338,481	92,113	782,483	2,213,076
LSJR Alternative 3	738,473	-387,781	377,854	728,546
LSJR Alternative 4	-319,743[a]	-2,414,141	-440,110	-3,173,994

Note: Revenues shown in 2008 dollars.

[a] An increase or decrease in revenue that is contrary to the direction of change in average hydropower generation is explained by the shift in power generation over the year from a lower price to a higher price. Although the overall generation is lower (or higher), the change in price leads to higher (or lower) revenue (e.g., shifting an equal generation January–April to June–October would result in increased revenue due to higher prices charged for energy).

Adaptive Implementation

Adaptive implementation would take place based on required evaluation of current scientific information and would need to be approved as described in Appendix K, *Revised Water Quality Control Plan.* Accordingly, the frequency and duration for any use of adaptive implementation methods 1, 2, 3, and 4 cannot be determined at this time. Adaptive implementation method 1 potentially has the greatest likelihood of changing economic effects as it would allow the unimpaired flow requirements to be increased or decreased by up to 10 percent from the objective unimpaired flow (with a minimum requirement of 20 percent and a maximum of 60 percent unimpaired flow). For LSJR Alternative 2 an increase from 20 percent to 30 percent of the unimpaired flow would likely result in different effects as compared to those shown above for LSJR Alternative 2, depending upon flow conditions and frequency of the adjustment. As such, under LSJR Alternatives 2 or 3, if the percentage of unimpaired flow is increased with adaptive implementation method 1, hydropower revenue could be slightly less than is predicted without adaptive implementation. On the other hand, under LSJR Alternatives 3 and 4, if the percent of unimpaired flow is reduced with adaptive implementation method 1, hydropower revenue could be slightly higher than predicted without adaptive implementation.

In addition, adaptive implementation methods 2 and 3 could also affect hydropower generation, given that hydropower generation is affected by the timing of reservoir releases. Method 2 involves shifting flow between months within the February–June period to improve conditions for fish and wildlife, whereas method 3 involves shifting flow from February–June to later in the year to prevent negative impacts for fisheries. Under both methods for all LSJR alternatives, shifting the timing of reservoir releases could produce small changes in revenue as a result of the fluctuating value of power generation. Changes in reservoir storage levels as a result of adaptive implementation could also affect hydropower generation. For example, retaining water until later in the February – June time frame or until fall, will keep reservoir storage higher for a longer amount of time and thereby increase hydropower generation. However, adaptive implementation is not expected to substantially affect revenues related to hydropower generation.

Baseline Regional Economy Conditions and Potential Regional Effects Related to Hydropower

This section qualitatively evaluates potential regional economic effects associated with predicted changes in hydropower generation and associated revenues under LSJR Alternatives 2, 3, and 4. Predicted changes in hydroelectric power generation could potentially affect residents statewide in terms of electricity rates; however, modeling results presented in Tables 20.3.4-2 and 20.3.4-3 above suggest that the changes in energy generation would be virtually imperceptible at the statewide level.

Potential impacts on the regional economy caused by changes in hydropower generation can be evaluated by describing the underlying relationship between changes in hydropower production and regional economic conditions. From the perspective of the statewide electricity grid, power lost as a result of implementing one of the LSJR alternatives would need to be replaced to meet statewide electricity demand, especially during peak summer months. Presumably, purchasing replacement power from other sources would be more costly to power utilities than purchasing power from hydropower facilities on the three tributaries. Electricity providers could offset the cost of purchasing replacement power by raising utility rates for residential, commercial, and industrial users. For these users, increased spending on higher electricity bills could cause reduced spending on other goods and services, in turn, causing some employment and revenue losses for certain sectors of the state's economy. The extent of these effects would depend on the size of the hydropower losses relative to California's overall supply of electricity.

Hydropower generation on the eastside tributaries under LSJR Alternatives 2, 3, and 4 is estimated to increase by 29 GWh under LSJR Alternative 2, decrease by 4 GWh under LSJR Alternative 3, and decrease by 87 GWh under LSJR Alternative 4 (Table 20.3.4-2). According to the California Energy Commission (2012), California's electricity generating system annually produces more than 296,000 GWh, accounting for 69 percent of the electricity the state uses. Compared to annual statewide electricity production, the hydropower changes potentially caused by one of the LSJR alternatives would range from an increase of less than 0.0001 percent under LSJR Alternative 2 to a reduction of about 0.0003 percent under LSJR Alternative 4. Thus, the impacts of the LSJR alternatives on hydropower related revenues are relatively small and would not likely affect ratepayers in any substantial way. In addition, given the virtually imperceptible effects at a regional and statewide level under each of the LSJR alternatives, adaptive implementation is not expected to have an effect on regional hydropower generation or revenue.

20.3.5 Effects on Fisheries and Associated Regional Economies

Introduction

This section addresses potential economic effects concerning commercial and sport fisheries, with a specific emphasis on Chinook salmon, which could be affected by implementation of the LSJR alternatives. Because biological impacts on fishery resources, such as expected population shifts for key fish species (e.g., Chinook salmon), are highly uncertain and difficult to quantify, the corresponding economic effects also are difficult to evaluate. As a result, this analysis of fisheries-related economic effects is necessarily qualitative.

The study area for this analysis includes areas where there is commercial and sport fishing activity for species that could be affected by the LSJR alternatives. This not only includes the rim reservoirs and three eastside tributaries, but also the greater Bay-Delta region and the more expansive Pacific Ocean, plus coastal fishing areas along the western United States.

As discussed in Chapter 7, *Aquatic Biological Resources*, improving flow conditions in the SJR Watershed to the Delta at Vernalis can be expected to benefit many native fishes. However, relevant information on potential effects on native species is too limited to estimate exact population responses to habitat improvements. It is likely, however, that LSJR Alternatives 2, 3, and 4 would benefit many native plant and animal species (Merz and Moyle 2006) that exist in and adjacent to the Stanislaus, Tuolumne, and Merced Rivers through increased availability of marine derived nutrients and through improved habitat (e.g., riparian and floodplain) conditions. Information is too limited, however, to predict the exact expected positive biological responses and then to assign an appropriate economic value to those responses.

Because information on potential effects on native fish species is limited, a case study approach that focuses on Chinook salmon, a key fish species expected to benefit substantially from LSJR Alternatives 2, 3, and 4, is instructively used to examine potential economic effects associated with aquatic habitat improvements. Although results from evaluating the biological impacts of LSJR Alternatives 2, 3, and 4 on Chinook salmon populations also are limited, historical population and harvest information concerning Chinook salmon are available; this information is used to provide some insight into potential monetary values associated with improving salmon habitat in the three eastside tributaries.

Potential benefits to native fish populations such as Chinook salmon would be expected at spatial scales that extend beyond the plan area. For example, there is the potential to improve the population resiliency and stability to Central Valley fish populations by improving SJR fish populations (Carlson and Satterthwaite 2011).

This section is organized by first presenting relevant background information, including information on game species and associated sport fishing activity, on salmon management and harvest in the study area, and on recent salmon fishery closures in California. This discussion is followed by an assessment of the effects of LSJR Alternatives 2, 3, and 4 on commercial and sport fisheries, focusing on Chinook salmon. The section describes the potential economic effects on use and non-use (passive use) values associated with improving habitat conditions and sustaining salmon populations, and addresses potential effects on the regional economies affected by commercial and sport fishing activity.

Background Fishery Conditions

This section describes historical and recent information on commercial and sport fisheries that could be affected by the plan amendments. Unlike other topics covered in this chapter, the information presented here is not referred to as a baseline, primarily because these conditions characterize historical information, trends, and other dynamic factors that do not serve as an specific point of reference. Overall, there is too much uncertainty concerning the many factors that affect fishery conditions (e.g., population conditions, management actions, harvest rates) to establish a point of reference (or baseline) for evaluating potential effects. This background section describes game and sport fishing activities, salmon management actions, commercial harvest levels, and recent salmon fishery closures within the study area.

Game Species and Sport Fishing Activity

Fishing is a common recreational activity on the rivers and reservoirs of the plan area. As discussed in greater detail in Chapter 7, *Aquatic Biological Resources*, the mainstem LSJR and three eastside tributaries support several warmwater game fish populations, such as smallmouth and largemouth bass, sunfish, and catfish, as well as a variety of native fishes, such as hardhead, Sacramento pikeminnow, Sacramento sucker, sculpin, and lamprey. The mainstem LSJR and the three eastside tributaries also provide habitat for coldwater species, such as trout and Chinook salmon. Historically, the Upper SJR supported abundant populations of spring- and fall-run Chinook salmon and steelhead. Today, however, only small populations of fall-run Chinook salmon and steelhead are found in the three eastside tributaries.

Among the many game fish in the mainstem LSJR and its tributaries (refer to Chapter 7*, Aquatic Biological Resources*), the most commonly caught by sport anglers are as follows.

- LSJR: largemouth bass, striped bass, catfish, and sunfish.
- Stanislaus River: striped bass, largemouth bass, smallmouth bass, American shad, and rainbow trout.
- Tuolumne River: American shad, largemouth bass, smallmouth bass, striped bass, catfish, and sunfish.

- Merced River: largemouth bass, smallmouth bass, American shad, catfish, and sunfish.

The tributary reservoirs support a variety of fish species, including rainbow trout, brown trout, largemouth bass, smallmouth bass, kokanee, catfish, and sunfish. Sport anglers typically fish from the shore or boats for the following species in tributary reservoirs.

- New Don Pedro Reservoir: kokanee, Chinook salmon, brown trout, brook trout, rainbow trout, largemouth bass, smallmouth bass, spotted bass, catfish, and sunfish.
- New Melones Reservoir: rainbow trout, brown trout, kokanee, largemouth bass, smallmouth bass, catfish, and sunfish.
- Lake McClure: kokanee, rainbow trout, Chinook salmon, largemouth bass, spotted bass, catfish, and sunfish.

Historical (1990s and early 2000s) estimates of fishing activity at major recreation areas (rivers and reservoirs) within tributary Watersheds are identified in Section 20.3.6, *Effects on Recreational Oportunities, Activity, and the Regional Economy* (Table 20.3.6-1). As shown, sport fishing activity on the tributaries are approximated to be 5,200 angler days annually along the Lower Stanislaus River and 34,900 angler days annually along the Lower Tuolumne River; no fishing-specific estimates are available for the Merced River. Annual sport fishing activity on the LSJR is approximated at 57,500 angler days.

Salmon Management and Harvest in the Study Area

This section describes salmon management and harvest conditions in the study area. As noted above, the study area includes geographic areas where commercial and sport fishing activity occurs that could be affected by salmon production in the three eastside tributaries.

Ocean Salmon Fisheries in the Pacific Region

Ocean commercial and recreational fishing for salmon originating from Central Valley rivers occurs along the California coast, primarily from Monterey north to central Oregon. Salmon harvest levels for ocean and river fisheries are managed by federal and state agencies. The Pacific Fisheries Management Commission (PFMC) coordinates this process and annually assesses salmon populations to establish sustainable salmon harvest levels for the Pacific Region (California, Oregon, and Washington). The PFMC also sets ocean commercial and recreational fishing seasons for harvesting of salmon in federal waters. Each year, the PFMC recommends ocean fishing regulations designed to meet constraints established by escapement goals and jeopardy opinions for federally listed species. California fisheries are managed, in part, to meet escapement, allocation, and rebuilding goals for Klamath River fall-run Chinook salmon, coastal natural spawning coho salmon, and Sacramento River spring-, fall-, and winter-run Chinook salmon (Boydstun 2001).

In the Pacific region, salmon fisheries are subject to weak stock management, where access to the harvestable surplus of healthier stocks is often restricted to protect weaker stocks with which they co-mingle in the ocean. This makes establishing regulations difficult. For example, in 2008 and 2009 (see *Recent Salmon Fishery Closures in California* section below), virtually all fishing in the ocean off California was closed to protect Central Valley fall-run Chinook, even though Klamath fall-run Chinook salmon returns were large enough to support limited ocean angling (Morse and Manji 2009). Salmon management is further complicated by the need to ensure equitable allocation of harvest among diverse user groups and the need to coordinate with the entities that have jurisdiction over other aspects of salmon management. The PFMC also develops a catch-sharing plan for tribal and non-tribal fisheries conducted in federal waters (NMFS 2014).

Historically, Native American tribes along the West Coast relied on natural resources as a source of food, nutrients, and trading commodities. Over time, the opportunity to engage in traditional use fisheries has been dramatically limited by political forces and human population expansion. Native American natural resource initiatives along the West Coast have resulted in an array of contemporary outcomes, including the sometimes controversial Boldt Decision in the Pacific Northwest (Norman et al. 2007). For California state-managed waters (i.e., those extending 3 nautical miles offshore), the California Fish and Game Commission (Commission) establishes salmon fishing regulations to ensure that California's non-tribal harvest allowances are not exceeded by commercial fishers and recreational anglers.

