THE ECONOMIC BENEFITS OF THE SAN JOAQUIN RIVER RESTORATION

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Prepared by:

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FRESNO REGIONAL FOUNDATION
Your Vision - The Valley's Future

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EXECUTIVE SUMMARY

The main work to restore the San Joaquin River and the resulting recreational industry expansion will generate more than 11,000 jobs in the San Joaquin Valley." In a region suffering from chronic unemployment, the San Joaquin Valley is desperate for a jolt to its economy wracked by the recent housing crisis and a sharp decline in construction related-employment.

The San Joaquin River, the second longest river within the state of California, once boasted one of the nation's most robust Chinook salmon populations. Since the opening of the Friant Dam in 1942, however, the San Joaquin River's flow ends approximately 30 miles downstream of the dam dewatering approximately 60 miles of the river, thus cutting off the salmon from their historic spawning areas. In Fall 2006, after more than 18 years of litigation, a settlement was reached in a lawsuit that challenged the renewal of the U.S. Bureau of Reclamation's long-term water service contracts and sought to restore river flows that would sustain a healthy fish population. The Settlement agreement, which was codified by the federal San Joaquin River Restoration Settlement Act of 2009 (Title X of Public Law 111-11), authorized federal funding and agencies to implement the Settlement. In its simplest form the Settlement has two primary objectives:

> To restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish;

> To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

Various federal and state agencies are slated to expend up to $892 million, drawn from a variety of local, state, and federal monies, to implement the terms of the Settlement. Expenditures from FY2007 to 2012 have already amounted to about $99.3 million, leaving approximately $792.8 million yet to be invested in a variety of projects that the San Joaquin River Restoration Program agencies put into the following categories: channel and structural improvements, restoration flows, fish reintroduction, and water management (SJRRP, 2012). A map of the restoration area is displayed in Figure 1.

The main purpose of this study is to quantify the job-creating potential and anticipated economic-catalyst effect associated with the large investment that will occur to implement the terms of the Settlement. The main work to restore the San Joaquin River and the resulting recreational industry expansion resulting from the river restoration will generate at least 11,392 jobs in the San Joaquin Valley. In a region suffering from chronic unemployment, the San Joaquin Valley is desperate for a jolt to its economy wracked by the recent housing crisis and a sharp decline in construction-related employment.

The estimates reported in this study indicate that 10,282 full-time-equivalent jobs will be created as a result of the formal San Joaquin River Restoration Program through 2025, with a significant number of jobs created in construction-related activities.

This degree of job-creation indicates that the San Joaquin River Restoration Program will generate 14.1 jobs per $1 million of investment, which is comparable to other studies relating to other ecological restoration projects around the country. The number of direct annualized full-time-equivalent jobs – i.e., jobs associated with the projects themselves – that would be created by the restoration is estimated to be 4,696. Indirect employment,

triggered by supply-chain purchases associated with getting the work completed, will contribute 1,891 annualized full-time-equivalent jobs. Finally, the "induced effect" will add another 3,695 jobs. These so-called induced jobs will be triggered by the increased consumption that results from the added labor income that employees working directly on the projects or those who benefit from indirect purchases will receive. The induced jobs are largely service jobs such as food and restaurant services, retail, real estate, and other professional services.

While the San Joaquin River Restoration Program's federal and state agencies carry out the requirements of the Settlement, another source of job-creation is underway that is complementary to their activities. Private nonprofit organizations that are active in the San Joaquin Valley region may see their ability to secure competitive grant funding from various sources increased as a result of the main work of the San Joaquin River restoration. Based on new data collection it seems reasonable to assume that at least $45 million will be spent by private entities on river restoration work by 2020. Applying the job-creation estimate of 14.1 per $1 million investment, the activities of private entities could bolster the total number of jobs estimated above by at least 635 for a grand total of 10,917 jobs.

The report also considers some longer-term benefits associated with a restored San Joaquin River. Enhanced recreational opportunities could support 475 jobs annually by 2025, increasing the total of number of jobs created to 11,392. Improved recreational opportunities in the region could serve as a basis for long-term economic growth as citizens, especially in the western U.S., value such amenities and are eager to live and work in areas that support a high quality of life. Finally, the river restoration provides a unique research opportunity that would benefit UC Merced researchers and students. The river restoration could serve as a training ground for skilled workers in future construction and ecological restoration projects, further preparing California workers for additional economic activities as state and federal agencies continue to invest in such ecological restoration projects.

Conservative estimates presented in this report indicate that over 11,000 jobs will be generated as a result of the San Joaquin River Restoration. Table 1 summarizes the sources of the job creation.

Table 1

Sources of Job Creation from the San Joaquin River Restoration

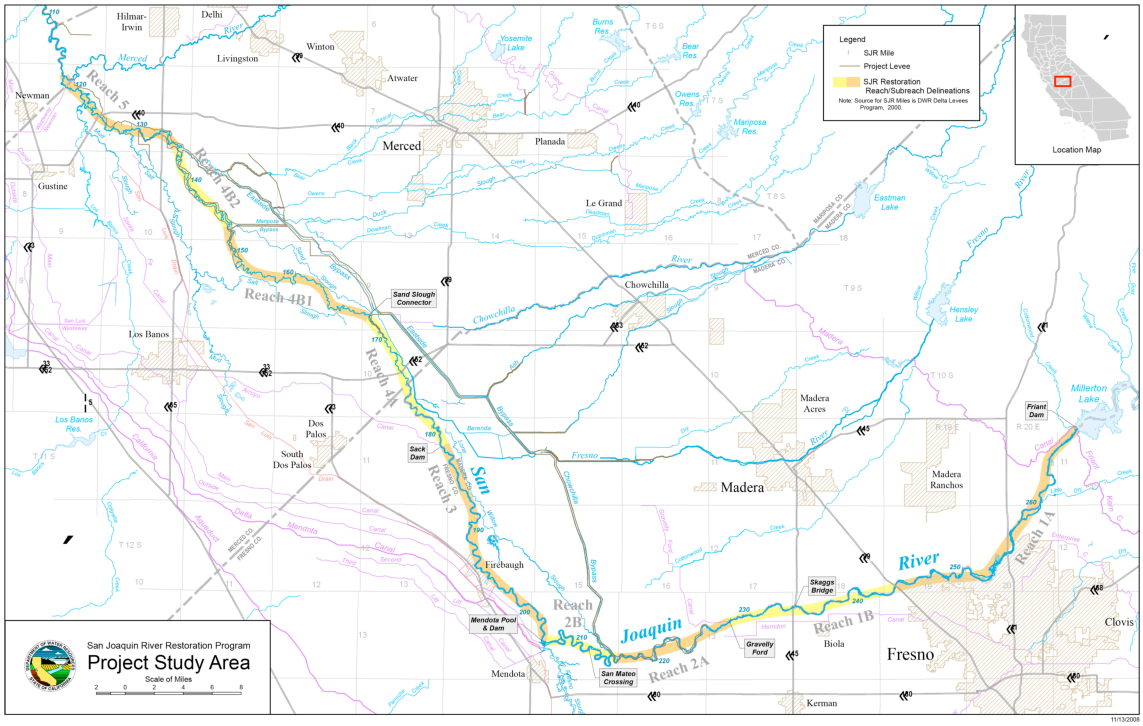
Source of Jobs	Number of Jobs
San Joaquin River Restoration Program --Direct, Indirect and Induced jobs	10,282
Private nonprofit organizations	635
Recreation industry	475
Total Jobs	11,392

Source: Author's calculations. See text.

As a recent economic analysis of the $11.5 billion Comprehensive Everglades Restoration Plan found, each dollar of ecological restoration work can produce at least four dollars of broader economic benefits to the surrounding region. These spillovers are generated not just from the jobs created to perform the restoration work, but also from such diverse sources as higher home values and increased tourism spending because of enhanced boating and fishing opportunities.[i] While the San Joaquin River Restoration would be just a fraction of the massive Everglades Restoration, the resulting economic benefits will be the same: the restoration projects will generate good paying jobs in construction, engineering and the sciences, and a wide range of industries will experience enhanced employment opportunities resulting from the economic spillovers of the restoration work and from the restored river itself.

Figure 1

Map of the San Joaquin River Restoration Area



Source: SJRRP, "Framework for Implementation," p. 4.

THE ECONOMIC BENEFITS OF THE SAN JOAQUIN RIVER RESTORATION

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I. INTRODUCTION

In an arid region such as California's San Joaquin Valley, irrigated water serves as a critical link in translating abundantly fertile soil into a multi-billion dollar agricultural economy. Significant local, state, and federal investments over the past century to control the flow of water emanating from the Sierra Nevada has not only provided necessary water for farmers and urban residents, but it has also served to control flooding in an area geologically prone to such inundation. Publically-funded water infrastructure projects have made the Central Valley the world-renowned agricultural region that it has become over the past century.

