Kern Fan Groundwater Storage Project

FEASIBILITY REPORT

Appendix F: Economic Benefits Evaluation and Supporting Documentation

October 21, 2019
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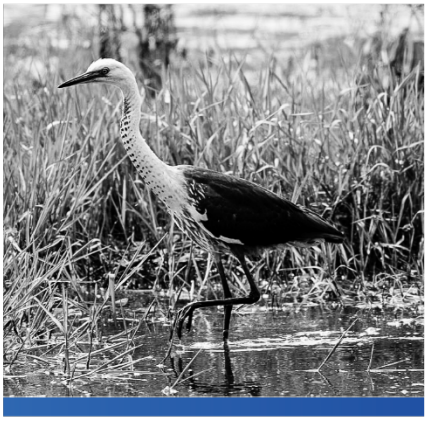

Irvine Ranch WATER DISTRICT

Rosedale-Rio Bravo WATER STORAGE DISTRICT

POLICY ANALYSIS FOR THE PUBLIC AND PRIVATE SECTORS

M.CUBED

October 15, 2019

To: Fiona Sanchez, Irvine Ranch Water District

From: Richard McCann, Partner

RE: Estimate of Benefits from the Kern Fan Groundwater Storage Project for the Water Infrastructure Improvement for the Nation Program (WIIN)

Introduction

This technical memo outlines the data and methodological approach for calculating the economic benefits of Irvine Ranch Water District's (IRWD) and Rosedale Rio Bravo Water Storage District's (Rosedale) proposed Kern Fan Groundwater Storage Project in support of a feasibility study under the Water Infrastructure Improvement for the Nation Program (WIIN).

Overview

The Kern Fan Integrated Groundwater Storage Project (Project) will provide ecosystem benefits for the Delta and its tributaries and other public and non-public benefits by recharging and storing up to 100,000 acre-feet (AF) of unallocated State Water Project (SWP) Article 21 water, unallocated Kern River floodwater, and other water, as available, in the Kern County groundwater basin. Water would be stored for subsequent extraction and recovery to offset surface water demands during periods of need. Deliveries of unallocated Article 21 water would be made on behalf of Irvine Ranch Water District (IRWD) as a landowner in Dudley Ridge Water District (DRWD) and Rosedale as a sub-unit of the Kern County Water Agency. During droughts or times of need when surface supplies are reduced, stored groundwater will be recovered from the Project with up to 12 new extraction wells and conveyed to points of use in DRWD, IRWD and Rosedale's service areas. Approximately 25% of the stored Article 21 water would be held as SWP system water that would be used for ecosystem benefit purposes in the Delta. This 25% of the water would be made available for ecosystem benefits through operational exchanges, which would be facilitated through a Coordinated Operating Agreement that would be executed between the project partners and Department of Water Resources (DWR). The project will provide a variety of benefits, including water supply, groundwater improvement, ecosystem, agriculture, and emergency response benefits. Based on project information provided by IRWD, Rosedale, Cramer Fish Sciences and MBK Engineers, M.Cubed completed estimates of the economic benefits in these five benefit categories. Estimates of the net present value (NPV) of total benefits in 2018 dollars are outlined in Table 1.

Table 1. Summary of Benefit Estimates

Type of Benefit	NPV of Benefits (2.875%)
Water Supply Benefits—M&I	$49.5
Water Supply Benefits—Agriculture	$77.8
Water Supply Benefits--Groundwater	$9.1
Environmental Benefits—Fish species recovery	$37.5
Environmental Benefits—Incidental Wetland Habitat	$162.6
Emergency Response—Extended drought	$18.1
Emergency Response—Delta failure	$29.6
Agricultural Benefits	$25.8
Total Benefits	$410.0

Project benefits are expected to begin in 2026 and continue throughout the 50-year life of the project, through 2075. We calculate net present value at the project start in 2026. The net present value calculation uses a discount rate of 2.875%, which is the rate Federal agencies use in water resources planning.[1]

Throughout this analysis we rely on work already produced for the Kern Fan Project to apply for funding under California's Water Storage Investment Program (WSIP).