The California Department of Fish and Wildlife (CDFW), as the state fishery management agency, manages fishery regulations, implements management plans, provides technical expertise, and coordinates the implementation of policy throughout California. CDFW is responsible for providing recommendations to the Commission and for carrying out research that informs these recommendations or other management decisions to be made by the California State Legislature. All of these regulations affect recreational and commercial fishing opportunities and, therefore, the economic value of these fisheries in California (Morse and Manji 2009).

Historical Harvest of Ocean Commercial and Sport Salmon in California

Ocean commercial harvest levels for Chinook salmon in California have varied considerably over the last four decades, as shown in Table 20.3.5-1. Excluding the fishery closure years of 2008 and 2009 (see *Recent Salmon Fishery Closures in California* section below), statewide commercial salmon catch between 1976 and 2013 varied from about 1,317,200 salmon in 1988 down to 15,100 salmon in 2010. During this period, catches could change substantially from year to year. The best 5-year period occurred from 1986–1990, with an average of 794,700 fish caught per year.

Table 20.3.5-1. California Commercial Troll Chinook Salmon Landings (in number of fish) and Prices by Catch Area, 1976–2014

	Catch Area						Price Per Pound	
Year	Crescent City	Eureka	Fort Bragg	San Francisco	Monterey	Statewide	Nominal	Adjusted 2014 $[a]
1976	20,971	165,419	115,683	138,231	99,626	539,930	NA	NA
1977	36,285	161,175	138,886	185,164	78,675	600,185	NA	NA
1978	59,636	155,168	131,854	158,158	132,842	637,658	NA	NA
1979	71,783	218,363	202,467	180,087	54,060	726,760	$2.53	$6.27
1980	32,622	131,283	130,443	211,778	82,524	588,650	$2.27	$5.15
1976–1980 Average	**44,259**	**166,282**	**143,867**	**174,684**	**89,545**	**618,637**	**$2.40**	**$5.71**
1981	81,821	99,709	116,624	199,910	89,995	588,059	$2.25	$4.67
1982	73,317	95,654	170,049	289,462	136,678	765,160	$2.55	$4.99
1983	24,686	35,177	55,886	75,019	103,215	293,983	$2.09	$3.93
1984	14,369	13,979	49,751	167,668	53,992	299,759	$2.67	$4.84
1985	0	0	153,980	175,681	36,637	366,298	$2.56	$4.51
1981–1985 Average	**38,839**	**48,904**	**109,258**	**181,548**	**84,103**	**462,652**	**$2.42**	**$4.59**
1986	13,976	36,738	272,418	302,302	200,154	825,588	$2.01	$3.46
1987	33,535	54,737	341,216	355,615	91,231	876,334	$2.78	$4.65
1988	15,619	46,414	424,663	642,693	187,818	1,317,207	$2.86	$4.63
1989	5,470	17,467	144,229	255,817	107,955	530,938	$2.39	$3.73
1990	1,386	6,289	79,553	199,147	137,072	423,447	$2.77	$4.16
1986–1990 Average	**13,997**	**32,329**	**252,416**	**351,115**	**144,846**	**794,703**	**$2.56**	**$4.13**
1991	0	4,700	35,600	174,800	79,800	294,900	$2.58	$3.74
1992	0	0	-	95,800	64,500	160,300	$2.74	$3.88
1993	0	0	19,891	154,999	104,663	279,553	$2.25	$3.12
1994	0	0	5,210	219,856	70,508	295,574	$2.07	$2.81
1995	0	0	8,714	357,486	313,112	679,312	$1.76	$2.34
1991–1995 Average	**0**	**940**	**17,354**	**200,588**	**126,517**	**341,928**	**$2.28**	**$3.18**
1996	254	8,821	22,930	167,379	181,467	380,851	$1.44	$1.88
1997	0	1,424	3,776	253,484	228,731	487,415	$1.38	$1.77
1998	0	2,501	2,882	126,120	95,433	226,936	$1.66	$2.10
1999	125	2,375	2,283	180,960	78,709	264,452	$1.93	$2.41
2000	251	1,776	30,773	250,368	197,184	480,352	$2.01	$2.46
1996–2000 Average	**126**	**3,379**	**12,529**	**195,662**	**156,305**	**368,001**	**$1.68**	**$2.12**

	Catch Area						Price Per Pound	
Year	Crescent City	Eureka	Fort Bragg	San Francisco	Monterey	Statewide	Nominal	Adjusted 2014 $[a]
2001	223	5,300	14,993	136,630	35,940	193,086	$1.98	$2.56
2002	4,459	9,008	65,336	242,872	69,980	391,655	$1.55	$1.98
2003	3,356	688	248,875	202,876	36,099	491,894	$1.91	$2.39
2004	26,220	5,695	107,259	298,229	64,707	502,110	$2.87	$3.49
2005	1,255	5,799	45,869	170,531	117,408	340,862	$2.97	$3.50
2001–2005 Average	**7,103**	**5,298**	**96,466**	**210,228**	**64,827**	**383,921**	**$2.26**	**$2.78**
2006	0	0	10,835	47,689	11,204	69,728	$5.13	$5.87
2007	2,367	6,395	16,116	75,254	14,009	114,141	$5.18	$5.77
2008	NA	NA	NA	NA	NA	NA	NA	NA
2009	NA	NA	NA	NA	NA	NA	NA	NA
2010	0	0	12,553	1,105	1,430	15,088	$5.47	$5.86
2006–2010 Average[b]	**789**	**2,132**	**13,168**	**41,349**	**8,881**	**66,319**	**$5.26**	**$5.83**
2011	417	1,974	39,311	21,912	6,414	70,028	$5.18	$5.44
2012	400	4,831	38,211	118,570	52,796	214,808	$5.34	$5.51
2013	1,225	8,953	116,158	143,654	27,637	297,627	$6.23	$6.33
2014	17	596	76,801	81,506	7,566	166,486	$5.54	$5.54
1976–2014 Average[b]	**14,217**	**35,362**	**95,891**	**190,779**	**93,291**	**426,949**	**$2.91**	**$3.99**

Sources: Pacific Fishery Management Council 1997, 2013, 2014, 2015 (Tables A-3 and IV-2).

NA = not available. Note that the commercial salmon fishery was closed in 2008 and 2009.

[a] Nominal prices adjusted to 2014 dollars using the gross domestic product implicit price deflator.

[b] Averages exclude the salmon fishery closure years of 2008 and 2009.

Compared to the 1976–2014 average annual harvest of 426,900 salmon, commercial harvests between 1976 and 1990 were relatively high, averaging 625,300 fish per year. However, commercial harvests then dropped to an average of 364,600 fish from 1990 until 2005, and then further declined to an average of 67,200 fish per year from 2006–2011, excluding 2008 and 2009 when fisheries were closed. Although more recent harvests have shown large improvements, average harvests from 2012 to 2014 were still 47 percent below the 37-year (1976–2014, excluding 2008 and 2009) average. Commercial landings in the San Francisco port area accounted for 45 percent of statewide landings over the 37-year period, followed by the Monterey (22 percent), and Fort Bragg (22 percent) port areas (Table 20.3.5-1). The remainder of the statewide salmon catch was landed in the Eureka (8 percent) and Crescent City (3 percent) port areas. However, annual harvests vary significantly for all ports.

As can be seen by reviewing the harvest data in Table 20.3.5-1, Chinook salmon harvests in the Crescent City and Eureka port areas, and to a lesser extent in the Fort Bragg port area, were eliminated or greatly reduced from 1991–2001. For these port areas, stringent commercial fishing regulations have been imposed in some years to protect Klamath River fall-run Chinook in the PFMC's Klamath Management Zone (KMZ) (encompassing Curry County in Oregon and Humboldt and Del Norte counties in California). By severely constraining harvest in the KMZ, the PFMC is able to maintain fishing opportunities in other areas farther from the KMZ (e.g., San Francisco, Monterey) that have lesser impacts on this stock (Pomeroy et al. 2010). Additionally, the California portion of the KMZ was closed to commercial salmon fishing from 1992–1995 due to several localized factors. These factors include the need to protect Oregon Coastal Natural coho, a determination that the Klamath fall-run Chinook had been overfished, and a court decision allocating 50 percent of Klamath-Trinity River salmon to the Yurok and Hoopa tribes (Pomeroy et al. 2010). Finally, in 2006, failure of Klamath fall-run Chinook to achieve established escapement minimums for the third consecutive year prompted the PFMC to close the commercial fishery in the California KMZ and curtail the season in other areas (Pomeroy et al. 2011). Until recently, Klamath River fall-run Chinook was the constraining stock in the ocean fishery, prompting the restrictive regulations. Since 2007, however, conservation concerns regarding Sacramento River fall-run Chinook have prompted unprecedented recreational season reductions and closures statewide (see *Recent Salmon Fishery Closures in California* section below [Pomeroy et al. 2010]).

In inflation-adjusted 2014 dollars, ex-vessel prices[9] for Chinook salmon averaged $3.99 per pound between 1979 and 2014 (Table 20.3.5-1). Annual inflation-adjusted salmon prices were above $3.00 every year through 1993. From 1994 through 2003, however, average prices did not exceed the 1994 value of $2.81. After 2003, prices rebounded and have not fallen below an inflation-adjusted $3.49 through 2014. The 1979–2014 overall inflation-adjusted average price of $3.99 was exceeded in every year since 2005 (excluding 2008 and 2009 when the California commercial salmon fishery was closed). The 2014 average inflation-adjusted price of $5.54 was 39 percent above the average between 1979 and 2014.

Similar to commercial harvests, ocean sport (or recreational) catch has varied substantially from year to year. Excluding the complete or partial closure years of 2008 and 2009 (see *Recent Salmon Fishery Closures in California* section below), statewide ocean sport catch of Chinook salmon between 1976 and 2014 ranged from 397,200 fish in 1995 to 14,800 fish in 2010, averaging about 128,200 fish per year over the entire period (Table 20.3.5-2). During that time, the best 5-year period for sport catch occurred from 1991–1995, with an average catch of approximately 170,300 salmon per year.

[9] The *ex-vessel price* is a measure of the dollar value of commercial landings, usually calculated as the price per pound at first purchase of the commercial landings multiplied by the total pounds landed.

Table 20.3.5-2. California Ocean Recreational Chinook Salmon Landings (in number of fish) by Catch Area, 1976–2014

	Catch Area					
Year	Crescent City	Eureka	Fort Bragg	San Francisco	Monterey	Statewide
1976	2,991	7,111	2,324	63,760	4,807	80,993
1977	7,400	13,261	6,323	72,594	4,006	103,584
1978	1,986	2,308	2,534	64,085	1,809	72,722
1979	2,879	3,647	4,626	102,547	5,929	119,628
1980	2,718	4,046	1,308	73,093	4,020	85,185
1976–1980 Average	**3,595**	**6,075**	**3,423**	**75,216**	**4,114**	**92,422**
1981	4,007	4,406	1,787	70,084	3,743	84,027
1982	6,196	7,084	2,948	116,910	5,586	138,724
1983	3,445	5,484	1,933	49,717	3,243	63,822
1984	3,523	4,611	999	73,233	5,437	87,803
1985	17,989	26,384	4,985	112,475	9,276	171,109
1981–1985 Average	**7,032**	**9,594**	**2,530**	**84,484**	**5,457**	**109,097**
1986	5,760	10,459	10,584	86,255	28,558	141,616
1987	12,060	18,436	9,201	119,526	33,320	192,543
1988	17,236	14,345	9,406	114,455	15,919	171,361
1989	25,275	24,642	5,803	93,659	37,248	186,627
1990	12,717	11,109	3,388	77,562	35,053	139,829
1986–1990 Average	**14,610**	**15,798**	**7,676**	**98,291**	**30,020**	**166,395**
1991	3,367	9,508	5,854	37,274	24,830	80,833
1992	889	1,706	4,263	47,193	19,526	73,577
1993	1,272	3,614	5,821	78,733	20,584	110,024
1994	6,321	3,664	14,018	140,977	24,835	189,815
1995	5,556	8,075	29,048	155,677	198,875	397,231
1991–1995 Average	**3,481**	**5,313**	**11,801**	**91,971**	**57,730**	**170,296**
1996	3,828	6,919	24,002	84,471	44,812	164,032
1997	2,527	6,456	11,584	123,974	84,427	228,968
1998	1,123	1,790	4,663	70,969	43,468	122,013
1999	1,016	5,175	5,263	69,251	7,140	87,845
2000	3,571	9,903	25,942	64,653	81,782	185,851
1996–2000 Average	**2,413**	**6,049**	**14,291**	**82,664**	**52,326**	**157,742**
2001	2,236	10,588	26,064	39,856	20,039	98,783
2002	1,107	15,024	31,202	87,008	47,703	182,044
2003	391	8,361	16,180	56,616	13,126	94,674
2004	1,290	21,554	23,205	130,220	44,845	221,114
2005	1,498	16,046	22,183	72,824	30,706	143,257
2001–2005 Average	**1,304**	**14,315**	**23,767**	**77,305**	**31,284**	**147,974**

	Catch Area					
Year	Crescent City	Eureka	Fort Bragg	San Francisco	Monterey	Statewide
2006	756	15,647	13,993	54,926	10,970	96,292
2007	871	18,025	5,751	16,796	6,261	47,704
2008	-	-	6	-	-	6
2009	147	525	-	-	-	672
2010	0	720	1,678	6,116	6,295	14,809
2006–2010 Average[a]	**542**	**11,464**	**7,141**	**25,946**	**7,842**	**52,935**
2011	113	9,874	7,398	19,734	12,703	49,822
2012	7,432	32,012	7,929	46,189	30,364	123,926
2013	6,063	27,918	10,168	61,291	10,634	116,074
2014	3233	12,594	12,540	32,359	14,020	74,746
1976–2014 Average[a]	**4,882**	**10,879**	**10,186**	**75,326**	**26,916**	**128,189**

Sources: Pacific Fishery Management Council 2013, 2014, 2015 (Table A-5).