This economic success for some has come at an economic and environmental cost for others. The abundant wildlife habitat that made the San Joaquin Valley a unique destination for migrating birds is only a fraction of what is was historically, rivers that once

supported a thriving salmon stock now run dry or are impeded, causing job and economic losses to recreational and commercial fishing industries, and downstream farmers and residents confront water-quality problems that result from upstream water-management decisions. Managing California's water supply and demand is, and will continue to be into the foreseeable future, a delicate balance.

This balance is well demonstrated in the San Joaquin River Restoration Program (SJRRP), which has been championed by U.S. Senator Dianne Feinstein. The San Joaquin River, the second longest river within the state of California, once boasted one of the nation's most robust Chinook salmon populations. Since the opening of the Friant Dam in 1942, however, the San Joaquin River's flow ends approximately 30 miles downstream of the dam resulting in the dewatering of approximately 60 miles of the river and cutting off the salmon from their historic spawning areas. In 1988 a coalition of organizations, including the Natural Resources Defense Council (NRDC) and the Pacific Coast Federation of Fishermen's Associations (PCFFA), filed a lawsuit challenging the renewal of the U.S. Bureau of Reclamation's long-term water service contracts and sued to restore river flows that would sustain a healthy fish population. In Fall 2006, after more than 18 years of litigation and negotiations, NRDC, PCFFA, the Friant Water Users Authority, and the U. S. Departments of the Interior and Commerce, agreed to a Settlement, which quickly won Court approval.[ii] Congress then authorized federal funding and agencies to implement the Settlement (Title X of Public Law 111-11, also known

as the "San Joaquin River Restoration Settlement Act," was approved by the U.S. Senate by a 77-20 vote and by the U.S. House of Representatives by a 285-140 vote as part of the Omnibus Public Land Management Act of 2009).

In its simplest form the Settlement has two primary objectives:

> To restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish;
>
> To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement."[iii]

The effort to restore fish populations in the river, while mitigating impacts to water users, represents a significant economic and environmental investment in the San Joaquin Valley. Various federal and state agencies are slated to expend up to $892 million, drawn from a variety of local, state, and federal monies, to implement the terms of the Settlement.[iv] Expenditures from FY2007 to 2012 have already amounted to about $99.3 million, leaving approximately $792.8 million yet to be invested in a variety of projects that the SJRRP puts into the following categories: construction of channel and structural improvements, restoration

flows, fish reintroduction, and water management (SJRRP, 2012). To put the significance of this infrastructure investment in the San Joaquin River into perspective, consider that the California Department of Transportation currently has a workload portfolio of about $1.4 billion worth of projects in various stages of completion scheduled to 2019 in Fresno, Madera, and Merced Counties.[v] Roadwork is presently bolstered as a result of Proposition 1B funded projects reaching their construction phase. Thus, it is difficult to deny that the San Joaquin River restoration represents a major infusion of economic activity in the local economy.

In a region historically beholden to a specific industry for its economic success, criticism might be lodged against any action that will divert a critical resource – water – for purposes beyond agriculture. While most economists would have great difficulty denying that there are tradeoffs society faces as critical resources are allocated to alternative uses, an important aspect of the debate over the San Joaquin River Restoration that has been under-appreciated is that there are clear economic benefits anticipated as well. The range of economic benefits include the jobs and economic catalyst generated from the heavy investment to restore the river, the increase in recreational opportunities for both local and non-local residents, the research and teaching opportunities generated for local colleges and universities, and the implicit benefits that citizens receive knowing that wildlife habitat is being restored to a more natural state. Resource economists have devoted significant effort to quantify the economic benefits associated with the recreational and more intrinsic benefits associated with natural

areas, but much less work has tried to measure the anticipated economic spillovers from environmental restoration projects. In fact, in their study of community support for the Cache River Wetlands restoration in Illinois, Davenport, et. al. (2010) found that "Project managers typically have a crystallized set of ecological goals or measurable criteria for success in ecosystem restoration. What may be less apparent are potential cultural and economic goals." Given the significant degree of unemployment in the San Joaquin Valley, especially in construction-related industries that have been decimated by the recent housing bust, delineating the economic aspects of the San Joaquin River Restoration helps to put its broader societal impact into better perspective.

The purpose of this study, therefore, is to quantify the job-creating potential and anticipated economic-stimulus effect associated with the large investment that will occur to restore the San Joaquin River. This report is not meant to provide a full-scale cost-benefit calculation; its purpose is more to emphasize that the economic debate surrounding the San Joaquin River's restoration is much more nuanced than is typically realized because jobs and economic stimulus will come from the physical work to implement the restoration and because a restored river and fishery will produce important and significant recreational benefits for the region. It is the latter benefits that have been most discussed in the environmental economics and ecological literatures, only recently has discussion turned to understanding the broader economic development benefits associated with ecological restoration work.

II. THE ECONOMIC BENEFITS OF ENVIRONMENTAL RESTORATION: AN ANALYTICAL FRAMEWORK

The economic benefits from environmental, or ecological, restoration are generated from multiple channels. The two most discussed determinants considered in the environmental economics literature are "use values" and "non-use values."[vi] Use value refers to items that people either directly or indirectly consume and benefit from as a result of a restoration project. For example, thinking in terms of a river restoration like the one considered for the San Joaquin, direct benefits might include the salmon and other species that will be fished one day or the recreational benefits (e.g., canoeing, kayaking, wildlife watching, swimming, picnicking, etc.) that local and more distant citizens might enjoy as a result of a flowing river. Indirect use values stem from the social benefits generated by the overarching restoration project that may or may not be directly consumed by a specific individual. For example, enhanced river flows may increase the quality of water that downstream users can consume, flood control capacity will be enhanced as a result of the restoration, or property values will be enhanced as a result of increased recreational opportunities nearby. Thus, these societal benefits will accrue indirectly to various individuals depending upon their geographic proximity to the river.

Non-use values are subjective, yet fall squarely within the realm of economic value because people derive a benefit from an

environmental restoration project, despite the fact that it might be something intangible from which people derive such benefit. More specifically, the non-use economic values of restoration fall within two broad categories – bequest and existence values. First, bequest values derive from the knowledge that future generations will be able to enjoy a resource that has been managed for long-term sustainability. People derive economic value from the knowledge that their children and future generations will be able to enjoy the same amenities that they enjoy today. The second non-use value category is existence value, which relates to the benefit that people receive simply knowing that a natural resource exists in some natural state. That is, someone can derive a personal economic benefit from a national park or forest system that preserves wilderness areas, even if that person were never to step foot on such lands. Clearly, non-use economic values are extraordinarily difficult to quantify, but economists have improved survey and experimental techniques over the past two decades thus enabling regulators to begin including non-use values in their decision-making.[vii]

The third generator of economic value from environmental restoration pertains to the direct economic growth and activities that result from this work. As shown below, the bulk of the work to restore the San Joaquin River will involve heavy infrastructure work, such as channel improvements and structural water-flow and diversion mechanisms, so the construction activities will generate a significant number of jobs in the construction sector. Of course, the spillover effects from this direct investment will contribute to a

local economic boost in other sectors as well. Furthermore, residents and small business owners in communities near the river will enjoy enhanced opportunities for economic growth as recreational amenities attract visitors who will spend money in these local communities. In a recent comprehensive survey analysis of academic research on ecological restoration, James Aronson and his colleagues (2010, p. 150) found that "explicitly linking ecosystem services to beneficiaries of ecosystem restoration, and demonstrating their values to society, has only recently begun to enter the mainstream academic literature on the science and practice of ecological restoration." One reason that the authors cite for the lack of due consideration of such socioeconomic benefits of "ecosystem [restoration] services" to society is that "Those involved in developing economic development pathways generally have overlooked the value of conserving ecosystems, and restoring natural capital through ecological restoration, as catalysts for economic development."[viii]

Given the deep recession of late-2007 to mid-2009, and the subsequent, on-going anemic economic recovery, job creation has become a central focal point in many public policy debates. Not surprisingly, then, recent work has begun to estimate how environmental restoration impacts regional economies and job creation. Table 2 reports the findings of a number of recent studies that have attempted to offer credible estimates of the job-creation potential of many restoration projects around the country. The "annualized full-time-equivalent jobs" estimates are wide ranging, from 5 jobs created per $1 million dollars expended for tree

planting in Louisiana to 31.5 on river restoration and toxic clean-up in Montana. The median value across all of the individual estimates is that 15.5 jobs are created per $1 million investment in ecological restoration. An "annualized full-time-equivalent job" is one in which a person is employed full-time for an entire year. Of course, many jobs in restoration work do not require such a commitment, so there would be many more workers involved in the actual project, but all of their contributions are accounted for in an annualized full-time-equivalence.