Benefits

Water Supply--Municipal and Industrial

Municipal and Industrial (M&I) Water Supply benefits are non-public benefits that will accrue to IRWD, Rosedale, and Dudley Ridge, and their service area customers. According to modeling results from MBK Engineers, considering only Article 21 water supplies, the project will provide on an average annual basis 2,700 acre-feet of water by 2030 and 3,000 acre-feet by 2070 in non-public water supply benefits. However, Rosedale estimates that an additional 9,415 AF will be available on average annually from non-Article 21 water sources including other State Water Project Table A, Kern River high flow, Kern River flood, and Friant 215 supplies, of which an additional 2,900 acre-feet of water will be available annually for non-public water supply benefit. According to historical supply sources for Rosedale and IRWD, on average there would be approximately 7,468 AF of water available to agriculture,[2] and approximately 1,947 AF of water available to IRWD.[3] To be conservative we assume that this supply remains constant over time, rather than increasing in the same way that Article 21 water is projected to do. Approximately three-quarters of the total water supply will be available to Rosedale and Dudley Ridge for agricultural use, and the remaining one-quarter will be available to IRWD under both future conditions.

[1] U.S. Bureau of Reclamation, "Change in Discount Rate for Water Resources Planning," https://www.federalregister.gov/documents/2018/12/18/2018-27331/change-in-discount-rate-for-water-resources-planning, December 18, 2018.

[2] Based on deliveries to the smaller 300-acre Kern-Tulare and Rag Gulch water storage facilities operated by RRBWSD from 2004 to 2017, weighted by probability of water-year type.

[3] For 2010 to 2017, weighted average by water year type, and only in wet years for IRWD water.

We use the alternative cost approach to estimate the water supply benefits of the project. The water supply benefit is divided between agricultural (75%) and urban uses (25%), which face different alternative costs of water.

For urban municipal and industrial uses by IRWD, the alternative supply cost is the Tier 1 untreated rate from Metropolitan Water District of Southern California (MWDSC), which was $676 per AF in 2015. We escalate this rate over time using MWDSC's forecast of Tier 1 prices as found in their Ten-Year Financial Forecast provided at a February 9, 2016 MWDSC Board Meeting.[4] According to the forecast of Full Service Untreated Tier 1 water, prices are projected to increase by an average of 5.6% from 2016 to 2026. Over the same period, average CPI inflation is projected to be 2.3%, resulting in an average real price increase of 3.3%. We apply this rate of increase to MWDSC Tier 1 rates over the life of the project. We consider documentation provided by MWDSC on their expected price increases to be sufficient rationale and documentation of urban water price escalation. We also apply conveyance costs using data provided by Dudley Ridge, which includes monthly conveyance costs from 2001 to 2017.[5] Conveyance costs average $18.67 per AF in 2018 dollars.

Applying the 2.875% discount rate to the stream of alternative water supply costs, we arrive at the total net present value of non-public water supply benefits of **$49.5 million**.

Water Supply--Groundwater

To evaluate the groundwater benefit, we use the alternative cost approach to estimate how much it would cost to purchase the same volume of water for groundwater recharge in Kern County as that provided by the project.

According to groundwater policy in Kern County, a portion of banked groundwater is not recovered by the banking entity and remains in the ground to bolster local groundwater levels. For this project groundwater basin leave-behind percentages vary depending on the water supply account--9% of water in the urban account and 4% of water in the agricultural account will be left to help recharge local basins, according to groundwater modeling assumptions used by MBK Engineers. These numbers are also consistent with an existing Memorandum of Understanding (MOU) between Rosedale and other Kern Fan banking entities. For the environmental account, we apply an average of these two rates, or 6.5%. Based on these values, we find a weighted average leave-behind rate of 6.6% in 2030 and 6.5% in 2070 and use these shares to calculate the total groundwater level benefit.