[a] Averages exclude the salmon fishery closure years of 2008 and 2009.

Sport landings from the San Francisco catch area accounted for almost 60 percent of statewide ocean sport landings over the 37-year period (i.e., excluding 2008 and 2009), followed by the Monterey area (21 percent) (Table 20.3.5-2). Sport landings in the Crescent City, Eureka, and Fort Bragg areas, which accounted for 19 percent of statewide ocean sport landings over the period, have been affected by many of the same management considerations that have restricted commercial salmon harvests.

According to historical data maintained by the U.S. Fish and Wildlife Service's (USFWS's) Anadromous Fish Restoration Program (AFRP) (USFWS 2015), between 1967 and 2010, the in-river catch of Chinook salmon in the Central Valley by sport anglers averaged 57,611 fish. Average annual in-river catch has been higher over the past two decades than in the preceding 25 years, with catches from 1992–2010 averaging about 64,900 salmon, compared to an average of 51,200 from 1967–1991.

In addition to commercial and sport fishing, California has approximately 100 recognized tribes, some of which engage in traditional uses of fish (Shilling et al. 2014). Currently, CDFW uses the term "recreational" for fishermen who do not earn revenue from their catch, but fish for pleasure or for personal consumption. Information on subsistence fishing by tribal members in California is captured within the broader scope of sport fishing data (Norman et al. 2007; Shilling et al. 2014).

Contribution of Central Valley Salmon to Ocean and Inland Fisheries

Located within California's Central Valley, the Sacramento-San Joaquin River system is the principal producer of Chinook salmon caught in California's ocean fisheries. Its salmon runs also contribute to the ocean fisheries of Oregon and Washington (CDFW 2014). Historically, the rivers in the SJR Watershed supported abundant populations of spring- and fall-run Chinook salmon and steelhead (discussed in greater detail in Chapter 7, *Aquatic Biological Resources*). However, degradation of habitat and increasing pressures from the human expansion has negatively affected those populations. Today, only a relatively small population of fall-run Chinook salmon remain in the three eastside tributaries to the LSJR. These fish pass through the LSJR during their migrations to and from the Delta and Pacific Ocean, where they contribute to the commercial and sport ocean salmon fisheries.

According to historical data maintained by the AFRP, 1967–2010, the average annual ocean catch of Central Valley Chinook salmon by San Francisco and Monterey port area-based boats was 382,070 fish per year. Of this total, 71 percent of the landings were by commercial fishermen and 29 percent were by sport anglers. Furthermore, based on the historical data, it was estimated that 95 percent of the catch originated from the Sacramento River Watershed, with the remaining 5 percent originating from the SJR Watershed. Based on these estimates, the average annual commercial and sport ocean catch of Chinook salmon originating from the SJR totaled about 13,560 and 5,540 fish, respectively, between 1967 and 2010. Catch data for boats based in the Fort Bragg, Eureka, and Crescent City port areas were not available; however, data from recent years suggest that a large proportion of the commercial and sport salmon harvest in these areas originates from Central Valley watersheds (CDFW 2012, 2013, 2015).

Recent Salmon Fishery Closures in California

As discussed above, in 2008 and 2009 the sudden decline of the Sacramento River Basin fall-run Chinook salmon population led the PFMC to almost completely close salmon fishing seasons for the first time in California's history. In both years, the ocean commercial salmon fishery was completely closed. The ocean recreational salmon fishery also was closed in 2008, but was opened for a 10-day period in 2009 (August 29–September 7) from Horse Mountain (near Shelter Cove) to the Oregon border, allowing fishing along the northernmost portion of the California coast (PFMC 2010). Fishing rebounded beginning in 2010, but still remains below the levels prior to the closures (NMFS 2014.)

Recreational fishing for salmon in Central Valley rivers was also highly restricted in 2008 and 2009 relative to recent years. In 2008, an estimated 650 Sacramento River fall-run Chinook salmon were harvested during a 2-month season lasting from November 1 through December 31, which was only 1 percent of the river run. Angler surveys conducted in the Sacramento River Basin for 9 years between 1991 and 2007, during which harvest regulations were much less restrictive than in 2008, suggested a mean harvest rate of 14 percent of the river run (PFMC 2009). In 2009, the Upper Sacramento River late fall-run fishery was the only Central Valley fishery open to Chinook retention, and in an attempt to decrease harvest and protect Sacramento River fall-run Chinook, the fishery was not opened until November 16, 2009. Preliminary estimates indicated that no Sacramento River fall-run Chinook salmon were harvested by recreational anglers in the 2009 late-fall fishery (PFMC 2010).

The prohibition of commercial and recreational salmon fishing in 2008 and 2009 caused substantial economic effects on California's fishing industry, including direct employment and income losses in the fishing industry and secondary employment and income losses in dependent industries. Additionally, the populations of Columbia River Chinook and coho salmon from Oregon and Washington also declined to near record-low levels. In April of 2008, the Governors of all three states (California, Oregon, and Washington) wrote the Speaker of the House requesting assistance in obtaining emergency appropriations to help mitigate the economic impact, which at the time totaled $290 million and included the loss of more than 4,200 jobs (Schwarzenegger et al. 2008).

Two subsequent studies estimated similar impacts on industrial output and employment in California caused by the closures of the ocean salmon fisheries. The first study as reported in

CDFW's *Outdoor California*[10] magazine (Morse and Manji 2009), estimated that the 2008 closure cost the California economy $255 million in industrial output and 2,263 jobs. The publication also estimated that the 2009 closure resulted in a loss of $279 million in output and 2,690 jobs. The closures put some boat owners and commercial salmon fishermen out of business, causing economic hardships for tackle shops, bait and boat dealers, motels and restaurant owners, and other related businesses during those years (Morse and Manji 2009).

This assessment was corroborated to some extent by a second study of the fishery closure effects conducted by the University of the Pacific Business Forecasting Center (Michael 2010).[11] This study assessed effects relative to 2004 and 2005 salmon fishery production, when annual commercial harvests in California averaged 421,500 salmon. For commercial salmon fishing, the Michael study estimated economic effects for only those directly and indirectly related to salmon harvesting and processing, assuming that no effects would occur at the wholesale, distribution, or retail levels because consumers could switch to substitute products. The Michael study estimated that the fishery closure cost $21.3 million in revenue for the commercial salmon fishing industry, $47.9 million in total income, and 961 total jobs. For recreational salmon fishing, estimated impacts included the loss of $70.5 million in total income and 862 jobs.[12] Combined, the closures of California's commercial and recreational salmon fisheries cost the economy $118.4 million in annual income and 1,823 jobs compared to the income and employment for 2004 and 2005.

The Michael study noted that salmon abundance was much higher in recent decades and that recovery to these levels would generate even larger economic impacts. Additionally, it noted the role of seasonality and dispersion in interpreting the results of its study. For example, the study's employment impacts represent annual averages, whereas an industry with highly seasonal employment patterns such as fishing would have employment impacts at some point during the year higher than those represented by the annual average employment losses. On the other hand, economic effects of salmon fishing are dispersed across hundreds of miles of coastline and inland waterways, somewhat diluting the concentration of effects. However, relatively small fishing communities may feel the effects more acutely than would a larger port area such as San Francisco. These smaller, more-isolated communities, considered somewhat dependent on commercial and recreational fishing, include Crescent City in Del Norte County; Eureka, Trinidad, and Fields Landing in Humboldt County; Fort Bragg, Albion, and Point Arena in Mendocino County; Bodega Bay in Sonoma County; Point Reyes, Marshall, and Bolinas in Marin County; Princeton and Half Moon Bay in San Mateo County; and Moss Landing in Monterey County (Langdon-Pollock 2004; Norman et al. 2007).

The studies above (i.e. Morse and Manji 2009; Michael 2010) did not estimate the potential economic effects caused by curtailment of inland sport fishing for Central Valley Chinook salmon. Although sport anglers can shift their effort to other species when salmon are not available, the

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[10] *Outdoor California* is an official California fish, wildlife, and habitat magazine published by CDFW that describes noteworthy stories on California's native species and habitat.

[11] A third salmon closure study, conducted by Southwick Associates, produced much higher estimates of economic impacts than did CDFW and Michael studies. However, Michael (2010) concluded that several methodological flaws led to highly exaggerated estimates of commercial fishing-related impacts, particularly for effects in California's retail and salmon distribution sectors.

[12] Note that the modeling of recreational salmon fishing effects used only the expenditures of out-of-state anglers based on the premise that recreational spending by in-state anglers may simply be transferred to fishing effort for different species or entirely out of fishing and directed towards other recreational pursuits in the area, offsetting the effects attributable to decreased salmon fishing.

reduction of salmon fishing opportunities in Central Valley rivers likely adds to the economic effects estimated by the two ocean closure studies.

In 2006, a federal socioeconomic study conducted by PFMC and the National Marine Fisheries Service (NMFS) evaluated the needs of fishing communities. The study identified several Northern California counties and port communities as "most vulnerable" and "vulnerable" with high levels of dependence on commercial fishing and low levels of resilience. For example, the county of Del Norte was classified as "vulnerable," and the counties of Humboldt, and Mendocino were classified as "most vulnerable." Additionally, the communities of Crescent City, Eureka, Fort Bragg, Point Arena, and Bodega Bay were classified as "vulnerable." These areas may be particularly susceptible to fishery closures and the associated economic losses that occur.

Effects on Commercial and Sport Fisheries

Expected Effects on Salmon in the San Joaquin River Watershed

The impacts of LSJR Alternatives 2, 3, and 4 on aquatic resources are detailed in Chapter 7, *Aquatic Biological Resources*, and summarized in Table 7-1. Reservoirs releases on the LSJR tributaries are made in response to multiple operational objectives, including flood management, downstream diversions, instream flow requirements for fisheries, instream water quality requirements, and water quality and flow objectives at Vernalis. Under LSJR Alternatives 2, 3, and 4, increased flows would largely be confined within existing channels, preventing an increase in flood frequency, and would have similar timing and magnitude compared to historical flows. As a result, increased flows from LSJR Alternatives 2, 3, and 4, with and without adaptive implementation, are not anticipated to have substantial adverse impacts on fish species in the tributary watersheds and LSJR. Specifically, flow alterations would not be sufficient to substantially impact aquatic resources in the tributary rivers or watershed reservoirs. As a result, impacts on fish species in the tributary rivers and reservoirs, and consequently on recreational fisheries, would be less than significant.

The potential benefits of the LSJR alternatives on aquatic resources are detailed in Chapter 19, *Analyses of Benefits to Native Fish Populations from Increased Flow Between February 1 and June 30*, and Chapter 3 of Appendix C, *Technical Report on the Scientific Basis of Alternative San Joaquin River Flow and Southern Delta Salinity Objectives*. The following information is largely taken from those sources and repeated here for ease of reference.

The results shown in Chapter 19 indicate that there would be significant temperature benefits for Central Valley fall-run Chinook salmon and Central Valley steelhead on the eastside tributaries and the mainstem LSJR under some of the alternatives. These fish evolved to spawn and develop at higher elevations where the water temperatures are colder. However, with the construction of the rim dams they can no longer reach these elevations and must spawn in the lower, warmer reaches of the tributaries. Increasing flow in tributaries at the right times can help buffer streamflow temperatures against hotter air temperatures in the late spring and early summer, when young salmon are developing and migrating. Significant temperature improvements are expected on the Stanislaus and Merced Rivers, primarily under LSJR Alternatives 3 and 4, with and without adaptive implementation (i.e., requirements of 40–60 percent unimpaired flow). On the Tuolumne River, significant temperature improvements are expected under all LSJR alternatives, with the least benefit under LSJR Alternative 2, and the most benefit under LSJR Alternative 4, both without adaptive implementation.