The estimates from these various studies are each quite different, which is expected given that each study is considering a unique restoration project each with its own array of activities, the studies do not share a similar methodology, and that some studies were able to provide highly detailed breakdowns of the broad range of work performed under the specific restoration program. It is also worth noting that the estimates reported below only consider the economic spillovers from the restoration activities themselves and do not include the jobs that might ultimately result from a restored fishery or recreational area. In a sense, then, these estimates should be viewed as lower-bound estimates of the job-creation benefits of ecological restoration.

Prior work suggests that the San Joaquin River Restoration will contribute significantly to the local economy and the California economy, more generally. As discussed in the next section, the San Joaquin Valley suffers chronic unemployment and under-employment, especially in construction-related industries, which has been exacerbated as a result of the recent recession and

housing crisis. Thus, the San Joaquin River Restoration not only provides critical environmental benefits, but it also offers a significant boost to an economy that is clearly struggling.

Table 2

Survey of Recent Studies Estimating the Economic Effects of Restoration Projects

Author	Region Studied	Type of Restoration Project	Jobs Created Per $1 Million Expenditure in Restoration Work
Baker (2005)	Humboldt County, CA	Multi-faceted salmonid habitat, watershed, and ecosystem repair	14.3[a]
Kruse and Scholz (2006)	Klamath River, CA & OR	Remove dam	21.5
Wagner and Shropshire (2009)	Montana	River restoration and toxic substance clean-up	31.5
Mather Economics, Inc. (2010)	Everglades, FL	Heavy construction projects to control water	20.0
Fayanju (2010)	Central Wetlands Unit, New Orleans, LA	Restore flooded area to natural forest habitat	
		(a) Site preparation work (dredging and filling)	(a) 29
		(b) Pipeline construction	(b) 17
		(c) Tree planting	(c) 5
Nielsen-Pincus and Moseley (2010)	Oregon	Multi-faceted watershed restoration projects	16.7 (average)
Industrial Economics, Inc. (2012)[b]	(a) Broad Meadows, MA	(a) Excavation of dredge spoils and re-creation of salt marsh	(a) 12.9
	(b) Eel River, MA	(b) Remove six dams, replace two culverts, restore 40 acre of wetlands in former cranberry bog	(b) 13.2
	(c) Stony Brook, MA	(c) Remove culvert to restore fish passage	(c) 11.8
	(d) North Hoosic River, MA	(d) Remove dam	(d) 12.2

Notes:

[a] This estimate is derived from the author's survey of local private and public restoration work, which supported 208 full-time-equivalent jobs in 2002. In that same year, Humboldt County expended approximately $14.5 million on restoration work.

[b] The study attempted to distinguish expenditures for materials and other supplies that would take place in Massachusetts versus neighboring states. The job-creation estimates are those that assume that all expenditures take place within the state of Massachusetts. In other words, these estimates are higher than the alternatives presented that speculate that some purchases for supplies are made out-of-state, thus leaking some job-creating potential.

III. BACKGROUND ON THE SAN JOAQUIN VALLEY ECONOMY AND THE CHALLENGE AHEAD

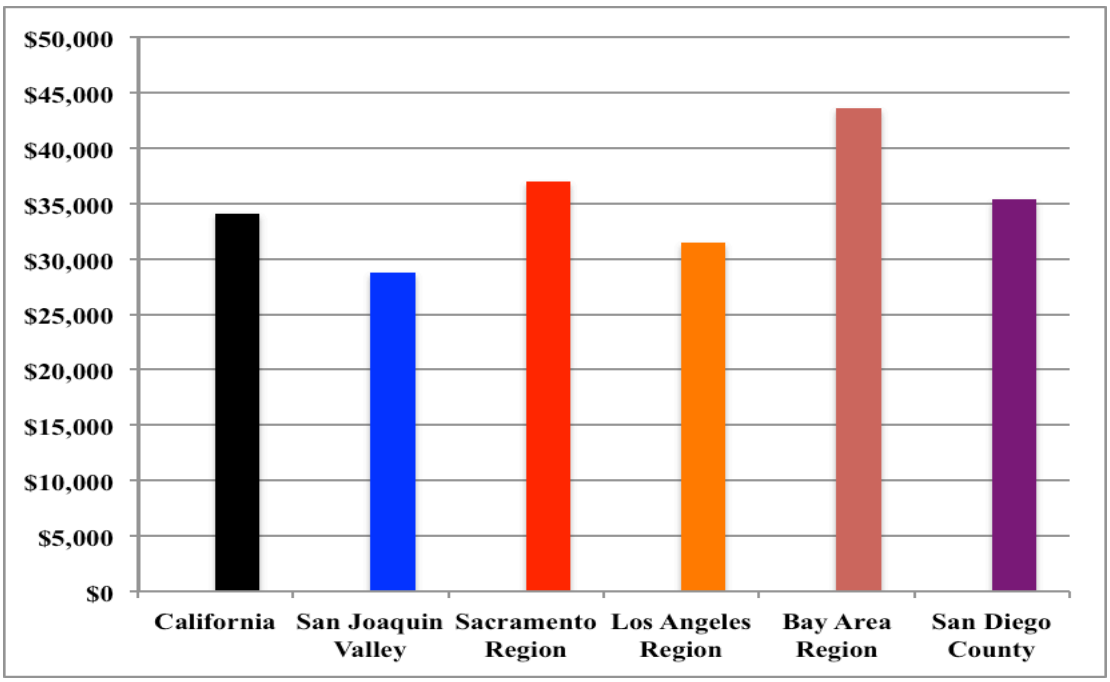
The San Joaquin Valley (SJV) population will grow significantly over the next four decades. The California Department of Finance projects the state's population to increase from about 37 million today (2010) to 51 million by 2050, or a 38 percent increase. By contrast, the SJV population is expected to increase by approximately 87 percent, from about 4 million people today to 7.5 million in 2050.[ix] How will the region accommodate such growth, while providing the appropriate degree of economic, cultural, recreational, and environmental opportunities to both retain and attract the number of residents forecasted to reside in the area? As the coastal urban regions of California have become increasingly expensive, residents have traditionally looked to the SJV for affordable living. But that has typically meant a tradeoff in terms of job opportunities or has meant a long commute to a job. Expanding job opportunities, diversifying the economy, and raising the skill-level and educational attainment of the population, which will attract outside employers and investors, are all interlinked factors associated with the future economic development of the SJV.

The San Joaquin Valley clearly lags the remainder of the state in terms of economic vitality and opportunity. Figure 2 shows 2009 median incomes, based on the most recently reported data from the California Franchise Tax Board, across various California

regions. The average median income of the eight SJV counties ($28,775) is about 84 percent of the state's median income ($34,079), and only 78 percent of that in the Sacramento region and 66 percent of the Bay Area's median income. The regional average, however, masks the relatively low incomes that are prevalent within individual counties of the SJV (see Figure 3). While San Joaquin and Stanislaus Counties both have median incomes greater than $30,000, they are still less than the median income across the entire state. The other five SJV counties have median incomes below $30,000. The three SJV counties that serve as the main focus of the San Joaquin River Restoration have some of the lowest incomes in the state.

Figure 2

Median Income, By Region, 2009



Notes and source:

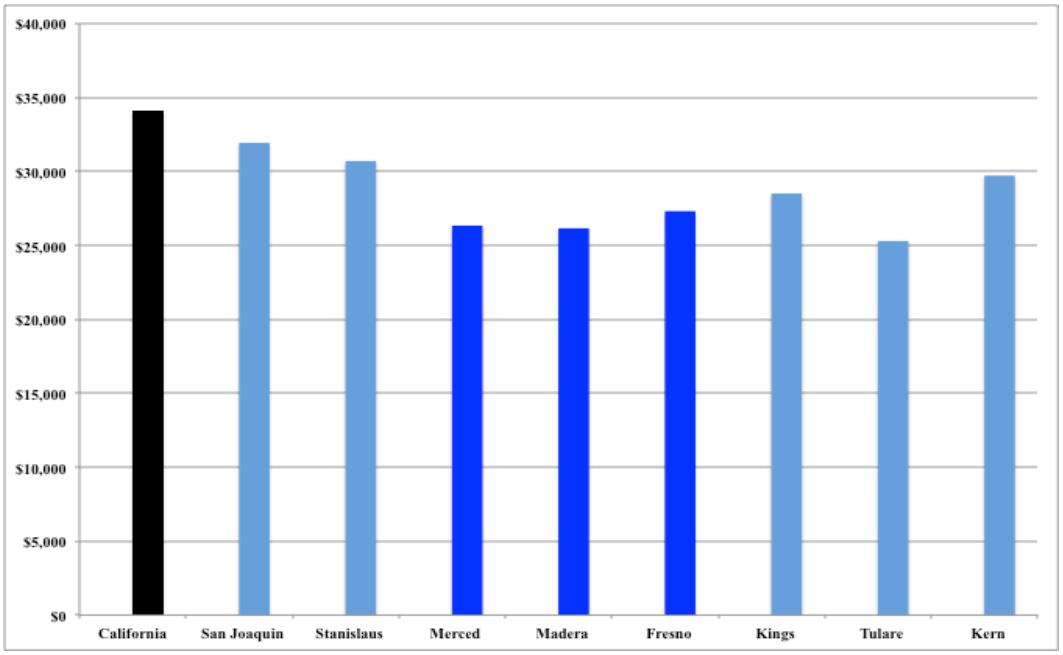
Author's calculations based on data from California Franchise Tax Board, Annual Report, 2010, Table B-6:

https://www.ftb.ca.gov/aboutFTB/Tax_Statistics/2010.shtml.