For the purpose of recharging groundwater, we consider the alternative cost to be the cost of purchasing water through a water market, likely in northern California, that would be exported through the Sacramento-San Joaquin Delta. For an estimate of average costs of purchasing Delta export water on the water market, we use unit values developed by the California Water Commission in their Water Storage Investment Program Technical Reference.[6] These unit values were developed from a statistical analysis based on water transfer prices from 1992 to 2015, the Statewide Agricultural Production Model (SWAP), and assumptions regarding groundwater sustainability requirements in the state by 2045. These unit values were developed for various water year types (wet, above normal, below normal, dry, and critical) for 2030 and 2045, the year it is assumed that groundwater basins will reach sustainable levels. We weight Delta Export costs according to historic water year type frequency according to the San Joaquin River Water Year Index[7] to arrive at benchmark values for 2030 and 2045. As in the Non-Public Water Supply benefit above, we also added SWP conveyance costs to Delta Export costs. We use the same conveyance

[4] MWDSC Board meeting minutes with forecast summary included in the Appeal Supplement.

[5] Data from Dudley Ridge WD included the Appeal Supplement.

[6] California Water Commission. Technical Reference. November 2016. https://cwc.ca.gov/-/media/CWC-Website/Files/Documents/2017/WSIP/TechnicalReference.pdf

[7] California Department of Water Resources. http://cdec.water.ca.gov/reportapp/javareports?name=WSIHIST

cost of $18.67 in 2018 dollars based on 2001-2017 conveyance cost data provided by Dudley Ridge. Interpolating between 2030 and 2045 values and taking the sum across all project years, we find a net present value of **$9.1 million** at the project start, in 2018 dollars.

Water Supply--Agricultural

We use the alternative cost approach to estimate the water supply benefits of the project. The water supply benefit is divided between agricultural (75%) and urban uses (25%), which face different alternative costs of water. All of Rosedale's water supply is used for agriculture, and half of IRWD's water supply goes toward agricultural end uses in Kern County.

For agricultural water use, we use the Delta Export unit value described in the groundwater benefit section above as the value of an alternative water supply for Rosedale and Dudley Ridge. Delta export values are provided for 2030 and 2045, which we re-weight according to the water year types during which IRWD and Rosedale are expected to recover stored groundwater according to MBK Engineers. Since IRWD and Rosedale are projected to accrue water supplies in different water year types (with Rosedale drawing on their supplies mainly in dry and critically dry years, while IRWD's supply benefits occur in above normal through critically dry years) two different water values are required—one weighted for IRWD's supply and one weighted for Rosedale's supply. These weights are available for 2030 and 2070 based on MBK's Engineering analysis. We therefore use water cost anchor points of 2030, 2045, and 2070—2030 unit values weighted at 2030 recovery levels, 2045 unit values weighted at 2030 recovery levels and 2045 unit values weighted at 2070 recovery levels. We interpolate between these points and extrapolate to find unit values for 2026 to 2075. These unit values range from $345 per AF for IRWD, and $353 per AF for Rosedale in 2030 to $917 per AF for IRWD and $944 per AF for Rosedale in 2045 in 2018 dollars. We also apply conveyance costs using data provided by Dudley Ridge, which includes monthly conveyance costs from 2001 to 2017.[8] Conveyance costs average $18.67 per AF in 2018 dollars.

Applying the 2.875% discount rate to the stream of alternative water supply costs, we arrive at the total net present value of non-public water supply benefits of **$77.8 million**.

Environmental—Fish Species Recovery

We consider two approaches to evaluating the environmental benefit from salmon conservation—the willingness to pay approach, based on a per fish benefit value for two runs of Chinook salmon and the alternative cost approach. We describe the willingness to pay approach below but ultimately use the alternative cost approach as our final estimate of project benefits.