In addition to temperature benefits, results indicate that providing more flow of a more natural regime during the February–June time period would significantly increase the amount of floodplain habitat that is available to native fish. Increasing the floodplain area or duration could provide several benefits for young salmon, including cover from predators, greater access to food resources, and low flow zones to rest in. Higher unimpaired flow requirements will produce greater benefit, in terms of floodplain frequency and magnitude (and presumably duration), compared to lower unimpaired flow requirements or baseline conditions. In general, flood inundation will increase the most (compared to baseline) during the months of April, May, and June under the LSJR alternatives.

Potential Effects on Use and Non-Use Values Resulting from Improved Salmon Production

The following assessment focuses on potential use and non-use benefits associated with supporting and maintaining sustainable Chinook salmon populations in the Stanislaus, Tuolumne, and Merced Rivers. The assessment of use benefits focuses on potential commercial and recreational[13] fishing-related economic effects. Information collected by CDFW, PFMC, USFWS, AFRP, and others is used to characterize the economic values of existing commercial and sport fisheries that could be affected by LSJR Alternatives 2, 3, and 4.

Potential non-use benefits (i.e., monetary values associated with just protecting fish resources rather than from directly using fish resources) also are considered in this section. Although this assessment is necessarily more qualitative because of the lack of specific information on potential effects on salmon populations and other native species, estimates of non-use monetary values, as measured in terms of the public's willingness to pay (WTP) for programs or actions designed to restore or enhance fish populations, are presented for context. For this assessment, non-use values (passive use values) are defined as the non-fishing public's perceived values associated were merely knowing that salmon are being protected, even if these individuals have no intention to ever use the resources.

Improving salmon production in the Stanislaus, Tuolumne, and Merced Rivers would improve Central Valley adult escapement rates for salmon and could help avoid salmon fishery closures in the future. Healthier populations and more viable fisheries could have economic benefits for California residents and businesses, as well as for out-of-state visitors or those who reside out of the state but place value on maintaining and improving Central Valley fish species. As discussed above under *Recent Salmon Fishery Closures in California*, the closures of the ocean commercial and sport fisheries in 2008 and 2009 cost the California economy an estimated $255–$275 million in industrial output (sales), $118 million in personal income, and 1,800–2,700 jobs during each year of the closure. If economic effects from curtailment of the freshwater sport salmon fishery also are considered, the total economic impact would be substantially greater. There is also a direct relationship between the prosperity of fishing-dependent communities in the Central Valley and along the Pacific Coast and the viability of commercial and recreational fisheries that contribute economic activity to these communities. Additionally, there is a direct benefit for residents of California and other regions to avoid further extinctions of California's salmon and other native fishes.

[13] Recreational and sport fishing refer to the same activity; the term *sport fisheries* is used in this section to refer to marine and freshwater areas where sport fishing activities are managed. This terminology is intended to differentiate fishing activity from more general recreational activities discussed in Section 20.3.6, *Effects on Recreational Opportunities, Activity, and the Regional Economy.*

Non-use values are considered public goods that can be simultaneously enjoyed by millions of people across a region and the country (Loomis 1996). Existence value is a non-use value defined as the benefit received from simply knowing that a resource exists even if no use is made of it. Increasing stocks of Chinook salmon and steelhead in the SJR Watershed to sustainable levels would have associated existence values as it provides assurance that the resource will continue to exist. Although data on salmon recovery rates and associated population levels is too limited to reliably estimate non-use values associated with recovering Chinook salmon in the SJR Watershed, these values are conceptually measurable and would likely differ to some extent among LSJR Alternatives 2, 3, and 4.

Table 20.3.5-3 identifies four salmon restoration programs with studies conducted to estimate non-use values associated with the restoration programs. Typically, non-use values can only be measured reliably by designing and implementing program-specific public surveys; however, the number of such studies is very limited due to the time and costs associated with conducting public surveys of this nature. Although the underlying reason for conducting the four studies referenced in Table 20.3.5-3 was similar (i.e., to estimate the monetary value that the public would place on restoring salmon habitat and populations), each study embodied different actions for achieving the salmon restoration goals of the programs. In the case of the Elwha River and the Klamath River, removing dams that blocked access to habitat important for salmon was central to the program. In the case of the Columbia River, interest in substantially increasing (doubling) salmon runs was the overriding goal. Lastly, the Upper SJR study was part of a broader federal and state program to improve deteriorating habitat conditions for fish and wildlife resources in the San Joaquin Valley.

Acknowledging non-use values similar to those in Table 20.3.5-3 is important to a comprehensive assessment of costs and benefits for LSJR Alternatives 2, 3, and 4. Although difficult to accurately measure without conducting a public survey tailored to the outcomes of specific physical and biological program objectives, the importance of relevant non-use values in an economic assessment of the plan amendments should not be overlooked. Oftentimes, estimates of non-use values can total in the hundreds of millions of dollars or more. However, thoroughly understanding important causal relationships between restoration (e.g., enhanced flows) and the resulting physical and biological outcomes is challenging. As such, the best result that typically can be expected from a review of values similar to those studies identified in Table 20.3.5-3 is to develop a contextual foundation for these values. This foundation provides an understanding about the general magnitude of non-use values and their contribution to the economic calculus.

The evaluation described above is limited to potential use and non-use benefits associated with supporting and maintaining sustainable populations of Chinook salmon in the three eastside tributaries. As noted, improving salmon production in the Stanislaus, Tuolumne, and Merced Rivers would be expected to improve Central Valley adult escapement rates and could help avoid salmon fishery closures in the future, resulting in direct economic benefits to California businesses and residents. There also may be additional benefits to other native fish species and other plant and animal species at spatial scales that extend beyond the scope of the plan amendments; however, uncertainty and lack of information on the potential biological effects preclude a more quantitative evaluation of these benefits.

Table 20.3.5-3. Existing Studies that Estimate the Non-Use Monetary Benefits Associated with Restoring Salmon Populations, as Measured by the Public's Willingness to Pay

	Upper San Joaquin River Study (1990)[a]	Columbia River Study (1989)[b]	Elwha River Study (1996)[c]	Klamath River Study (2012)[d]
Description of Salmon Program Benefits	Increase annual populations of Chinook salmon in the Upper SJR from less than 100 fish to about 15,000 fish as a result of increasing flows in the river	Restore (double) annual salmon and steelhead runs (increase of 2.5 million fish annually) as a result of habitat restoration efforts	Increase pink salmon runs by 200,000 fish annually and chum, steelhead, and Chinook runs by 100,000 fish annually as a result of dam removal/habitat restoration	Increase populations of wild salmonids (Chinook salmon and steelhead), with increases ranging from 30% to 150%; changes in extinction rates for the shortnose and Lost River suckers, and for coho salmon as a result of dam removal/habitat restoration
Estimates of Annual Willingness to Pay (WTP) per Household	Annual WTP benefits ranged from $103 per household (out-of-state residents) to $202 per household (residents of the San Joaquin Valley) (in 1990 dollars)	Monthly WTP benefits range from $2.21 per respondent to $4.88 per respondent (in 1989 dollars), depending on the probability of future use of the river for salmon fishing	Annual WTP benefits vary by location of respondent, ranging from $59 per household for residents of Clallam County, to $73 per household for residents elsewhere in Washington State; out of state residents indicated an average (mean) WTP benefit of $68 annually (in 1996 dollars)	WTP benefits vary by program characteristics; annualized values (discounted) range from $65.82 to $112.28 per household (in 2012 dollars)

Sources:

[a] Jones & Stokes Associates, Inc. 1990.

[b] Olsen et al. 1991.

[c] Loomis 1996.

[d] RTI International 2012.

Effects of Commercial and Sport Fisheries on Regional Economies

This section addresses potential effects on fishery-dependent regional economies from flow-related effects on recreational and commercial fisheries. The analysis considers potential changes in fisheries associated with improved conditions for native fisheries affected by LSJR Alternatives 2, 3, and 4.

Potential effects on regional economic conditions caused by changes in fishery conditions in the three tributaries and the LSJR can be viewed by tracing the underlying relationship between fishing activity (both commercial and sport fishing activity) and regional economies affected by this activity. Conceptually, local and regional economic activity generated by the use of fishery resources can be followed from the availability of (and changes to) the resources to the generation of employment and income within a region. Management of commercial and sport fishery resources in marine waters, as well as those at freshwater reservoirs and rivers, affects the amount and type of commercial and sport fishing activity at different fishing areas. Changes in the availability and management of fishing facilities result in changes in sport fishing activity, which, in turn, typically alters the location and level of fishing-related spending. For example, a highly developed facility, such as a marina with a resort and restaurants, boat slips, and boat launching facilities, may attract large numbers of anglers from outside the region who spend money on accommodations, restaurant meals, boat rentals, and fuel in the vicinity of the facility. Alternatively, an undeveloped campground on a reservoir may attract relatively few anglers from outside the local area, resulting in fishing-related spending that largely consists of food and gasoline purchases made at home or en route to the site.

As discussed previously in this section, fisheries-related activities in the study area would likely increase under LSJR Alternatives 2, 3, and 4 in response to enhanced populations of salmon and other native fish species. LSJR Alternative 2 would likely have a relatively minor impact on fisheries-related economic activity, but the economic benefits would grow under Alternatives 3 and 4 as salmon populations further increase. However, the overall economic and employment effects for most businesses directly and indirectly linked to fishing activity in the study area would likely not be substantial. Some small, fishing-dependent communities, where fishing-related activity contributes more than just minimally to local economic activity, may see greater economic benefits.

As discussed in Section 20.3.5, *Effects on Fisheries and Associated Regional Economies*, implementation of the San Joaquin River Restoration Program[14] (SJRRP) is expected to have fishery-related benefits, which, in turn, would benefit fishery-dependent communities within the study area. When considered in conjunction with the SJRRP, the plan amendments may have a more substantial effect on economic activity for fishery-dependent communities in the study area. In addition, greater economic activity could also bring additional economic opportunities (i.e., jobs, income) to these areas.

Adaptive Implementation

Adaptive implementation would take place based on required evaluation of current scientific information and would need to be approved as described in Appendix K, *Revised Water Quality Control Plan.* Accordingly, the frequency and duration for any use of adaptive implementation

[14] Implementation of the settlement and the Friant Dam release flows required by the San Joaquin River Restoration Program are expected to increase the existing SJR flows at Stevinson in the near future

methods 1, 2, 3, and 4 cannot be determined at this time. Adaptive implementation method 1 potentially has the greatest likelihood of changing economic effects as it would allow the unimpaired flow requirements to be increased or decreased by up to 10 percent from the objective unimpaired flow (with a minimum requirement of 20 percent and a maximum of 60 percent unimpaired flow). For LSJR Alternative 2, an increase from 20 percent to 30 percent of the unimpaired flow would likely result in different effects as compared to those shown above for LSJR Alternative 2, depending upon flow conditions and frequency of the adjustment. As such, under LSJR Alternatives 2 or 3, if the percentage of unimpaired flow is increased with adaptive implementation method 1, regional economic effects related to enhanced fisheries could increase more than conditions without adaptive implementation. Under LSJR Alternatives 3 and 4, if the percent of unimpaired flow could be reduced with adaptive implementation method 1, if there were no effect on fish, and as such, use and non-use benefits and regional economic conditions would not be expected to change much compared to conditions without adaptive implementation.

20.3.6 Effects on Recreational Opportunities, Activity, and the Regional Economy

Introduction

As described in Chapter 10, *Recreational Resources and Aesthetics*, changing flow regimes and reservoir-storage levels may potentially affect the timing, duration, and quality of recreational opportunities. Therefore, implementation of LSJR Alternatives 2, 3, and 4 may affect recreational activities through adoption of new and updated water management practices that could alter reservoir-storage levels and downstream releases.

Changes in reservoir-storage levels could affect recreational activities primarily by reducing access to boat ramps, marinas, and boat-in campgrounds; reducing water surface area for boaters; and exposing large areas of shoreline, negatively affecting aesthetic quality and access for picnickers, swimmers, and shore side users. Changes in downstream flows could affect both water-dependent and water-enhanced recreation in the Stanislaus, Tuolumne, and Merced Rivers and potentially along the LSJR. Furthermore, altering the timing, duration, and quality of recreational opportunities could affect the value that recreationists place on the activities and, in turn, change the frequency with which these recreational resources are used.

As described in Gallo (2002), recreational opportunities can generate economic benefits through two pathways. The first pathway is the value (net benefit) to those participating in the activities, as indicated by their willingness to pay over and above trip expenditures (i.e., transportation and parking fee costs) for these recreational opportunities. This measure of value depends, to a large extent, on the quality of the recreation environment. For example, wildlife watching is more rewarding when there is more viewable wildlife, creating greater value in that environment. Improving the quality of the environment can augment recreational benefits, which is typically measured by the increase in willingness to pay (i.e., monetary value over and above trip-related expenditures) for the recreational activities.