The regional measures represent the population-weighted average of the counties' median incomes within the specific region. The San Joaquin Valley comprises Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare Counties. The Sacramento Region includes El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba Counties. The Los Angeles Region comprises Los Angeles, Orange, Riverside, San Bernardino, and Ventura Counties. Finally, the Bay Area Region consists of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.

Figure 3

Median Income in San Joaquin Valley Counties, 2009



Source: See Figure 2.

Another measure that puts the poor economic performance of the SJV into stark perspective is each county's ranking among the 58 counties within the state. As Figure 4 shows, some of the lowest-earning counties in the state are located in the SJV. For example, Merced, Madera, and Fresno Counties are ranked 54th, 55th, and 51st among all 58 California counties, respectively, in terms of median income reported to the Franchise Tax Board.

The fact that median incomes in the San Joaquin Valley are lower than other parts of the state could be the result of two factors. First, holding the industry of employment constant, SJV residents may earn less than their counterparts in the rest of the state. This outcome might arise if SJV workers were employed in lower-skilled occupations within the industry and, thus, commanded lower wages. Second, it may be that SJV residents are disproportionately employed in lower-paying industries. In fact, both of these factors hold true for the SJV. As shown in Figure 5, in all major industry classifications, SJV workers earn less than their peers in the same industries across the state. In some of the higher

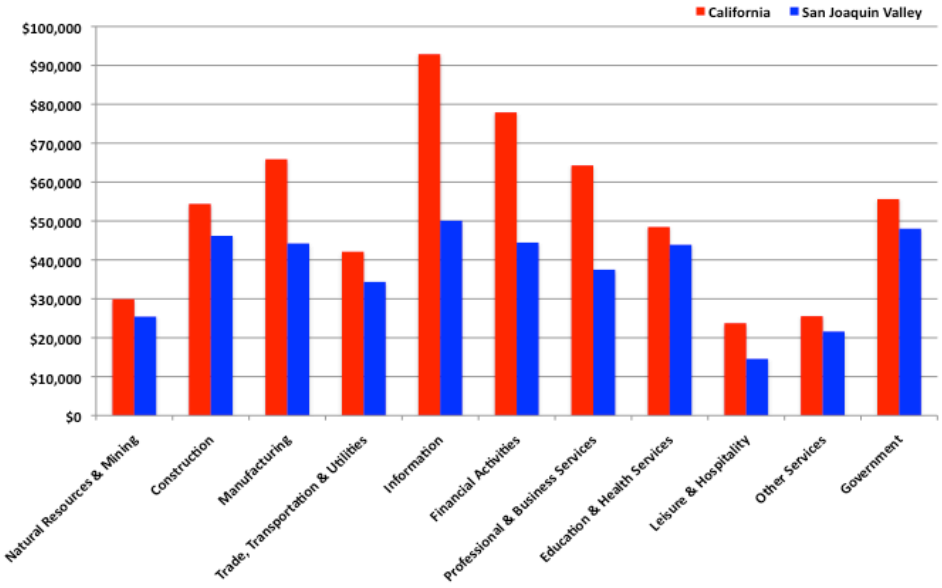
Figure 4
Ranking of San Joaquin Valley Counties' Median Income Among All 58 California Counties, 2009

Source: See Figure 2.

paying industries such as Information, Financial Activities, and Professional & Business Services, the SJV earnings are significantly less than the state average. Furthermore, as shown in Figure 6, SJV workers are disproportionately employed in the relatively lower-paying Natural Resources & Mining industry grouping, which includes agriculture. SJV workers, on the other hand, have fewer opportunities in the aforementioned higher-paying industries in comparison to other workers across the state.

Figure 5

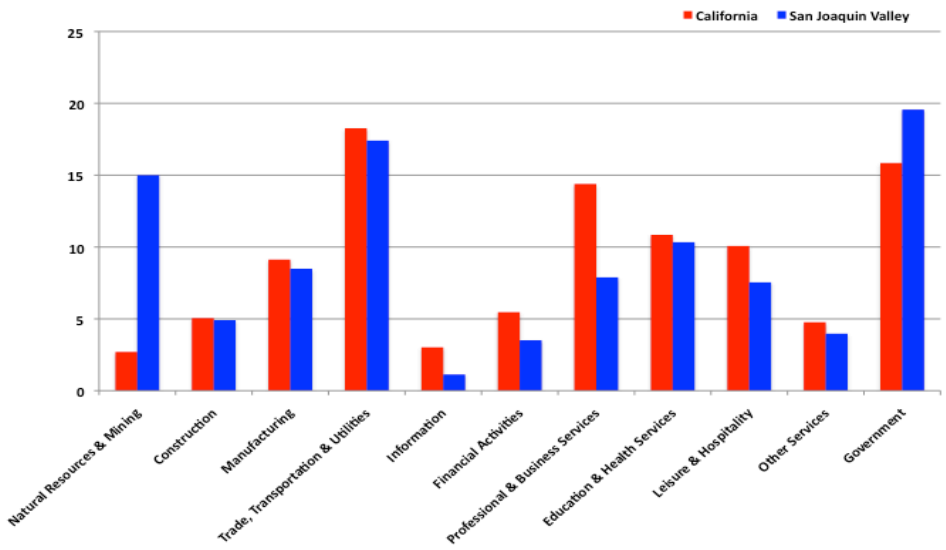
Comparison of Average Annual Earnings Across Industries in California and the San Joaquin Valley, 2008



Source: California Employment Development Department

Figure 6

Comparison of the Distribution of Industries in California and the San Joaquin Valley, 2008



Source: California Employment Development Department

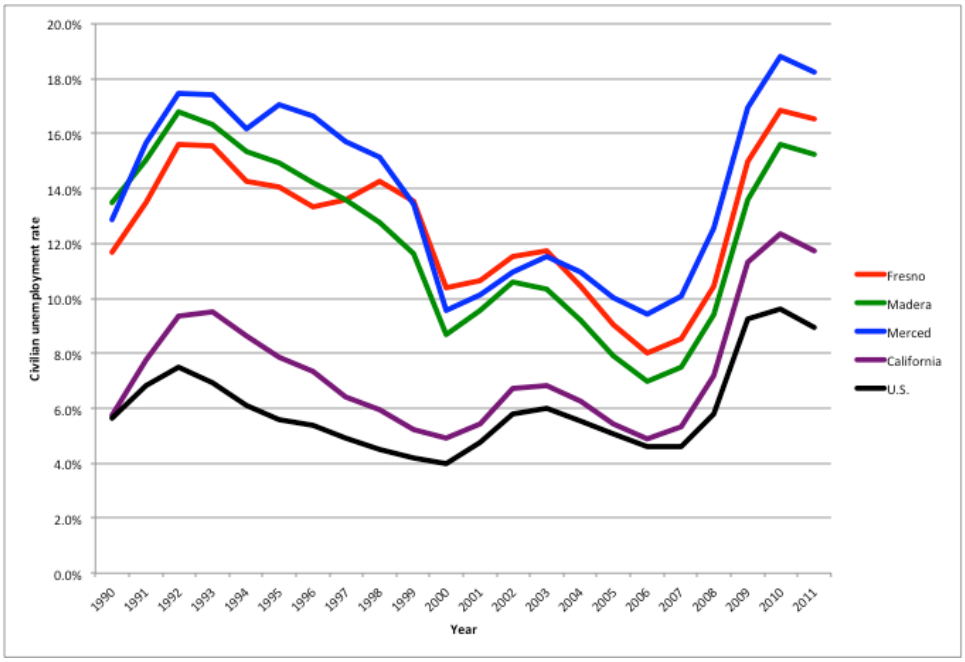
The data presented thus far portrays a picture of SJV workers earning relatively lower incomes than workers in the rest of the state, but another important variable to consider is employment in the first place. In this dimension as well, the SJV fares poorly. Figure 7 graphs the annual unemployment rates in the U.S., California, and the counties of Fresno, Madera, and Merced from 1990 through 2011. Although there was some narrowing of the large unemployment gap in the latter part of the 2000s, the ongoing recent recession has been particularly acute in the SJV. The loss of construction jobs as a result of the housing crisis, with the SJV at its epicenter, has been a clear drag on the economic recovery of the region. The most recent data (July 2012) from the California Employment Development Department indicate the dire state of the employment picture in these three SJV counties: Merced County has one of the highest unemployment rates in the state at

17.8 percent, with Fresno and Madera Counties at 15.3 and 14.6 percent, respectively. All of the counties are well above the state average of 10.7 percent, which is remarkably high in its own right.