The project will create increased environmental flows in dry and critical years by offsetting State Water Project Table A water demands and making that water available for instream flows from Lake Oroville, along the Feather and Sacramento Rivers, and in the Delta estuary. Based on water modelling carried out by MBK Engineers, Cramer Fish Sciences recommended pulse flows on the Feather River to maximize benefits to Winter and Spring run Chinook Salmon, and Steelhead Trout.

Cramer Fish Sciences modeled the number of fish that would be restored in the 2030 and 2070 future conditions based on the project using Article 21 water supplies only. No further analysis is available on how additional non-Article 21 water would impact fish populations. Based on Article-21 water only, we take the annual expected number of additional winter-run and spring-run Chinook for 2030 and 2070, and interpolate between the two points, and extrapolate backwards to 2026.

The WSIP Technical Reference recommends a benefit of $100,000 per fish per year for winter and spring-run Chinook.[9] In order to arrive at that estimate, the California Water Commission reviewed numerous

[8] Data from Dudley Ridge WD included the Appeal Supplement.

[9] California Water Commission. Technical Reference. November 2016. https://cwc.ca.gov/-/media/CWC-Website/Files/Documents/2017/WSIP/TechnicalReference.pdf

contingent valuation studies for West Coast salmon and steelhead trout, and ultimately drew on two studies. The first is a willingness to pay survey of 11.9 million California households, that found a median willingness to pay of $80,000 per fish for salmon restoration.[10] In addition, a study by the National Oceanic and Atmospheric Administration estimated the cost of restoring Central Valley Chinook salmon and steelhead at $58,000 to $120,000 per adult fish.[11] The California Water Commission found that these two studies provide a reasonably consistent basis for estimating the value of restoration for these fish species, recommending a value of $100,000 per fish per year. We apply this value to the stream of future additional Chinook to calculate a net present value of $59.1 million. However, this is only a partial benefit, based on a fraction of the total project supply.

This analysis did not quantify benefits separately to steelhead trout or green sturgeon due to lack of sufficient information, however, Cramer Fish Sciences found that there would be additional benefit to both species, both of which are considered highest priority by the California Department of Fish and Wildlife. Since this analysis ultimately uses the alternative cost of procuring environmental water, rather than the willingness to pay approach, impacts to these individual species are not evaluated. However it should be noted that they would also benefit from the project.

To calculate the final environmental benefit of Salmon recovery we rely on the alternative cost approach. This approach is based on the cost of procuring a similar volume of water in dry and critical years for environmental flows. We again rely on unit values for Sacramento Valley agriculture developed by the California Water Commission in their WSIP Technical Reference as the alternative water source for environmental pulse flows, weighted by the years in which pulse flows would be available from the project. Unit values were derived in the same manner as for Delta Exports, described above in the section *Public Benefits—Agricultural Water Supply*, for the Sacramento Valley, which typically has more water resources available and therefore lower market prices.

To provide these flows in April and May of a Dry or Critically Dry year with a similar amount of certainty as the Kern Fan Storage Project would provide, an option agreement would need to be in place with suppliers in the Sacramento Valley. It is currently uncertain whether 18,000 acre-feet of water would be available in any given critically dry year. In addition, there is an issue of timing, since the water year type is not known with any certainty until March,[12] but pulse flows would provide the greatest benefit in April or May. Meanwhile farmers in the Sacramento Valley who would be making water available to transfer through fallowing would need to make their planting decisions in February and would incur losses if they make the decision to instead fallow land in the spring. Farmers would need to be compensated for this uncertainty in their planting decisions or would need to plant lower-value crops that require less initial investment. In fact, one of the main benefits of a storage project like the Kern Fan Project is that it provides certainty that water would be available for the environment in dry and critical years, and at any time in the spring when it would be most beneficial.