The second pathway to assess the economic contribution of recreational opportunities is the beneficial impacts that recreation-related spending by nonresidents of a region brings to a local economy where the nonresidents are visiting. Nonresidents are particularly important in this regard because their economic activities may not otherwise occur within the region. More frequent trips by visitors means additional spending in the region. These types of economic effects are typically referred to as *regional economic impacts*, where a region can range from a small geographic area (e.g., a county or city) to a large multi-county area. While these effects do not directly affect residents, increased visitor spending does support local economic activity. Although not considered here, those who do not directly use the improved environment for recreational activities may still benefit just from knowing that biodiversity is enhanced and from other environmental enhancements that contribute to amenity values (i.e., non-use value).

The study area for evaluating recreation-related economic effects in this analysis includes the reservoirs (i.e., New Melones, New Don Pedro, and Lake McClure) and the three eastside tributaries (Stanislaus, Tuolumne, and Merced Rivers) extending from the reservoirs, downstream, to the LSJR. (Potential economic effects of LSJR Alternatives 2, 3, and 4 on fishing are discussed in Section 20.3.5, *Effects on Fisheries and Associated Regional Economies.*) This section begins by presenting a description of baseline conditions, including information on recreational activity in the study area and its relationship to river flows and reservoir levels. Then, potential effects of the LSJR alternatives on recreational opportunities, participant benefits and recreation-related spending are assessed. This assessment is followed by a qualitative assessment of potential recreation-related regional economic impacts on the regional economy.

Description of Baseline Conditions

In this analysis, estimates of existing recreational use help establish a baseline of potentially affected recreational activity and associated spending in the study area. Table 20.3.6-1 presents estimates of baseline recreational use, in terms of annual visitor days, at recreation areas in the study area. Approximating recreation activity at the specific locations identified in Table 20.3.6-1 is useful for evaluating the relative economic importance of these recreational areas within the surrounding region. Although some of the values in Table 20.3.6-1 are somewhat dated, these estimates are considered to reasonably characterize existing recreational activity because of the many factors affecting recreational use levels over time, both positively and negatively.

As shown in Table 20.3.6-1, annual recreational use at New Melones Reservoir, Don Pedro Reservoir, and Lake McClure totals about 2.4 million visitor days, of which it is assumed that residents and non-residents each account for about 50 percent of the total. Annual recreational activity along the Stanislaus, Tuolumne, and Merced Rivers and the LSJR totals an estimated 710,200 visitor days. Although the proportion of visitor days to the eastside tributaries made by residents or nonresidents is unknown, it is assumed to be similar to the proportions at the reservoirs (50 percent made by residents and 50 percent made by non-residents of the study area).

For this analysis, recreational activities are grouped according to flow ranges developed by Whittaker and Shelby (2003) to support different types of river recreation activities. Based on this study, low-range flow activities, like swimming, account for about 25 percent of all use; that mid-range flow activities, including motorized boating, rafting, and kayaking, account for about 60 percent of all activities; and that high-range flow activities, such as advanced kayaking and rafting, account for about 15 percent of all activities.

Table 20.3.6-1. Estimated Use (in Visitor Days) of Affected Recreation Areas, by Watershed

Watershed/Recreation Area	Counties	Estimated Visitor Days (Year)	Type of Activities
Stanislaus	San Joaquin, Calaveras, Tuolumne, Stanislaus		
New Melones Reservoir		800,000 (2011)[a]	All activities
Stanislaus River		330,200 (1999)[b]	Fishing, camping, swimming, whitewater boating, water-enhanced activities
		5,200 (average of 1999/2000)[c]	Fishing only
Tuolumne	Tuolumne, Stanislaus		
Don Pedro Reservoir		244,000 (peak season, April through September - 2012)[d]	All activities
Tuolumne River		150,000 (1992)[e]	Boating, fishing, swimming, rafting, wildlife viewing
		34,900 (2000)[f]	Fishing only
Merced	Mariposa, Merced		
Lake McClure		1,400,000 [2010][g]	All activities (camping, boating, swimming, hiking, bicycling, house boating, fishing)
Merced River		73,000 [1999][h]	Kayaking, rafting, canoeing, water-enhanced activities
Lower San Joaquin River	San Joaquin, Stanislaus, Merced	157,000 [2001][i]	Boating and fishing
		57,500 [2000][j]	Fishing only

Sources:

[a] USBR 2011; use is measured in 12-hour recreation visitor days (RVDs).

[b] MacAfee 2000.

[c] Derived based on information from CDFG 2001a and 2001b; includes reach of the river from Goodwin Dam (Tulloch Reservoir) downstream to the McHenry Avenue bridge near Meyers.

[d] TID & MID 2013.

[e] USBR 1999; use is measured in 6-hour RVDs.

[f] Derived based on information from Gallo 2002. Note that estimates in Table 20 of the Gallo report were adjusted to account for all visitors; as stated in the referenced report, county residents account for an estimated 51 percent of all recreation days.

[g] As cited in Merced ID 2014.

[h] As cited in USBR 1999; use is measured in 6-hour RVDs.

[i] As cited in USBR 2001; use is measured in 6-hour RVDs.

[j] Derived based on information from Gallo 2002. Note that estimates in Table 20 of the Gallo report were adjusted to account for all visitors; as stated in the referenced report, county residents account for an estimated 51 percent of all recreation days.

Residents of the study area who use the rivers and reservoirs for recreational activity are estimated to receive, on average, $25 (in 2007 dollars) per visitor day in net benefits, as measured by their willingness to pay for these recreational opportunities over and above their trip-related expenditures (Hanemann 2005). Non-residents of the region who use the rivers and reservoirs for recreational activity are estimated to spend, on average, $30 (in 2007 dollars) per visitor day (Hanemann 2005). Based on information presented in Table 20.3.6-1, the three eastside tributaries and their upstream rim reservoirs account for about 3.5 million visitor days per year. Assuming that half of the visitors to the region are residents of the region and the other half are non-residents, the residents spend an estimated $43.7 million per year and the non-residents spend about $52.5 million per year, which have additional benefits for residents in terms of generating local economic activity.

Effects of the LSJR Alternatives

This section describes the potential effects on recreational activity and associated economic effects from changes in recreational opportunities in the study area under the LSJR Alternatives 2, 3, and 4. The assessment is based primarily on predicted flow differences between modeled baseline conditions and the LSJR alternatives, as presented in Chapter 10, *Recreational Resources and Aesthetics* (Tables 10-4 through 10-6), and on how changes to reservoir storage levels could impact recreational opportunities and the use of recreational facilities at affected reservoirs (Tables 10-8 through 10-13).

Effects on River Recreational Activities

This analysis uses hydrology modeling results for the LSJR alternatives to measure the frequency of flows within particular ranges that support different types of river recreational activities, as presented in Chapter 10, *Recreational Resources and Aesthetics*, (see Tables 10-4 through 10-6). Although optimal flows vary for each river due to hydrologic and geomorphic conditions, flows can generally be classified into the following flow ranges for purposes of evaluating potential effects on certain types of recreational activities.

- Low-range flows (less than 500 cfs) for supporting swimming, floating, canoeing and kayaking.
- Moderate-range flows (between 500 and 1,500 cfs) for supporting motorized boating, rafting, and kayaking (but may still support swimming, wading, and floating, particularly in certain locations).
- High-range flows (between 1,500 and 2,500 cfs) for supporting advanced rafting or kayaking.

A flow above 2,500 cfs is generally considered unsafe for recreational activities, although advanced whitewater rafting and kayaking often still take place.

Although impacts on recreational opportunities and activities, and associated economic effects, would be relatively minor under all LSJR alternatives, these effects would vary by alternative and river.

Under LSJR Alternative 2, the frequency of low-range, moderate-range, and high-range flows on the Stanislaus, Tuolumne, and Merced Rivers would not substantially change. The Merced and Tuolumne Rivers would experience a slight decrease in the frequency of low-range flows when compared with modeled baseline conditions (see Tables 10-4 and 10-5); however, a slight increase in the frequency of moderate flows could offset the impact of changes in the frequency of low-range flows on recreation activity on these rivers. The Stanislaus River would experience even less change in the frequency of low-range, moderate-range, and high-range flows (see Table 10-6). Overall, changes in flows under LSJR Alternative 2 would not be expected to substantially impact recreational activities on these rivers.

Under LSJR Alternative 3, the frequency of low-range flows on the Merced River would likely decrease, while the frequency of moderate-range and high-range flows would be expected to increase. ~~Overall, recreational opportunities could be slightly greater, primarily because activities associated with the more frequent moderate-range (500–1500 cfs) and high-range (1,500–2,500 cfs) flows could more than offset the expected decrease in recreation activity supported by low-range (<500 cfs) flows (see Table 10-4). Conversely, t~~The frequency of low-range and moderate-range flows on the Tuolumne River would likely decrease, whereas the frequency of high-range flows would be expected to increase. There would also be an increased frequency of flows over 2500 cfs that do not support most recreational activities. Overall, recreational opportunities on the Tuolumne River could slightly decrease as reduction in recreation activity supported by low-range and mid-range flows would be greater than~~could more than offset~~ the increased activity supported by high-range flows (see Table 10-5). Finally, on the Stanislaus River there would be minor shifts in the frequency of low-range, moderate-range, and high-range flows and, therefore, recreation activity would be more or less unchanged under LSJR Alternative 3 (see Table 10-6).

Under LSJR Alternative 4, flow frequency impacts would be similar to those under LSJR Alternative 3. On the Merced River, the frequency of low-range flows would likely decrease while the frequency of moderate-range and high-range flows would increase~~, resulting in slightly greater recreational opportunities and activity~~ (see Table 10-4). On the Tuolumne River, the frequency of low-range and moderate-range flows would likely decrease slightly, while the frequency of flows over 2500 cfs would increase. In response, recreational opportunities and activities could slightly decrease on the Tuolumne River because activities that rely on low-range and moderate-range flows could not be performed as often (see Table 10-5). Finally, on the Stanislaus River the frequency of low-range and moderate-range flows would slightly decrease, whereas the frequency of flows over 2500 cfs would increase. As a result, recreational opportunities on the Stanislaus River may slightly decrease, as activities that rely on low-range and moderate-range flows could not be performed as often (see Table 10-6).

In summary, flow changes associated with LSJR Alternatives 2, 3, and 4 would be expected to result in minor increases or decreases in recreational opportunities and activities in the three eastside tributaries. Low-range flows would likely occur less frequently under the LSJR alternatives, while high-range flows would likely occur more frequently. In turn, there may be slight shifts in the types of recreational activities performed, depending on historical use of each river. As flows shift higher more people may participate in boating rather than wading, but overall recreational opportunities should remain more or less unchanged. Consequently, benefits to local residents and potential effects on visitor spending in the region associated with recreational activity on the tributaries would be relatively unchanged under LSJR Alternatives 2, 3, and 4.

Effects on Reservoir Recreational Activities

As discussed in Chapter 10, *Recreation Resources and Aesthetics*, operational changes at the three rim reservoirs (New Melones Reservoir, Don Pedro Reservoir, and Lake McClure) under LSJR Alternatives 2, 3, and 4 would be expected to have less than significant (and presumably slight) effects on recreational opportunities and associated activity. Overall, recreational opportunities and use at all three reservoirs would be expected to decrease slightly or remain generally unchanged under LSJR Alternatives 2, 3, and 4 (see Tables 10-8 through 10-13). Under LSJR Alternative 2, the relatively small changes in reservoir elevations would not be expected to affect levels of recreational activity at any of the reservoirs. Under LSJR Alternative 3, the predicted changes in reservoir elevations would not be expected to substantially affect recreational use levels at any of the three rim reservoirs; however, elevation shifts at New Don Pedro Reservoir would be more noticeable than at the other two reservoirs, although recreation opportunities and associated activities still would not be expected to decrease substantially (see Tables 10-10 and 10-11). Finally, under LSJR Alternative 4, predicted changes in reservoir elevations would still not be expected to substantially affect recreational use levels at any of the three rim reservoirs.

Because access to recreational facilities~~water levels in all three reservoirs~~ would not change significantly under the LSJR alternatives, the impacts on recreational opportunities at the reservoirs would likely be small. Consequently, benefits to local residents and effects on visitor spending in the region associated with reservoir recreation activity would be relatively unchanged under LSJR Alternatives 2, 3, and 4.

Potential Effects on the Regional Economy

Management of recreational resources in the plan area, including reservoir-elevation levels and river flows, affects recreational opportunities and the number of visitors and types of activities that they take part in. For example, a highly developed recreation area, such as a reservoir that includes a resort with restaurants, boat slips, and boat launching facilities, may attract a large number of visitors from outside the region who spend money in the vicinity of the recreation area. Alternatively, an undeveloped campground may attract relatively few visitors from outside the local area, while local visitors will primarily purchase food and gasoline at home or en route to the site. Conceptually, local and regional economic activity generated by recreational spending can be traced from the use of recreational resources to the generation of employment and income by recreational activities within the region.