The restoration of the San Joaquin River will certainly enhance environmental conditions in the region and open new recreational opportunities for citizens, thus raising the quality of life in the region. By providing additional recreational amenities, the restoration project may also help local communities attract additional employers and new jobs. Yet the most immediate benefit of the San Joaquin River restoration will be job creation, adding an important jolt to the lagging San Joaquin Valley and California labor market. An estimation of the employment effects of the river restoration are calculated and presented in the section below.

Figure 7

Unemployment Rates in the U.S., California, and Selected San Joaquin Valley Counties, 1990-2011



Source: California Employment Development Department

IV. MEASURING THE ECONOMIC IMPACT OF THE SAN JOAQUIN RIVER RESTORATION PROJECT

On June 19, 2012, the San Joaquin River Restoration Program distributed its Framework for implementing the terms of the Settlement in the Natural Resources Defense Council, et. al. v. Kirk Rodgers, et. al. lawsuit and the 2009 federal legislation codifying the negotiated Settlement agreement. While the "Framework for Implementation" document goes a long way toward identifying the important restoration projects that stand at the core of the overall Restoration Program, and those that the implementing agencies see as secondary, it is important to emphasize that the document serves as an early roadmap of how the Restoration Program will evolve over the coming decade. It is worth emphasizing the introductory words of the Framework document:

> The Implementing Agencies intend this to be a "living" document, subject to revision as more information is gained and milestones reached. This Framework represents a path forward in compliance with the Settlement and the Act [Title X of 2009 Public Law 111-11] but may not encompass all actions that may ultimately be taken to implement the San Joaquin River Restoration Program (SJRRP). The ultimate implementation of the SJRRP will depend on decisions made through the National Environmental Policy Act (NEPA) and/or California Environmental Quality Act (CEQA) process, issuance of permits, the Fisheries Management Plan, the Reintroduction Strategy and other steps which will help inform implementation.

With these caveats in mind, the Framework is nonetheless tremendously useful in that it offers an important look at the types of work that will be performed over the course of the Restoration Program that is detailed out through 2025.

An analysis of the details of the core projects anticipated in the Restoration Program revealed an expected expenditure of $728.8 million that will serve as a catalyst to the regional economy, with roughly 70 percent (about $514 million) being spent on construction activities alone. When a range of possible implementation actions were proposed in the "channel and structural improvements" section, caution was taken to assume that the modest expenditure option would be chosen, which serves to bias the job-creation estimates downward.[x] If a more costly option were chosen, which would involve more extensive work, naturally more employment would be generated. Levee stability to handle river flows of 2,000 cfs, which is deemed consistent with the core objectives of the overall Restoration Program ("Framework for Implementation," p. 38), are included in the jobs estimates below. However, the Framework document points out that "The costs for levee stability were separated from the Program total due to uncertainty in which agencies and entities would be responsible for providing the funding to establish conveyance at design capacities. The Agencies will work together to identify sources of funding to accomplish levee stability work" (p.11). A listing of the various projects included in this study is reported in the Appendix.

IMPLAN3, an economic impact assessment software system widely used by consultants and regulators, is used to estimate the

direct jobs created as a result of the restoration efforts. The forecasting tool also allows for a measure of the so-called indirect and induced jobs. IMPLAN3 calculates its multipliers based on an input-output accounting of commodity flows within an economy from producers to intermediate and final consumers. The model establishes a matrix of supply-chain relationships between industries and also between households and the producers of household goods and services. Assumptions about the portion of inputs for a given industry that is likely met by local suppliers, and the portion supplied from outside the region under consideration, are derived internally within the model using actual data on the industrial structure of the region, collected by the U.S. Bureau of the Census. The forecasting model that is implemented in this study is tailored to the specific economic conditions within the state of California in 2010, the latest data available.

The model's prediction is generated by tracking how changes in the demand for final goods and services filter through the supply chain. Industries that produce final goods and services must purchase inputs from other producers, which, in turn, purchase goods and services from their own suppliers. Moreover, the employees of the business in question and its suppliers purchase consumer goods in the region under consideration, which itself creates a set of economic spillover benefits. The model tracks these relationships through the economy to the point where leakages from the local region stop the cycle. The model identifies how a change in demand occurring within one industry affects a set of 439 other industry sectors. The projected economic response to

a change in final demand can be expressed in terms of economic output, employment, or labor income. For the purposes of this study, employment effects are reported.

As noted above, the model is able to delineate the overall economic impact of a project, including the direct, indirect, and induced impacts. Direct impacts represent those jobs directly associated with implementing the project's goals. The impacts are based on employment experiences of similar industries within the state. Indirect impacts relate to jobs or economic outcomes that will be generated in California as a resulting consequence of the restoration projects. The indirect impacts can accrue from supplier purchases or from government services or utilities that are needed to complete the projects. In essence, the indirect effects correspond to the supply-chain influences that one industry has on another, which are based on actual data collected by the U.S. Bureau of the Census. Finally, induced impacts represent jobs and economic activity created as a result of the jobs created by the new project. For example, local retail stores, restaurants, real estate sales, construction (those not involved in the actual restoration work), insurance, medical services, etc. all would provide services to the employees, clients, and suppliers of the project. All of this supplemental economic activity would be considered induced by the San Joaquin River Restoration.

Given that ecological restoration work in not something that fits neatly into a standard industrial framework, the model was built based on the described activities in the "Framework for Implementation" document. Even with these distinctions the level

of detail is fairly high, so the estimates presented here are fairly crude, but provide reasonable insights into the anticipated job-creation from the restoration projects. Table 3 shows the breakdown of the $728.8 million restoration expenditures as they were allocated according to the 440 potential IMPLAN industry classifications.

Table 3

Distribution of Restoration Expenditures by Industry

Industry Classification	IMPLAN Industry Code	Total Expenditure ($728,825,100)	Fraction of Total
Construction, non-residential	36	$513,835,100	70.50%
Environmental Consulting Services	375	61,550,000	8.45
Federal Government	439	46,800,000	6.42
State and Local Government	437	35,200,000	4.83
Scientific Research Services	376	34,380,000	4.72
Engineering Services	369	22,560,000	3.10
Other Agricultural Work[a]	10	13,000,000	1.78
Miscellaneous Scientific Services	380	1,500,000	0.21

Notes: [a] Given the difficulty of specifying an appropriate industry classification for invasive plant species control, it was placed in the "all other crop farming category." This is clearly a rudimentary classification, but should not have a material impact on the results given the low amount of planned expenditures.
Sources: San Joaquin River Restoration Program, "Framework for Implementation" (June 19, 2012) and author's calculations.

The IMPLAN results based on these model inputs reveal a total economic impact of 10,282 full-time-equivalent jobs. This degree of job-creation indicates that the San Joaquin River Restoration Program will generate 14.1 jobs per $1 million of investment. This estimate is slightly less than the median of the estimates from other studies (15.5) reported in Table 2. One potential explanation for this finding is that roughly 25 percent of the SJRRP expenditures are for such activities as environmental consulting, scientific research, or federal and state government payrolls which all have relatively smaller indirect economic effects than other types of activities, like construction, that make heavy use of various inputs into their end products. Nonetheless, the results found here for the San Joaquin River Restoration are fully consistent with other regions of the country and other studies using different methodologies.