Options have been used for larger-scale Sacramento Valley water transfers at least four times—1995, 2003, 2005, and 2008. Without an option agreement already in place, there would not be sufficient time to reach an agreement in March, or if there was, there is a real possibility that farmers would need to be compensated for sunk costs in their initial planting. The options provide a level of certainty that water supply can be called every year on relatively short notice, given that the conditions driving that decision

[10] Hanemann, M. 2005. Rebuttal Expert Report of Professor W. Michael Hanemann, Ph.D. Page 71. 3C. 3 A New Valuation Study of the Restoration of the San Joaquin River. Case No. Civ-S-88-1658 LKK/GGH.

[11] National Oceanic and Atmospheric Administration (NOAA). 2014. Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead. Southwest Regional Office. Sacramento, CA. July.

[12] Based on DWR's updated Water Supply Index at http://cdec.water.ca.gov/water_supply.html.

cannot be known until shortly before the call is made. Options payments take these uncertainties into account.

We rely on several historical options contracts in the Sacramento Valley to estimate an appropriate option payment. There are four well-documented option contracts that have been used to account for the uncertainty of water transfers from the Sacramento Valley since 1995. For all of these transfers the option payment ranged from $3.50 to $10.00 per acre-foot paid every year whether the water was called or not, for the option of calling on water by February 15 of each year, before farmers have made investments in their fields.[13] The two more recent transfers, which took place in 2005 and 2008 include an additional option payment of $20.00 and $40.00 per acre-foot respectively, which allows the buyer to extend the call date from February 15 to May 2. This extra payment compensates farmers for any losses from initial planting. Since pulse flows provided by this project would be made available in April and May, this extension would be necessary to create an equal amount of certainty that flows would actually be available. We therefore use an average of the $30.00 option from the Glenn-Colusa Irrigation District, *et al*-Metropolitan Water District of Southern California transfer in 2005 and the $50.00 option from the Butte Water District-SDCWA transfer in the 2008 contract, both converted to 2018 dollars, or $50.48 as the appropriate option value. We apply this payment to the full pulse flow volume for every year, independent of water year type, since it would have to be paid for the life of the project to deliver an equivalent benefit. We use the Sacramento Valley unit values from the TR, weighted for the hydrologic year types (dry and critical) when environmental pulses are expected to take place as the actual cost of transferred water. Using the alternative cost approach with the fully supply of Article21 and non-Article 21 water, we find a benefit of **$37.5 million** in 2018 dollars.

When two valuation options are possible, the approach with the lesser benefit value should be used. However, since the willingness to pay analysis is incomplete, we use the alternative cost approach. However, it should also be noted that when the willingness to pay approach and the alternative cost approach are both applied to Article 21 water only, the alternative cost approach arrives as the lesser benefit value and is still the most suitable approach.

Environmental—Incidental Wetland Habitat

The water storage project will provide incidental wetland habitat for migratory birds during the years that the Kern Fan Project takes and recharges water into storage. During those years, the 1,280 acres that comprise the project will be inundated with water to percolate into the groundwater basin. The ponds will provide temporary habitat to migratory bird species along the Pacific Flyway.

To estimate the benefits associated with this habitat, we used the alternative cost approach.

In an alternative approach scenario IRWD would purchase the land to create an equivalent amount of wetlands over a similar period as those created by the project. To estimate the land value, we use the cost of a permanent easement rather than outright purchase. Based on the Project cost estimates the cost of a long-term easement, suitable for constructing water conveyance facilities on would cost $10,750 per acre in 2017 dollars, or $11,133 in 2018 dollars. We use the same costs to move water from the aqueduct as in the above approach, which includes a canal connection to the California Aqueduct, a conveyance canal to the site, canal siphons, and lift stations in addition to significant earthwork and interbasin structures to keep water in the basins. We assume that the Kern Fan project would be farther from the California Aqueduct than any other option (approximately 10 miles as identified in the Application), so the expected cost would be for a canal of half the length used in project cost estimates