Although not quantified for this analysis, potential regional economic effects associated with changes in recreational activity on the three tributaries and rim reservoirs are expected to be minor. LSJR Alternatives 2, 3, and 4 would likely have only minor effects on recreational activity and spending at the eastside tributaries and their associated rim reservoirs. The greatest potential effects would be associated with recreational activity on the Tuolumne and Merced Rivers where implementation of the LSJR alternatives could reduce the frequency of low range flows (<500 cfs), which are optimal for relatively calm water activities such as swimming and wading. In turn, LSJR Alternatives 2, 3, and 4 could also have relatively minor impacts on regional economic activity, as the number of non-local visitors may slightly decrease.

As identified in Section 20.3.5, *Effects on Fisheries and Associated Regional Economies,* implementation of the SJRRP is expected to provide additional recreational opportunities in the SJR Watershed that would benefit the local and regional economy. It has been estimated that the additional recreational activity (including fishing) provided by the SJRRP could support 475 recreation industry jobs annually by 2025 (Kantor 2012). The stimulus of economic activity from the SJRRP would result in a cumulative economic benefit to the local and regional economy within the SJR Watershed.

Adaptive Implementation

Adaptive implementation would take place based on required evaluation of current scientific information and would need to be approved as described in Appendix K, *Revised Water Quality Control Plan.* Accordingly, the frequency and duration for any use of adaptive implementation methods 1, 2, 3, and 4 cannot be determined at this time. Adaptive implementation method 1 potentially has the greatest likelihood of changing economic effects as it would allow the unimpaired flow requirements to be increased or decreased by up to 10 percent from the objective unimpaired flow (with a minimum requirement of 20 percent and a maximum of 60 percent unimpaired flow); however, this would likely result in tradeoffs between river and reservoir recreation economic effects. Methods 2 and 3 could change the timing of the flows and if more water is held in the reservoirs for later release, this might help reservoir and maybe river recreation. Overall, given the very small changes in recreational opportunities, it is not expected that adaptive implementation would substantially change the effects presented above.

20.3.7 Non-Flow Measures

This section provides cost estimates associated with implementing non-flow measures that affected entities or resource agencies (e.g., CDFW) may undertake between the rim dams on the Stanislaus, Tuolumne, and Merced Rivers and the confluence of the LSJR. These measures would inform the body of scientific information potentially used to make adaptive implementation decisions under LSJR Alternatives 2, 3, and 4. The costs described are based on reference projects and incorporate standard assumptions regarding the type and potential location of non-flow measures. These measures, which are grouped into habitat restoration, fish passage improvements, and other actions, include the following.

Habitat Restoration

- Floodplain and riparian habitat restoration.
- Gravel augmentation.
- Enhanced in-channel complexity.
- Improve temperature conditions.

Fish Passage Improvements

- Fish screens (screen unscreened diversions in tributaries and LSJR).
- Permanent physical barrier in the southern Delta.

Other

- Predatory fish control.
- Invasive species control (i.e., plant control).

The cost information described below is summarized from information presented in Chapter 16, *Evaluation of Other Indirect and Additional Actions*. The availability of information pertaining to the costs associated with several of the non-flow measures identified in Chapter 16 is very limited as such is not presented here. This includes reduction of vegetation disturbing activities and removal of human-made barriers to fish migration. In particular, the costs associated with the removal or modification of human-made barriers to fish migration are not presented below because the feasibility of this non-flow measure is unknown, as discussed in Chapter 16.

Floodplain and Riparian Habitat Restoration

Floodplain and riparian habitat restoration can be achieved through different approaches. While site specific conditions influence the cost of each approach, removal of riprap or other bank protection and active plantings are considered generally lower cost approaches, as compared to creating or expanding natural or engineered floodways, modifying river and floodplain geometry, or hydrologic reconnection of historical floodplains through levee breaches and/or setbacks. Removal of riprap and active plantings typically require fewer feasibility and design studies, fewer permits, and the involvement of fewer responsible agencies, and require limited adaptive management and mitigation monitoring plans to evaluate the effectiveness of the projects. In addition, removal of riprap and active plantings are less likely to require the purchase of property, which can be a substantial cost associated with floodplain and riparian habitat restoration.

Examples of floodplain and habitat restoration projects include the following.

- The Lower San Joaquin River Floodplain Protection and Restoration Project that acquired a total of 223.54 acres of wildlife habitat adjacent to the SJR and eastside tributaries for preservation and future enhancement of riparian and wetland habitats for an estimated cost of $1.1 million.
- The Basso Bridge Ecological Reserve and Merced River Ranch Land Acquisitions on the Merced River were purchased for approximately $830,000 in 1997 to protect spawning riffles and enhance riparian species. At the time, the purchase was simply to secure the land, with no active restoration planned. Depending on the size, scale, and location of a project, levee breaches can be very costly.
- The Cosumnes River floodplain restoration project where the U.S. Army Corps of Engineers breached and abandoned 5.5 miles of levees to allow the river to flow into the floodplain as a result of the 1997 floods. This project cost an estimated $1.55 million.

Gravel Augmentation

The cost of gravel augmentation is substantially influenced by site specific conditions. Generally, gravel injection is a low cost approach, whereas hydraulic structure installation is a higher cost approach. The costs associated with gravel injection primarily relate to fuel costs for gravel delivery. These costs are estimated at $15–$20 per ton, plus $0.16–$0.20 per mile to transport. Gravel injection is typically used where flows are high enough to mobilize the material, such as downstream of a reservoir or at locations with easy access to the river for gravel placement.

Spawning bed enhancement is more expensive than gravel injection as it typically requires engineering design. The cost of spawning bed enhancement, which does not include engineering design, is estimated at $25–$33 per ton ($19–$25 per cubic yard). Choosing an appropriate location and gravel mix is crucial for successful augmentation.

Hydraulic structure installation is generally the most expensive gravel augmentation approaches because it requires engineering analysis and in-stream work with heavy equipment that requires permits from different agencies that can take 6–18 months to obtain. Project costs for this approach can range from $1,500 to $100,000 depending on the complexity of the project, project length and materials.

The costs associated with the gravel augmentation approaches described above do not include maintenance and monitoring costs, which depend on the approach selected. Examples of gravel augmentation projects are shown in Table 20.3.7-1.

Table 20.3.7-1. Central Valley Project Improvement Act[a] Spawning and Rearing Habitat Restoration Projects

Project	Description	Construction/ Implementation[b]	Monitoring + Adaptive Management[c]
Sacramento River Project	Annual placement of 10,000 tons of gravel for spawning and rearing habitat restoration – between Clear Creek & Keswick Dam	$795,000	$120,000
American River Project	Annual placement of 7,000 tons of gravel at Nimbus Basin on the American River	$745,000	$6,000 + $100,000
Stanislaus River Project	Annual placement of 3,000 tons of gravel at the Two Mile Bar or Upper Honolulu Bar along the Stanislaus River	$670,000	$15,000
Program Management & Support (for three projects over 2 fiscal years)		$450,000	

Source: Hannon et al 2013.

[a] The Central Valley Project Improvement Act of 1992 (CVPIA) created a collaboration of agencies, including the Department of the Interior, USBR, and U.S. Fish and Wildlife Service in collaboration with state and local governments, tribes and stakeholders.

[b] Costs provided represent the requested funding for fiscal year 2015–2016. Costs represent the amount being cost-shared between the state and federal agencies involved in implementing the CVPIA.

[c] The adaptive management cost is intended for building a model and assembling information to develop model parameters for identifying restoration actions and monitoring priorities for the American River Project.

Enhanced In-Channel Complexity

The costs for enhancing in-channel complexity through the installation of cover structures, boulder structures and log structures depend primarily on the size of the stream, channel hydrology, complexity of the design, site accessibility, cost of materials, and equipment needed to transport and install the material. One of the primary costs associated with enhancing in-channel complexity is that cost for large woody materials (e.g., logs), which is highly dependent on the type of tree selected. For example, Washington Douglas Fir is $100 per 1,000 board feet (ft), whereas the cost for California Redwood is about $510 for the same amount. The National Resources Conservation Services cost share practice standard estimates that the material cost for large woody material ranges between approximately $1,900 per acre and $924 per acre (Guhin and Hayes 2015). The range in approximate costs (low–high) based on stream size is shown in Table 20.3.7-2.

Table 20.3.7-2. Engineered Log Structures and Large Woody Debris—Cost Estimates

Stream Size (cfs)	Cost[a] ($ Thousands) (Low–High)
Small stream (1–100)	10–40
Medium stream (101–2000)	20–70
Large stream (2000+)	10–80

Source: Thomson and Pinkerton 2008.

cfs = cubic feet per second

[a] Estimates identified above include construction, design, permitting, basic monitoring and routine maintenance (up to 2 years), reestablishing site to prior conditions and project management costs. These estimates assume purchased materials.

As part of the Lower Mokelumne River Joint Settlement Agreement (JSA) between East Bay Municipal Utilities District, the USFWS and CDFW, $25,663 in funding to the University of California, Davis was approved in 2008 to conduct a study along the Lower Mokelumne River to determine the effectiveness of large woody materials in aiding fish habitat. The project consisted of placing 542 large wood pieces along 4.8 miles on the Lower Mokelumne River directly below the Camanche Dam where the flows averaged 350 cfs.

Improve Temperature Conditions

Cost information concerning actions to improve temperature conditions, such as installation or modification of selective withdrawal structures, is limited. One factor that substantially affects the cost is construction. Examples of the costs of temperature improvement projects include the following.

- The Lake Natoma Temperature Curtains Pilot Project estimated the cost to be $1,960,196 for a 3-year study that included the installation of 2 curtains (one 700-ft long with a depth of 15-20 ft, second curtain 600-ft long with a depth of 20–25 ft). The costs associated with this pilot project included: design, permitting and environmental review, project management, temperature monitoring, project installation and removal, and project analysis and reporting.
- A temperature curtain was installed at Whiskeytown Lake in 2011 for a cost of $3 million. The new temperature curtain replaced a curtain from 1993 that had deteriorated and was no longer functional. The temperature curtain is 2,400 ft long and drops into the lake 110-ft and is anticipated to achieve a 2–4 degree drop in water temperature.

Fish Screens (Screen Unscreened Diversions in Tributaries and Lower San Joaquin River)

The costs for fish screens vary considerably depending on the size of the existing intake. Typically, screening smaller or private intakes that primarily serve agricultural uses are less costly as compared to the costs for screening large intake projects that primarily serve municipal and industrial uses. Agricultural diversions (with an average diversion rate of 10 cfs) have an estimated cost of $75,000 per diversion (unit cost of $7,500/cfs). Capital costs for agricultural diversion screens in the western United States can range between $3,000 and $20,000 per cfs, with maintenance and operations costs ranging between $3,000 and $5,000 per year.

The Anadromous Fish Screen Program (AFSP) established under the CVPIA has funded several fish screen projects in California. Recent projects include the following.

- Natomas Mutual Sankey Fish Screen Project (total cost of about $46.0 million) located off the left bank of the Sacramento River replaced existing unscreened diversions with a consolidated 434 cfs fish screen and intake facility.
- RD2035/Woodland Davis Clean Water Agency Joint Intake and Fish Screen (estimated cost of $44 Million) located off the right bank of the Sacramento River replacing unscreened diversion with a consolidated 400 cfs fish screen and intake facility to provide water to irrigate approximately 15,000 acres of crops and serve the cities of Davis, Woodland, and the University of California, Davis campus.

Another large municipal intake in the Central Valley that has been screened is the Davis Ranches Fish Screen Project, located in Colusa County at river mile 132.5. This fish screen consists of installing a self-cleaning, cylindrical, brushed intake fish screen with a retrieving system. The cost for this project is an estimated $414,900, which includes planning, design, project management, construction, installation, and monitoring. Table 20.3.7-3 provides a more detailed breakdown of the costs for the Davis Ranches Fish Screen Project.

Table 20.3.7-3. Design and Construction Costs for Davis Ranches Site 2, Pumps 4 & 5 Project

Cost Category	Davis Ranches Site 2, Pumps 4 & 5[a] ($)
Design & Construction of fish screen	310,964
Eng. Review, Inspection & documentation, permit costs	24,000
Accounting & project management & monitoring	79,940
Total	**414,904**

Source: Griffith 2001.

a Costs represent the total costs over 2 years.

Physical Barrier in the Southern Delta

A permanent operable barrier (gate) at the Head of Old River (HOR) is currently proposed as part of the California WaterFix to prevent out-migrating salmonids from entering Old River in the spring and improve adult passage conditions and water quality (dissolved oxygen) in the SJR (particularly the Stockton Deep Water Ship Channel) in the fall. DWR (2015) produced a report in response to requirements of the NMFS 2009 Biological Opinion on the long-term operations of the CVP and SWP, discussing engineering solutions to reduce diversion of emigrating salmonids. This report discusses the potential engineering solutions for HOR and four other areas in the Delta. The permanent, operable HOR gate is estimated to cost $43,200,000 for construction and $200,000 for operation and maintenance.