The specific details of the predicted employment effects are presented in Table 4. The largest numbers of jobs would be created directly at the restoration sites, including significant numbers of construction-related jobs. The number of direct annualized full-time-equivalent jobs that would be created by the restoration is estimated to be 4,696. One point to keep in mind is that this estimate corresponds to one person working an entire year at full-time. Given the nature of much of the restoration work, many more workers will actually be impacted by river restoration work as some are likely to work on projects for only short periods of time and perhaps only for a limited number of hours, depending on each person's specific duties. The IMPLAN estimates provide an

aggregation up to annualized full-time-equivalent jobs. Indirect employment, triggered by supply-chain purchases associated with getting the work completed, will contribute 1,891 annualized full-time-equivalent jobs. Finally, the induced effect will add another 3,695 jobs. These jobs will be triggered by the increased consumption that results from the added labor income that employees working directly on the projects or those who benefit from indirect purchases will receive. The induced jobs are largely service jobs such as food and restaurant services, retail, real estate, and other professional services.

Table 4

Aggregate Employment Effects of Proposed San Joaquin River Restoration Projects

	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Full-time-equivalent jobs created	4,696.2	1,890.6	3,694.7	10,281.5
Fraction of total	45.7%	18.4%	36.0%	100%

Source: Based on forecasts from IMPLAN3 modeling using input assumptions in Table 3 and those discussed in the text. Fractions do not add to 100 percent because of rounding.

While the San Joaquin River Restoration Program carries out the requirements of the Settlement, another source of job-creation is underway that is complementary to the activities considered above. Private nonprofit groups that are active in the San Joaquin Valley region, including the San Joaquin River Parkway and Conservation Trust, The Nature Conservancy, and River Partners, may see their ability to secure competitive grant funding from

various sources increased as a result of the main work of the San Joaquin River Restoration discussed above. Thus, the main work on the San Joaquin River will help to bring additional funds to the region, further catalyzing economic activities in the San Joaquin Valley. Table 5 reports a compilation of various restoration programs that are on-going and one proposed large-scale program that largely serve to enhance the work of restoring the San Joaquin River. The table reveals a few important points. First, there are abundant programs and funding streams currently available that provide competitive grants for restoration work that would bolster the restoration effort on the San Joaquin River. In fact, the Settlement reached to restore the river makes the San Joaquin more competitive for such funding. In other words, the large-scale Restoration Program will serve as a magnet for attracting other monies only available through a competitive bid process. Second, the amount of funding that is likely to bolster restoration work regionally is significant, well in excess of $50 million. Finally, based on estimates on the fraction of the expenditures in Table 5 that are likely to be spent on acquiring private lands from willing sellers near the river that will be restored, it seems reasonable to assume that roughly $45 million will be spent on restoration work by 2020.[xi] Applying the job-creation estimate of 14.1 per $1 million investment calculated above, activities of private entities could increase the total number of jobs estimated above by at least 635 for a grand total of 10,917 jobs.

The degree of potential job creation forecasted to result from the San Joaquin River Restoration is critical to a region with

chronically high unemployment and that is suffering disproportionately from the latest great recession. In particular, the construction industry in the San Joaquin Valley has been particularly negatively impacted by the recession and has been a consistent drag on the region's economic recovery. The over-building that took place during the housing bubble negatively impacts private construction activity today and the extraordinarily tight fiscal realities facing state and local governments means that the construction industry in the San Joaquin Valley can expect to lag behind other industries in its economic recovery. Therefore, the significant expenditures on construction activities to restore the San Joaquin River anticipated within the next several years will bolster a segment of the San Joaquin Valley's economy and labor force that would otherwise continue to languish. Expenditures on the order of half a billion dollars can clearly serve as a catalyst for improving the San Joaquin Valley economy, especially in the counties most impacted by the work – Merced, Madera, and Fresno Counties.

A $2 million private project to control invasive weed species in an area of the San Joaquin River to be restored exemplifies the type of spillover benefits that restoration work can have on the local labor market. The project is the joint effort of the San Joaquin River Parkway and Conservation Trust, River Partners, and The Nature Conservancy to monitor and control invasive plants that will primarily aid in the restoration of fish habitat on the river. However, an important ancillary goal of the project is to address the high unemployment, especially among the youth, in the areas

surrounding the river restoration. The grantees plan to hire local youth corps members and local agricultural laborers, especially during slack times of the planting and harvesting season, to carry out the project. While much of the construction work that is detailed in the Framework for Implementation document and listed in the Appendix Table will provide jobs for skilled workers, many of the projects carried out by private entities and projects considered secondary in the Framework document will provide job opportunities for unskilled workers. Importantly, in a labor market where unskilled workers experience fairly high levels of unemployment, securing entry into the labor market will enable them to acquire broad-based employment skills, such as reporting to work on time, following instructions, taking responsibility for one's work, etc., that will add to their overall productivity within the local economy.

In sum, the restoration of the San Joaquin River not only provides an opportunity to improve the ecological health of a vital natural resource within the San Joaquin Valley, but it also will help to restore a local economy that has experienced a devastating downturn over the past four years. To the extent that restoration work uses local contractors and workers, the greater the likelihood that these labor-income dollars will further enhance the economic prospects of the broader regional economy.

Table 5

Compilation of Other Sources of Funding and Programs Complementing the San Joaquin River Restoration

Source of Funding [a]	Program Name	Governing Agency [a]	Approx. Funding for SJR Restoration	Frequency	Approx. Lifespan
Farm Bill	Wetland Reserve Program	USDA NRCS	$1,000,000	annual	8 years
Farm Bill	Environmental Quality Incentives Program	USDA NRCS	$500,000	annual	8 years
Congressional Act (1964)	Land and Water Conservation Fund	USDI USFWS	$500,000	annual	ends 2015
NAWMP	North American Wetland Conservation Act	USFWS	$1,000,000	annual	TBD
SFPUC	Watershed Environmental Improvement Program	SFPUC	$2,000,000	one-time	ends 2015
CA Prop 1E	Flood Protection Corridor Program	DWR	$5,000,000	~3 years	ends 2016
CA Prop 117	Habitat Conservation Fund	WCB	$500,000	annual	TBD
CA Prop 84	San Joaquin River Conservancy Act	WCB	$25,000,000	one-time	ends 2018
CA Prop 1E	FloodSAFE California (Conservation Strategy)	DWR	$8,000,000	one-time	ends 2018
CVPIA	Habitat Restoration Program / Conservation Program	BOR/USFWS	$300,000	annual	TBD
CA Prop 84	CA Conservation Corps	CCC	$200,000	annual	ends 2018
Unknown	Bay Delta Conservation Plan - South Delta Habitat Restoration	DWR	$25,000,000	one-time	TBD

Notes: [a] The acronyms listed in these columns refers to the following entities: USDA (US Department of Agriculture); NRCS (Natural Resources Conservation Service; USFWS (US Fish and Wildlife Service); SFPUC (San Francisco Public Utilities Commission); DWR (CA Department of Water Resources); WCB (CA Wildlife Conservation Board); BOR (US Bureau of Reclamation); CCC (CA Conservation Corps; NAWMP (North American Waterfowl Management Plan (USFWS)); CVPIA (Central Valley Project Improvement Act).

Source: Data compilation generously provided by Julie Rentner – Central Valley Regional Director, River Partners

V. ADDITIONAL ECONOMIC BENEFITS OF RIVER RESTORATION

RECREATION

In terms of assessing the economic benefits of the San Joaquin River Restoration, job-creation will be the immediate impact that residents will experience. People will be put to work on restoration projects, while the economic stimulus of the restoration expenditures filters through local economies, triggering indirect and induced job creation. Yet, as Hurd (2009, p. 18) notes, "employment implications of watershed restoration only measure one aspect of societal welfare." In addition to the obvious ecological benefits that a river restoration can provide, such as improved floodplain management, water quality, and riparian habitat and wildlife, which clearly enhance citizens' value of their natural resource, restoration can "grow tourism revenues in local communities, increase housing values, provide inherent quality of life improvements, supply well-paying jobs, and facilitate long-term economic growth" (Hurd 2009, p. 17). As Cordell, et. al. (1990, p. 59) note, "protecting and managing rivers for outdoor recreation may provide a clean, economically viable means for enhancing local economic development" and that taking advantage of such "recreational uses of natural resources [provides] an added means for diversifying local economies."[xii]

Outdoor recreation is clearly important to Californians.[xiii] A recent study by BBC Research & Consulting (2011) for the California Department of Parks and Recreation concluded that California residents engaged in 3.5 billion days of outdoor recreation in 2008. The study estimated that residents spent over $20 billion in direct expenditures on their recreational pursuits, with $2.9 billion spent in the Central Valley. Statewide, this level of direct expenditure employed roughly 200,000 people in 2008, which does not include the indirect or induced spillover effects that might result from the direct expenditures. As the BBC study shows (p. 6), recreation is an important job-creator in California, employing citizens at levels similar to industries such as trucking transportation (185,000 jobs), legal services sector (222,000 jobs) and firms that support activities associated with agriculture and forestry (222,000 jobs). Further corroborating the important role that the natural environment plays in the California economy, a recent U.S. Fish & Wildlife Service study estimated that over 6 million people participate in wildlife-watching activities in the state. This degree of recreational participation, the study found, generates a total economic impact of $7.8 billion on the California economy, supporting 71,589 jobs (Leonard 2008, pp. 8-9).