[13] In 1995, the State Drought Water Bank paid water districts $3.50 per AF to call water at $40 per AF. In 2003, MWDSC established a transfer option agreement with Glenn-Colusa Irrigation District, of which about half of the 60.000 AF under option was called. In 2005 MWDSC signed a contract with Glenn-Colusa ID for just over 100,000 af. In 2008, San Diego County Water Agency agreed to an option with Butte Water District and Sutter Extension Water District. The documentation for the latter three agreements are included in the Appeal Supplement.

and do not include any costs associated with recharge and recovery. We also include the costs of restoring the land to its pre-wetland condition at the end of the project, based on a subset of costs from the project budget. For this approach, since the alternative project would only take excess water in wet years, we use the Delta Export unit value for wet years provided in the WSIP TR, which ranges from $204 in 2030 to $414 in 2045. We add in the conveyance cost from the period from 2001 to 2017, $17.10 per acre-foot. We interpolate between these values and leave prices beyond 2045 at $414 per AF to be conservative. Taking the net present value of this stream of benefits results in a total benefit of **$162.6 million** at the project start in 2018 dollars.

Emergency Response—Extended Drought

A major benefit of the project is that it provides water to IRWD, Rosedale, and Dudley Ridge in the event of extreme drought, when other water resources are at their most expensive. Groundwater stored as part of the project will be available to call on during a drought emergency or as an alternative supply in the case of a local supply outage. Here we use the alternative cost approach. We also apply the definition of an emergency drought as a critical year that occurs in the third or later year of consecutive dry and critically dry years.

Water modeling results carried out by MBK Engineers estimates a drought emergency supply availability of 4,750 in both the 2030 and 2070 future conditions. However, these estimates consider only Article 21 water and no other water sources. Water modeling is not available for the full supply of project water, so we consider these volumes to be conservative estimates of the actual drought benefit. The actual benefit is likely higher than these estimates.

Using these volumes, interpolating between them, and extrapolating to the beginning of the project in 2026, we arrive at the volume of water supply available for emergency response in each year of the project life.

Alternative costs are based on the lowest cost alternative agricultural water for Rosedale and Dudley Ridge, and urban water for IRWD. Under conditions of extended drought we rely on data provided by Dudley Ridge on the water offers it received from 2014 through 2016, as a documented source of the price that agricultural users in Kern County are willing to accept for water during an extended drought period.[14] There are only two cases of extended drought in the hydrologic record-- 1987-1992 drought and the recent 2012-2016 drought. Since water transfer data is only available for the most recent drought, we consider that 21 observations over three years at the end of the worst drought in California history to be sufficient basis for a drought emergency benefit. The median offer in 2018 dollars is $690 per acre-foot.[15] We include the SWP conveyance cost of $17.10 per acre-foot based on 2001-2017 monthly data from Dudley Ridge.

For the urban supply, the alternative source is imported water from MWDSC. However, in addition to the normal Tier 1 rate of $676 per acre-foot, IRWD would have to pay a $1,480 per acre-foot penalty for exceeding their allocation in an emergency scenario, bringing the total cost to $2,156 per acre-foot. As outlined above in the section on Water Supply Benefits, in this analysis we use 10-year projected escalation of Metropolitan's Tier 1 rate, net of CPI inflation over the same period, based on price projections provided by Metropolitan to its board in 2016. We apply this escalation rate, 3.3% to the Tier 1 rate only, and do not escalate the $1,480 penalty or any other additional charges to the Metropolitan rate. To be conservative we apply this 2015 rate to emergency water supplies for years from the start of the project through 2030.

[14] Data from Dudley Ridge available in "Other Supporting Documentation Uploaded" section of the Appeal letter.

[15] As a confirmation, Buena Vista Water Storage District also held an auction in which the median value paid by buyers was $1,200 per AF. Because these are cleared market prices rather than offers, we did not average the two data sources. The BVWSD data is included in the Appeal Supplement.