Predatory Fish Control

Predatory fish control can be accomplished through direct removal, or by the elimination/modification of habitat conducive to predators. Direct removal of predators is generally less expensive than the elimination/modification of habitat, as described below.

No long-term predator removal programs are in effect in the Delta; however, such programs have been implemented in rivers located in the western U.S. One example is the Upper Colorado Endangered Fish Recovery Program (Recovery Program), which was established in 1988 and is a partnership of local, state, and federal agencies, water and power interests, and environmental groups working to recover endangered fish in the Upper Colorado River. The Recovery Program implements long-term nonnative fish management by removing the most problematic nonnative fish predators from rivers. Among the nonnative fish management projects funded within the Recovery Program are the middle Yampa River northern pike and smallmouth bass removal and evaluation project; and the removal of smallmouth bass in the Upper Colorado River between Price-Stubb Dam near Palisade, Colorado and Westwater, Utah project. The total annual cost of each project from 2010 to 2015 ranged between $157,000 and $214,000.

The costs of habitat modification projects designed to reduce predator habitat in the Delta and upstream tributaries have been estimated as part of several recovery programs including: the Golden Gate Salmon Association Salmon Rebuilding Plan, the NMFS Final Recovery Plan (Recovery Plan), the Tuolumne River Corridor Restoration Plan, and the San Francisco Estuary Project 2007 Comprehensive Conservation and Management Plan. The costs of these projects are influenced by site-specific conditions and depend on the extent of modifications needed. Costs can vary from $100,000–$300,000 per site for reducing predator habitat at large screen structures, to more than $4.6 million for filling a gravel pit to reduce/eliminate habitat favored by predatory bass species, and replacing with high quality chinook salmon habitat. On a broader scale, the costs associated with Recovery Plan implementation projects designed to minimize predation at weirs, diversions, and related structures in the Delta are about $50 million over a period of 50 years.

Invasive Aquatic Vegetation Species Control

The California Department of Boating and Waterways (DBW) implements an Aquatic Weed Control Program, which includes a program to control water hyacinth. Established in 1982, the California state legislature designated DBW as the lead state agency to cooperate with other state, local, and federal agencies in controlling water hyacinth in the Delta, its tributaries, and Suisun Marsh. The total annual cost of DBW's Aquatic Weed Control Program for the years of 2001 through 2007 was between $6.2 and $7.9 million.

20.4 Southern Delta

Consistent with requirements in Water Code Section 13241, this section presents results from evaluating potential costs of compliance with salinity water quality objectives in the southern Delta. Potential effects on ratepayers and the regional economy resulting from higher treatment costs also are considered.

20.4.1 Costs of Methods of Compliance

This section includes a summary of information presented in Chapter 16, *Evaluation of Other Indirect and Additional Actions,* on the costs for WWTPs to comply with salinity objectives in the southern Delta. Because the actual methods of compliance ultimately used are necessarily site- and discharge-specific, only general estimates of compliance costs can be developed for this assessment; as such, this section presents cost ranges. A more precise evaluation of the actual costs is neither required in this plan-level analysis, nor is it feasible without specific information about projects that would be selected by project proponents as they move toward compliance.

As discussed in Chapter 16 and in Chapter 13, *Service Providers,* compliance costs in the southern Delta would be attributable to complying with NPDES based on salinity objectives that could be developed and applied to WWTP dischargers as a result of implementing the southern Delta water quality (SDWQ) alternatives. Appendix K states that desalination of effluent through RO treatment is currently not a feasible technology to control salinity in the Delta. It also requires an evaluation of whether technological or economic changes have made previously deemed infeasible upgrades to control salinity in effluent feasible. Where it does become feasible, ~~T~~the Cities of Tracy and Stockton and Mountain House CSD may be required to comply with traditional numeric effluent limitations and may need to modify wastewater treatment processes or domestic water supply cycles to comply with SDWQ Alternative 2.~~ and t~~Those service providers, plus the City of Manteca, may need to modify treatment processes to comply with the No Project Alternative (LSJR Alternative 1 and SDWQ Alternative 1). The following three methods of compliance, which are not intended to be limiting but rather as a sampling of methods available during different stages of the domestic water supply cycle or wastewater treatment cycle, are considered the most likely methods to be implemented by WWTPs to comply with potential NPDES.

- **Developing new source water supplies**. By reducing reliance on highly saline groundwater for potable water demand, salinity discharged to the southern Delta would decrease.
- **Implement salinity pretreatment programs.** Target salinity loading in the sewer collection systems by removing water softeners and reducing salinity discharged to the sewer collection system from commercial, industrial, or institutional dischargers.
- **Desalination at the WWTP.** Remove salts at the WWTP to improve treated water quality and meet waste discharge permit limits.

Additionally, under the program of implementation for SDWQ Alternatives 2 or 3, agricultural dischargers may implement agricultural return flow salinity controls, such as changing the timing of current releases of discharges into the southern Delta. Furthermore, SDWQ Alternatives 2 or 3 could require additional studies of circulation and monitoring of water levels in the southern Delta. Additional studies and monitoring may indicate the continued need for modifying the temporary barriers in the southern Delta. Alternatively, under the program of implementation for SDWQ Alternatives 2 or 3, the State Water Board may determine that installing low-lift pumping stations at the temporary barriers is feasible. These potential costs of these additional methods of compliance are described below.

New Source Water Supplies

Water supplies with high salinity content can contribute to elevated salinity discharges to the southern Delta. Generally, water purveyors in the plan area (e.g., the Cities of Stockton, Tracy, Manteca, and Modesto) rely on a combination of surface water and groundwater to meet potable water demand. Groundwater is typically more saline than surface water in the SJR Basin.

One method to reduce salinity discharges is to use more high quality water (i.e., surface water) to meet water demands. To obtain more surface water, a water purveyor may need to enlarge existing structures (water intake, treatment facility, and pipelines and pumps), or build new structures.

One comparable project is the Davis-Woodland Water Supply Project (DWWSP). The DWWSP will construct a surface water intake, water treatment plant, pump stations, storage tanks, and associated transmission lines to develop 45,000 AF/y of new, high quality water resources on the Sacramento River. The DWWSP is in the construction phase, which began in April 2014, and is estimated to be completed in September 2016. The estimated project costs are detailed in Table 20.4.1-1.

A second comparable project is the Delta Water Supply Project (DWSP), which is being completed by the City of Stockton and will divert water pursuant to Water Code, Section 1485. Water Code, Section 1485 allows any municipality disposing of treated wastewater into the SJR to seek a water right to divert a like amount of water, less losses, from the river downstream of the point of its wastewater discharge. The DWSP will develop 33,600 AF/y of new water resources in the Delta. A new surface water intake, water treatment plant, pump stations, and pipelines have been constructed. The estimated costs for this project are also detailed in Table 20.4.1-1.

Table 20.4.1-1. Design and Construction Costs for the Davis-Woodland Water Supply Project and Delta Water Supply Project

Cost Category	DWWSP (millions)	DWSP (millions)
Design and Construct Intake	$15.6	$22.3
Design and Construct Treatment Facilities and Pipelines	$236.9	$176.6
Project Administration[a]	$33.1	$14.2
Other Local Costs[b]	$51.4	$21.6
Total	$337	$234.7

Source: Price pers. comm.

Note: All costs in 2010 dollars.

DWWSP = Davis-Woodland Water Supply Project

DWSP = Delta Water Supply Project

[a] Project Administration includes environmental and construction permitting, land acquisitions, rights of way, pre-design, agency administration and contingency, program management, water rights permits, and water supply acquisition.

[b] Other Local Costs includes costs to the water purveyor not included in the project, but necessary to integrate the project into the existing infrastructure.

Based on the estimated costs of these two projects, the planning, design, management, and construction of facilities needed to develop 33,600 AF/y (DWSP) and 45,000 AF/y (DWWSP) of new surface water resources in the Delta would be an estimated $337 million and $234.7 million, respectively. These examples of costs for developing new water supplies do not represent potential total costs if all water purveyors in the southern Delta portion of the plan area were to develop new, higher-quality water supplies. To potentially offset or reduce total project costs, the regional water boards (e.g., Central Valley Regional Water Board) and the California Department of Public Health offer grants and low-interest financing.

Salinity Pretreatment Programs

A salinity pretreatment program would target salinity loading from domestic (residential) and industrial and commercial sources in a wastewater service provider’s wastewater collection system.

It would provide salinity source controls at different locations within a service district to reduce the overall salt loading into the sewer system.

Domestic water similar to that found in the southern Delta may have a high concentration of minerals (typically magnesium and calcium). Water softeners are frequently used in residences to remove these minerals. During a water softener's recharge cycle, brine is used to clean the system and remove magnesium and calcium that accumulate in the mineral exchange tank. The recharge water, with suspended minerals, is then discharged to the wastewater collection system. This brine[15] and mineral solution is rarely treated at a wastewater treatment facility. By removing self-regenerating (or "automatic") water softeners and reducing salinity discharged to the wastewater collection system, salinity in the southern Delta would be expected to be reduced. Many wastewater treatment agencies operate a water softener buy-back program to remove water softeners from domestic use.

Salts also can enter the wastewater collection system as a byproduct of commercial activities, industrial processes, and food preparation activities, which can contribute to elevated salt loads entering the wastewater collection system and discharging into the southern Delta. Some commercial and industrial sources of salinity are commercial laundry facilities, food processing operations, and industrial fabrication shops. To address salinity loading by commercial and industrial dischargers, many wastewater treatment agencies prohibit commercial and industrial users from discharging to the wastewater collection system or strictly regulate the quality of wastewater entering the wastewater collection system. To improve the water quality of commercial and industrial dischargers, a variety of pollution-control methods can be used, such as best management practices (BMPs) and desalination devices, depending on the activities conducted by the commercial and industrial discharger. These methods are typically applied at the industrial or commercial business generating the wastewater.

Many wastewater treatment agencies offer rebate programs for removal of water softeners. Currently, the Inland Empire Utilities Agency (IEUA), and the Los Angeles County Sanitation Districts (LACSD) offer $206–$2,000 to homeowners to remove water softeners. Rules for each agency's programs differ, but in general, once a homeowner certifies that the water softener is removed (and it is later verified by the wastewater treatment agency), the wastewater treatment agency will reimburse the homeowner for the cost of removal.

If a wastewater treatment agency anticipates replacing 2,000 water softeners over 5 years, the agency can reasonably expect to pay between $928,600 and $9,015,400 over a period of 5 years ($185,720–$1,803,080 per year). If a commercial and industrial discharger decides to install a desalination device, costs would vary based on what is being discharged, the volume, and the desired water quality entering the wastewater collection system. For example, some light commercial ~~reverse osmosis (~~RO~~)~~ filtration systems cost as little as $1,000 to install and $200 per year to operate.

Desalination

As discussed above, ~~S~~some wastewater treatment agencies may one day have~~opt~~ to remove salts at the WWTP before treated effluent is discharged to the southern Delta. Conventional wastewater treatment processes do not significantly remove salts from the wastewater treatment stream. To

[15] *Brine* is the saline solution prevented from traveling through an RO filter.

remove salts, a discharger must desalinate treated wastewater effluent. Methods to desalinate water at WWTPs include thermal separation, electro-dialysis, and RO. RO is analyzed here because it is the most common desalination technology in California and is comparable or less expensive than other desalination methods (e.g., ion exchange, distillation).

The costs of RO include the costs associated with constructing the RO facilities and operating and maintaining facilities associated with energy and brine disposal. Brine's salinity is a function of the quality and volume of the influent into the RO filter and the efficiency of the RO filter. For example, if the influent water had 75,000 pounds of salt per 10 million gallons per day, and the RO filter was 85 percent efficient, the brine would contain 75,000 pounds of salt per 1.5 million gallons of RO filter reject water (or a 5 percent saline brine solution).

The cost to install a desalination system at a WWTP is highly variable. Important factors include: the quality and quantity of water entering the desalination system, the desired water quality leaving the desalination system, energy costs, the chosen method of desalination, and the brine disposal method. Some WWTPs only would need to treat a portion of the influent wastewater to achieve effluent limitations for salinity, which would reduce costs.

DWR's California Water Plan Update 2009 discusses the costs of desalination, which are summarized in Table 20.4.1-2.

Table 20.4.1-2. California Water Plan Update 2009 Unit Cost of Desalination

	Total Water Cost ($/AF)	
Type of Desalting	Low	High
Groundwater	500	900
Wastewater	500	2,000
Seawater	1,000	2,500

Source: Chapter 16, *Evaluation of Other Indirect and Additional Actions,* Table 16-29.
AF = acre-feet.

Using the unit cost approximations in Table 20.4.1-2, a 10 million-gallon-per-day discharger could expect to pay between $5 and $22 million to construct an RO system at a WWTP. The unit cost for constructing and operating different desalination systems are not linear, however, because the associated administrative, engineering, and legal costs do not generally decrease for smaller projects. Larger RO facilities cost more, but the typical unit price of water produced decreases due to the scale of construction costs compared to administrative, engineering, and legal costs.