The restoration of the San Joaquin River and the renewal of a salmon run will play a transformative role in making the river a recreational destination for local and more distant visitors. A restored river will provide ample opportunities for residents to enjoy not only fishing, but also canoeing and kayaking, swimming,

picnicking, wildlife viewing and bird watching, hiking, and, more generally, finding pleasant places to spend time with family and friends. The renowned University of California, Berkeley resource economist W. Michael Hanemann (2005) conducted a comprehensive forecast of the direct recreational benefits that citizens would enjoy as a result of a restored river by 2025. He estimated that the economic value of increased use and enjoyment from water-related recreation would amount to $29.5 million annually in the Upper San Joaquin River reaches and $15.7 million annually in the Lower San Joaquin River. Hanemann (p. 84) predicted that 475 jobs would be supported as a result of the enhanced level of recreation that would take place on a restored river, increasing the number of jobs the Restoration Project can contribute to a total of 11,392.

ECONOMIC DIVERSIFICATION & COMMUNITY DEVELOPMENT

The modern economic developments that have swept across California in recent decades, such as biotechnology or computer technology, have largely skipped over the San Joaquin Valley. The SJV economy has historically relied disproportionately on the agricultural and food processing sectors and, more recently, government employment. Given the SJV's abundance of sunshine, wind, and organic materials from its agricultural operations, the emergence of clean-energy technologies could provide an important toehold on future economic opportunities.[xiv] Without doubt, future economic growth and prosperity relies on diversifying

the economy as a means of attracting future employers, talented workers, and economic growth opportunities. An important feature of economic development is the so-called "agglomeration effect" in which business and workers find benefits from being co-located near one another, thus creating a cluster of economic activity. In other words, innovative and productive firms and workers inherently encourage the co-location of businesses that can benefit from being near them.[xv] This phenomenon helps explain the stunning success of Silicon Valley, for example, where productive firms, highly skilled workers, and financiers are wholly integrated, thus creating an overall economic effect that is larger than if each were located in the region in isolation.

While a catalyst for economic growth is obviously a necessary condition for success, it is not a sufficient condition. Jesse Shapiro (2006) recently estimated that 60 percent of the growth rate in employment across metropolitan areas from 1940 to 1990 can be attributed to the agglomeration effects associated with the enhanced productivity of college graduates in a city. The remainder can be attributed to the notion that more highly educated areas experience more rapid growth in quality of life, which in turn contributes to growth in employment and wages itself. There is voluminous evidence in real estate economics research that suggests that residents value the positive amenities associated with their surroundings. Holding other factors constant, the overwhelming evidence shows that people are willing to pay higher real estate prices to gain access to such factors as good

schools, access to transportation links, low crime, cultural amenities, or proximity to parks.[xvi] A recent study issued by the U.S. Fish and Wildlife Service (Taylor, et. al., 2012) found compelling statistical evidence that proximity to national wildlife refuges increases local property values. Conversely, locations with negative attributes have relatively lower real estate values. In sum, people vote with their feet and are willing to pay to gain quality of life. Thus, as policymakers and residents think to the future economic success of their communities, understanding the critical importance of the non-economic features that make a community livable should not be underestimated.

Studies of business location decisions to rural areas have found that "the primary source of local economic vitality in much of the western U.S. is the quality of the living environment found in many rural communities."[xvii] The San Joaquin Valley's relative proximity to the Sierra Nevada and coastal areas certainly adds amenity value to the region, but a restored San Joaquin River brings the promise of numerous nearby recreational opportunities directly tied to an environmental feature that makes the region environmentally unique. ***By providing significant local recreational amenities, a restored San Joaquin river can help the region attract new and more diverse business investments that result in additional jobs and economic opportunities for the region's residents.***

EDUCATION & RESEARCH

Recent research in economics has highlighted the important role that universities can play in catalyzing local and regional economic growth.[xviii] According to James Adams (2002, p. 254), knowledge spillovers from universities are much more localized than industrial spillovers because "firms go to nearby universities for advice, research, and students. In contrast, industrial interactions take place over a greater distance and occur selectively." The University of California, Merced began its academic operations in Fall 2005 with a small contingent of faculty, yet has grown about five-fold since its first year. While it is hard to predict what areas the new university will achieve excellence in over the decades to come, what is clear is that research focusing on environmental sustainability has achieved early prominence, coordinated under UC Merced's Sierra Nevada Research Institute (SNRI).[xix] The university's proximity to the San Joaquin River provides valuable research opportunities for faculty and students to participate in and learn from the restoration process. If university researchers are able to become integrated into the restoration process, then the San Joaquin Valley could become a fountainhead for new knowledge that can inform future restoration efforts elsewhere.

The availability and quality of water is of critical importance to the San Joaquin Valley's agricultural success and the well-being of Californians. Presently, UC Merced has developed a strong research program in mountain hydrology that uses state-of-the art ground-based measurement systems, satellite, and other remotely sensed data to better understand and predict water and biogeochemical cycles in forested areas, above the tree line, in meadows, and in streams. Measuring and understanding the availability of water resources in the Sierra Nevada will facilitate better decision-making in the San Joaquin Valley. With population pressures intensifying over the coming decades, having the ability to manage scarce water resources efficiently is critical. But the restoration of the San Joaquin River opens up whole new avenues of potential research and educational opportunities for UC Merced. Having the opportunity to study a riparian habitat from desiccation to restoration, local researchers will be able to understand the science of the restoration process that can better inform future efforts. Importantly as well, the restoration effort in the university's proverbial backyard provides students valuable access to a natural laboratory that will enable them to secure critical training that will enhance their ability to secure future jobs in the ecological restoration or research sectors.

VI. CONCLUDING REMARKS

The main work to restore the San Joaquin River and the resulting recreational industry expansion resulting from the river restoration will generate at least 11,392 jobs in the San Joaquin Valley. The San Joaquin Valley is in dire need of this type of impetus as the region experiences some of the highest rates of unemployment in the country.

The Settlement Agreement to restore the San Joaquin River to support a thriving salmon run was clearly not designed as a make-work program, but the unanticipated positive consequences of the restoration is the significant infrastructure investment and job-creation that will take place in the regional economy. Assuming $728.8 million in restoration expenditures, this research suggests that 10,282 annualized full-time-equivalent jobs will be created between 2013 and 2025. The preponderance of these jobs will be generated during the peak construction years between 2015 and 2019, inclusive. In addition to this economic stimulus from the formal Restoration Program, private restoration activities will also add significantly to the regional economy. Based on very conservative estimates of current and anticipated restoration work by private entities, funded through a variety of competitive grants, forecasts presented in this report indicate another 635 annualized full-time-equivalent jobs will be created by 2020. In addition to the

higher-paid and more-skilled construction jobs directly related to the Restoration Program, these additional restoration activities may rely more on less skilled labor. These jobs will offer young workers and those with fewer skills important opportunities to gain a permanent foothold in the labor market, something that is desperately needed given the very slow recovery from the Great Recession.

Many of these restoration jobs, however, will only last as long as the large-scale restoration activities are active. The long-term economic benefits of the restoration of the San Joaquin River should not be overlooked, however. Especially in rural areas of the western U.S., residents place high value on the outdoor recreational amenities available to them near their homes. Moreover, a river that supports a thriving salmon population could become a significant tourist destination. Recreation is a flourishing business in California and a restored San Joaquin River would support fishing, boating, wildlife viewing, picnicking, swimming, and other outdoor activities. A careful analysis of the job-creation from expanded recreation activities on the San Joaquin indicated that 475 full-time jobs would be supported in steady-state directly as a result of the restoration. Enhancing the recreational and amenity values of the local economy only makes it easier to draw in businesses that require high-quality workers to sustain their success. Finally, the river itself can serve as a living laboratory for local researchers and students.

This report has shown that the economic debate surrounding the San Joaquin River's restoration is much more nuanced than typically demonstrated. Critics of the Settlement only see the opportunity costs of diverting water from agricultural to environmental purposes, but the economics of the river restoration must also consider the benefits that will accrue. Jobs and economic stimulus will result from the physical work to implement the restoration and the restored river, along with its renewed salmon stock, can serve as a lucrative recreational destination that can support jobs and leave the San Joaquin Valley region poised for future economic development. The study has not considered the non-use economic value that residents derive from the knowledge that future generations can enjoy this important natural resource and that the river once again will support a flourishing riparian ecology. Prior research in environmental economics indicates that these values can be substantial. As local residents become more fully engaged in the debate surrounding the San Joaquin River Restoration, this study will have achieved its goals if full consideration is given not only to the opportunity costs of San Joaquin River water, but also to the economic benefits of its alternative uses.

APPENDIX

San Joaquin River Restoration Program Projects

RESTORATION ACTIVITY	IMPLAN industry code	Expenditure
Program Staffing		
U.S. Bureau of Reclamation	439	$15,600,000
U.S. Fish & Wildlife Service	439	$15,600,000
U.S. National Marine Fishery Service	439	$15,600,000
CA Department of Water Resources	437	$15,600,000
CA Department of Fish & Game	437	$15,600,000
Channel & Structural Improvements		
Chowchilla Bifurcation Structure		
NEPA/CEQA	375	$500,000
Final Design	369	$370,000
Construction	35	$7,300,000
San Joaquin River Control Structure Passage (1)		
Final Design	369	$370,000
Construction	35	$7,300,000
Reach 2B Conveyance		
Final Design	369	$5,760,000
Construction	35	$88,110,000
Mendota Pool Bypass (1)		
-SJR Control Structure (above)		
-Fresno Slough Dam		
Final Design	369	$9,570,000
Fresno Slough Dam	35	$51,000,000
Mendota Dam Fish Ladder	35	$3,100,000
Extension Levees	35	$40,000,000
Main & Helm Canal Relocations	35	$8,900,000
Mendota Pool Short Canal & Control Structure	35	$13,600,000
Mendota Pool Fish Screen	35	$41,000,000
Columbia Canal Siphon	35	$28,000,000
Arroyo Canal Screening & Sack Dam Passage		

Construction	35	$25,000,000
Reach 4B, restore main channel to convey 4500 cfs		
Final Design	369	$5,850,000
San Slough Complex	35	$5,860,000
Levee Construction	35	$38,810,000
Road Crossings	35	$10,320,000
Eastside Bypass Control Structure		
Final Design	369	$220,000
Construction	35	$4,340,000
Mariposa Bypass Control Structure		
Final Design (low estimate)	369	$310,000
Construction (low estimate)	35	$6,250,000
Mariposa Bypass Drop Structure		
Final Design	369	$110,000
Construction	35	$2,170,000
Mitigation & Conservation Strategy		
Millerton Lake Boat Ramps	35	$210,000
Conservation Strategy	375	$10,000,000
Invasive Species Control	10	$13,000,000
Channel Capacity Advisory Group	437	$4,000,000
Consultation on Increased Flows	375	$7,500,000
Programmatic Cultural Resources	380	$1,500,000
Flow Management & Monitoring		
Stream Gauging	375	$2,600,000
Physical & Biological Monitoring	375	$40,950,000
Seepage Management		
Assumed for 2000 cfs	35	$22,974,100
Levee Stability (2000 cfs assumed)		
Reach 2A, 3, 4A, 5	35	$9,911,000
Reach 2B, Eastside Bypass	35	$50,120,000
Fish Reintroduction		
Conservation Hatchery Construction	35	$14,560,000
Hatchery Operation & Maintenance	376	$7,000,000
Monitoring of Source Stock	376	$7,800,000
Collection, Transport, & Release of Source Stock	376	$8,320,000

Trap & Haul Program	376	$11,260,000
Water Management		
Friant-Kern Canal and Madera Canal Capacity Restoration Project	35	$35,000,000
TOTAL		$728,825,100

Note: (1) Mendota Pool Bypass estimates based on the median valued alternative at $209 million for the "Fresno Slough Dam reforming the Pool" option.

Source: San Joaquin River Restoration Program, "Framework for Implementation," June 19, 2012.

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ENDNOTES

[i] See Mather Economics (2010).
[ii] The Friant Water Users Authority is a joint powers authority that has member water districts in Madera, Fresno, Tulare and Kern Counties.
[iii] See http://www.restoresjr.net/background.html
[iv] The agencies implementing the Settlement include the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fishery Service, California Department of Water Resources, and California Department of Fish and Game.
[v] This calculation is drawn from the Caltrans "FY 12/13 Workload File." See http://www.dot.ca.gov/docs/reports/Project_Development_Cost_Report_and_Project_Delivery_Report_spreadsheet.xlsx
[vi] For a succinct review article outlining the state of the present research on measuring the economic benefits from restoration, see Robbins and Daniels (2012). The article, however, devotes no attention to the "economic development values" that are depicted in Figure 1. Hurd (2009) offers another succinct treatment of the economic benefits of watershed restoration, more specifically, that does include a brief consideration of the local economic spillovers from the actual restoration work.
[vii] The measurement of direct use values tends to get more attention among economists, primarily because measuring them is more concrete. Assessing people's economic benefits from fishing and recreational opportunities, as opposed to a nebulous indirect effect that may or may not affect them, is more conducive to measurement. For representative examples of such work, see Daubert and Young (1981), Loomis and Creel (1992), Douglas and Taylor (1998), Colby and Smith-Incer (2005), and Robbins and Lewis (2008). Most of these studies, in fact, find that the recreational benefits associated with the ecological restoration exceed the costs of implementing the restoration, which range from dam removal, to increased river flows, to preserving sensitive riparian areas.
[viii] It is the case, however, that scholars have recognized the economic development potential associated with recreational opportunities on a restored river, for example. In a unique extension to the standard direct-value measurement of the benefit people receive from recreational visits to a river, Cordell, et. al. (1990) estimate how such visits have spillover economic stimulus benefits to local economies. Subsequent work includes Douglas and Harpman (1995) and Hjerpe and Kim (2007). In general, however, there is relatively little work attempting to estimate the broader economic spillovers associated with individuals' direct use, such as recreational use, of a natural resource.
[ix] See http://www.dof.ca.gov/research/demographic/reports/projections/interim/view.php
[x] Specifically, the estimates below first assume that Mendota Pool Bypass alternative chosen is the Fresno Slough Dam with an estimated cost of $201 million. The two other alternatives were the Compact Bypass Alignment and the Fresno Slough Dam with an Upstream Diversion Structure estimated at $174 and $259 million, respectively. Second, the estimates below assume that the alternative chosen for the Reach 4B, Eastside Bypass, and Mariposa Bypass project is

the "Restore Reach 4B Main Channel to Convey 4,500 cfs" at an estimated cost of $123 million. The other three alternatives that are presented cost $185, $178, and $164.11 million.

[xi] To calculate the amount that would be spent on restoration, I only included projects for which there was a distinct measure of its lifespan. In other words, I excluded projects for which the data suggest that an annual amount would be spent for an unspecified time frame. Also, the Bay Delta Conservation Plan has been excluded because of its uncertain funding at present. Including this project, in particular, would add significantly to the estimates of job creation from private projects.

[xii] For an annotated bibliography of the economic benefits of river conservation, see Rivers, Trails & Conservation Assistance Program (2001). Though out-of-date, the bibliography highlights some of the important studies that can offer important insights into the economic benefits, broadly construed, of river restoration.

[xiii] See the survey results presented in California Department of Parks and Recreation (2009).

[xiv] See Kantor (2010).

[xv] For an excellent analysis and discussion of agglomeration economies, see Glaeser (2008).

[xvi] For representative evidence that real estate values are positively correlated with various housing amenities, especially with respect to environmental qualities, see Kulshreshtha and Gillies (1983), Streiner and Loomis (1996), Song and Knaap (2004), Cho, et. al. (2006), Mohamed (2006), Provencher, et. al. (2008), and Bark, et. al. (2009).

[xvii] Quotation from Johnson and Rasker (1995, p. 413). See also Power (1988).

[xviii] For evidence that industries locate near universities to capture the unique local benefits of their research activities, see Zucker, Darby, and Brewer (1998), Woodward, Figueiredo, and Guimaraes (2006), Abramovsky, Harrison, and Simpson (2007), and Furman and MacGarvie (2007). The localized network effects associated with faculty, research staff, and graduate and undergraduate students, based on recent empirical research, seems to be a critical feature of the relationship between universities and their industrial counterparts that rely on knowledge generation. Kantor and Whalley (2009) measure empirically the economic benefits of knowledge spillovers from research universities in a study of urban counties from 1981 to 1996. The research shows that the spillovers are most pronounced for industries in which higher education shares a labor market or that are technologically closer to universities in terms of citing patents generated by universities in their own patents.

[xix] Information on the Sierra Nevada Research Institute is drawn from https://snri.ucmerced.edu/snri/index.html