Agricultural Return Flow Salinity Control

Real-time management of agricultural return flow, such as changing the timing of the release of agricultural discharge to receiving waters, is the potential method of compliance for agricultural water users that must comply with numeric salinity objectives. This method may reduce salinity entering the southern Delta.

Agricultural dischargers could monitor receiving water's assimilative capacity on a real-time basis, and time discharges to coincide with periods of high flow (i.e., more assimilative capacity). This potential method of compliance with proposed salinity standards would require dischargers to establish a network of monitoring stations and a discharge schedule. When there is no assimilative capacity, irrigators would either recycle water that would otherwise be discharged or would discharge to a detention pond until discharges to the receiving waters are permitted. This method of compliance could be integrated with other BMPs (such as water recycling or use of evaporation ponds) to reduce salinity entering the plan area.

Enhanced monitoring equipment, modeling, and forecasting capability would be needed to forecast assimilative capacity in the LSJR. Control gates and conveyance systems would also be needed to divert drainage from river discharge to permanent treatment structures when assimilative capacity is not available. Personnel would be needed to manage real-time systems and coordinate discharges from multiple subareas in the LSJR Watershed. It is assumed that there would be multiple subareas within the plan area that would manage discharges in real time, creating a real-time monitoring system. Table 20.4.1-3 estimates the components needed and costs associated with constructing a real-time management system.

Table 20.4.1-3. Costs and Components of a Real-Time Management System

Construction	
Computer and Software	$5,000
Control Gates (10)	$100,000
Floats, Weirs, and EC Monitoring Equipment	$50,000
Installation of Monitoring Components	$75,000
Conveyance to River	$100,000
Subtotal	$330,000
Contingency (30%)	$99,000
Total Construction Cost	$429,000
Operations and Maintenance	
Operations and Maintenance (Including Coordinating Discharges)	$100,000 per year

Source: Chapter 16, *Evaluation of Other Indirect and Additional Actions*, Table 16-31.

EC = electrical conductivity (salinity).

In this document, EC is *electrical conductivity*, which is generally expressed in deciSiemens per meter (dS/m). Measurement of EC is a widely accepted indirect method to determine the salinity of water, which is the concentration of dissolved salts (often expressed in parts per thousand or parts per million).

Based on the costs identified in Table 20.4.1-3, the total estimated construction cost for 11 systems to cover the plan area is $4,719,000, with an operations and maintenance budget of $1,100,000 per year. This cost is in addition to the costs to construct and operate temporary detention ponds.

Southern Delta Temporary Barriers

The program of implementation for the SDWQ alternatives requires continued operations of the agricultural barriers at Grant Line Canal, Middle River, and Old River at Tracy, or other reasonable measures, to address the impacts of the CVP or SWP export operations on water levels and flow conditions that might affect salinity. The existing temporary barriers would likely to continue to operate in the southern Delta under the program of implementation. The purpose of operating the temporary barriers is to protect salmon migrating through the Delta and provide an adequate agricultural water supply in terms of quantity, quality and channel water levels to meet the reasonable and beneficial needs of water users in the southern Delta area. The program is operated by DWR, which also takes actions to protect agricultural diversions that do not benefit from the adverse effects of operations of the barriers. As described in Chapter 16, *Evaluation of Other Indirect and Additional Actions*, the program consists of four rock barriers across southern Delta channels that primarily benefit migrating fish or agricultural water users. DWR posts a standing schedule for the operation of the barriers.

According to DWR, water levels and water circulation in the southern Delta have improved since installation of the agricultural barriers. Migration conditions for salmon have improved since the HOR barrier was installed. As such, DWR determined it is essential to continue barrier installations.

As indicated in Chapter 16, DWR recently awarded a contract to construct and remove the temporary rock barriers, including other related construction activities for approximately $7.5 million; this cost does not include preparation of environmental studies.

Low-Lift Pumping Stations

The program of implementation for the SDWQ alternatives requires additional studies and monitoring of the southern Delta circulation and water levels. It is possible that additional study and monitoring would determine the need for modifying the existing South Delta Temporary Barriers Project. If this determination is made by the State Water Board, DWR may be required to install low lift pumping stations at the temporary barriers as a method of compliance.

As described in Chapter 16, *Evaluation of Other Indirect and Additional Actions,* a cost and environmental evaluation was prepared by DWR in 2011 for the Low-Head Pumping Conceptual Plan that identifies installation of either permanent or temporary pumps at the southern Delta temporary barriers. Estimated cost ranges were based on different site layout configurations. The site layout that would provide the greatest reduction in water quality violations is a two-pumping site alternative with 1,000 cfs combined pumping capacity at Middle and Old River barriers. The capital cost of this layout is estimated to range from $55.5–$540.7 million, and annual operation and maintenance costs are estimated to range from $4.5–$62.7 million.

20.4.2 Effects on Ratepayers and the Regional Economy

As discussed more fully in Chapter 13, *Service Providers*, existing WWTPs are point source dischargers of salt into the southern Delta, influencing the southern Delta salinity. The following WWTPs,[16] all of which are required to comply with effluent limitations established by the NPDES permits, discharge into the southern Delta. These WWTPs, their NPDES wastewater discharge permit order numbers, and their receiving water bodies are identified in Table 13-7 in Chapter 13.

- City of Tracy WWTP: 16 mgd permitted discharge.
- Manteca Wastewater Quality Control Facility: 17.5 mgd permitted discharge.

[16] As discussed in Chapter 13, *Service Providers*, while Discovery Bay Community Services District (CSD) is very close to the southern Delta, it is not expected to result in any modifications or new construction to its facility. This is because of the large dilution in Old River and the good quality water in Old River coming down from the Sacramento River (Marshall pers. comm. 2012). Therefore, the Central Valley Water Board has determined the discharge from Discovery Bay CSD does not have reasonable potential to cause or contribute to an exceedance of the Bay-Delta water quality objectives in Old River (Marshall pers. comm. 2012). Thus, they can comply with the

- Stockton Regional Wastewater Control Facility: 55 mgd permitted discharge.
- Mountain House CSD WWTP: 5.4 mgd permitted discharge.

Ratepayer Effects

Costs to WWTP operators to comply with NPDES permit discharge limitations could result in rate increases for utility ratepayers. Assessing how sewer utility rates could be affected by compliance with salinity objectives is complicated by several uncertainties. To assess potential ratepayer impacts, the specific actions to be taken by each wastewater treatment agency to meet salinity objectives must be determined. As discussed previously, the decision that each discharger might make could include some or all of the following actions: (1) developing new surface water supplies, (2) developing and enforcing a salinity pretreatment program, and/or (3) developing desalination processes at WWTPs. These decisions, which have different cost implications, would be made by individual wastewater treatment agencies based on numerous considerations, including the needs of their service districts, availability of surface water and land, and specific operation of their wastewater facilities. Regional Water Boards are precluded from specifying the manner of compliance under Water Code Section 13360, so each wastewater treatment agency must choose for itself the appropriate mix of actions to meet its discharge requirements.

Once individual wastewater treatment agencies have decided on the proper combination of salinity control measures and the design and scale of the actions, the costs to implement an agency's compliance program to address salinity objectives under each SDWQ alternative would become apparent. Without knowing which actions an agency would take as part of its compliance strategy, estimating compliance costs is not feasible. However, once total costs associated with the compliance actions have been estimated, each individual agency would need to determine how these costs would be recovered (e.g., increasing utility rates for customers)

For example, as described in the City of Manteca's *Draft Sewer Rate Study* (2008), sewer rates for ratepayers are determined based on a systematic analysis of the contribution of sewerage made by different land uses and of the costs required to collect and treat sewer influent. The allocation of collection and treatment costs between customer categories is based on a combination of estimated usage and actual sewer influent. Sewer expenditures generally include the following categories.

- Collection operating and maintenance costs.
- Treatment operating and maintenance costs.
- Debt service (existing and projected).
- Capital replacement.
- Depreciation.
- Operating reserves/contingency.

Once the collection and treatment costs are allocated to the different customer categories, rates are determined by dividing the allocated costs by the number of users in each category. Customer categories generally include residential, commercial, industrial, and public users.

water quality objectives and do not need effluent limits based on the Bay-Delta water quality objectives (Marshall pers. comm. 2012). Accordingly, Discovery Bay CSD is not further included in the analysis.

The southern Delta dischargers that could be affected by the SDWQ salinity alternatives are communities that, to varying extents, serve a mix of residential, commercial, and industrial users, with service area populations ranging from the relatively small residential community of Mountain House (population 10,000) to the relatively large urban service area of the Stockton Regional Wastewater Control Facility (population 280,000). For each wastewater treatment agency, potential rate increases attributable to compliance with salinity objectives would be spread among user groups depending on each group's contribution to sewer system influent. Generally, rates for each user group could be expected to increase similar to the percentage increase in wastewater treatment agency budgets to achieve salinity objectives under the SDWQ alternatives, as described below.

No Project Alternative (LSJR/SDWQ Alternative 1)

Under existing conditions, the following existing wastewater treatment plant dischargers (service providers), meet amended NPDES permit requirements or are currently exempted from requirements, as described in Section 13.2.3, *Southern Delta,* of Chapter 13, *Service Providers:* the City of Tracy, the City of Stockton, the City of Manteca and Mountain House CSD. Two possible scenarios could occur under the No Project Alternative for these providers: no change to NPDES permits or a change. If, under the No Project, there would be no change to the NPDES permits the No Project Alternative would not cause the need for expansion of existing facilities or infrastructure and would not cause significant environmental effects. However, if the litigation in City of *Tracy v. California State Water Resources Control Board* is resolved in a manner that allows for the application of the Delta salinity objectives to municipal wastewater dischargers, existing wastewater treatment plant dischargers, such as the City of Tracy, the City of Stockton, the City of Manteca, and Mountain House CSD would likely be unable to meet the current 2006 Bay-Delta Plan salinity objective of 0.7 dS/m from April to August based on current effluent discharge concentrations and past violations (Tables 13-8, 13-9, and 13-20). City of Tracy, City of Stockton, and Mountain House CSD would also likely not meet the current 2006 Bay-Delta Plan salinity objective of 1.0 dS/m from September – March (Tables 13-8, 13-9, and 13-20. Therefore, it is expected that these wastewater treatment providers would potentially exceed wastewater treatment requirements during some parts of the year such that new wastewater treatment facilities, or expansion of existing facilities or infrastructure could result, the construction or operation of which could result in increased costs to ratepayers.

SDWQ Alternative 2

As discussed in Chapter 13, *Service Providers*, the City of Tracy, the City of Stockton, and Mountain House CSD would not be expected to meet the salinity objectives under SDWQ Alternative 2. As such, SDWQ Alternative 2 is anticipated to require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction or operation of which could result in increased costs to ratepayers.

SDWQ Alternative 3

As discussed in Chapter 13, *Service Providers*, all of the WWTPs would be expected to comply with the SDWQ Alternative 3 without new or modified facilities. Consequently, there would be no effects on ratepayers.

Regional Economic Effects

Although the amount that sewer rates could increase in response to expenditures by wastewater treatment agencies to achieve salinity objectives under SDWQ Alternative 2 is uncertain, any increase in sewer utility rates could shift a portion of the spending by residential ratepayers from purchases of consumer goods and services to monthly sewer utility bills. From the perspective of the regional economy of the southern Delta region, this shift, while somewhat speculative and not anticipated to be a large percentage of overall consumer spending in the region, could result in relatively small reductions in sales, employment, and income in consumer-serving sectors of the regional economy, such as retail stores and consumer-service businesses. Similarly, increases in sewer utility rates for commercial and industrial ratepayers could shift business spending from wages, supplies, and services to expenditures on higher sewer utility bills. This shift in spending could result in slightly higher prices for goods and services provided by commercial and industrial businesses, and potential reductions in employment by affected businesses. In both cases, reductions in consumer and business spending on goods and services could have ripple effects throughout the regional economy. These effects would be concentrated within the service areas of the City of Tracy, the City of Stockton, and Mountain House CSD, which are potentially affected by the SDWQ Alternative 2 and the City of Tracy, the City of Stockton, the City of Manteca, and Mountain House CSD, which could potentially be affected by the No Project Alternative.

To some extent, the adverse effects on the regional economy would be offset by increased employment generated by wastewater treatment agencies as these agencies spend to construct and operate facilities, and to establish and operate programs to achieve salinity objectives under the alternatives. These agencies and its employees would contribute to economic activity in the regional economy, directly and indirectly generating sales, employment, and income in businesses that provide good and services in the region.

The net change in regional economic activity from potentially higher sewer utility rates and from increased agency spending is not anticipated to be substantial because changes would largely represent regional shifts in sales, employment, and income rather than overall reductions in regional economic activity.

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