Applying the agricultural emergency supply rate to the 75% of the emergency water supply available to Rosedale and Dudley Ridge and the urban emergency rate to the 25% of the emergency water supply available to IRWD, we arrive at annual emergency supply alternative costs. However, according to historical hydrologic year data provided by MBK Engineers, a critical year in the third year or later of a multi-year drought has only occurred in 6 of the 82 years on record-- a 7% probability of occurrence. We apply this probability to the entire stream of alternative costs and take the net present value at the project start to arrive at a benefit of **$18.1 million**.

Emergency Response—Delta Failure

A separate emergency response benefit of the project is the emergency water supply it can provide in the event of a levee failure in the Delta that curtails State Water Project and Central Valley Project deliveries to the Central Valley and Southern California. We analyze this benefit using an alternative cost approach.

For this benefit, we assume that a Delta Failure occurs once, 30 years into the project operation period—2056 for this project. This is the recommended approach by the California Water Commission for valuing emergency response water supplies in their Technical Reference. According to the analysis carried out by MBK Engineers, according to historical hydrology, the project is likely to have 23,500 acre-feet of water available for emergency response after 30 years of operation. Again, these modeling results include only Article 21 water rather than the full project supply. These estimates therefore are conservative and the true benefit is likely to be greater.

In the event of interrupted flows through the Delta, IRWD's alternative supply will be water purchases from MWDSC. We therefore use MWDSC's Tier 1 rate of $676 per acre-foot in addition to a $2,960 penalty for water use over 115% of IRWD's allocation. In this analysis, as outlined in previous sections, we use an escalation factor based on Metropolitan's projected rates increases over a 10-year period, as presented to the MWDSC Board in 2016.[16] To be consistent with other benefits, we escalate only the Tier 1 rate at the projected rate increase based on MWDSC's estimates for 2016-2026. The $2,960 penalty and all other charges are not escalated. To be conservative, we use current water costs in the year 2030 and escalate costs after that point. As with other benefits, we apply the urban rate to the approximately 25% of the emergency supply that would go to urban users.

Because normal agricultural water deliveries through the Delta would not be available in this scenario, we use a different approach to value the agricultural benefit. As a unit value, we use the median offer price provided by Dudley Ridge for the 2014-2016 period of $632 per acre-foot on the presumption that a Delta emergency would be interpreted as equivalent to an extended drought due to the uncertainty about when exports would be resumed. Agricultural users have demonstrated that they are willing to pay this amount in times of a "normal" extended drought. We believe that a Delta outage, however, will represent unprecedented shortage conditions south of the Delta. Under such conditions, the only alternative supply available to agricultural users is groundwater. Presumably pumps would be turned on "24/7" to replace lost surface supplies in the San Joaquin Valley. To adjust for the overdraft of groundwater during an unprecedented drought we assume that under the Sustainable Groundwater Management Act, which requires all groundwater basins to come to sustainable levels by 2040, users would be required to recharge some portion of the overdraft in subsequent years. To account for this cost, we add to the agricultural value 50% of the average Delta Export unit value to purchase replacement water in subsequent years. While we do not have any certainty about what this recharge requirement will be in the future, we do know that the actual value of water under these emergency conditions will be greater than those for a normal drought period, that agricultural users in the Central Valley rely heavily on groundwater in times of project supply shortages, and that SGMA will require groundwater basins to reach sustainable yields by the time we assume the Delta Outage occurs. Therefore, some assumption is necessary. Because this type of emergency is unprecedented in California it is impossible to document

[16] Summary forecast included in Appeal Supplement

actual costs or demonstrate actual willingness to pay under similar conditions. Therefore, we believe that the value in an extended drought plus the 50% payback assumption is a conservative estimate of the true value of water under a Delta emergency.

Multiplying 25% of the 23,500 acre-feet emergency supply by the urban emergency water rate and 75% of the supply by the agricultural rate in 2056, we arrive at a total benefit estimate. The net present value of this benefit in 2026 is **$29.6 million**.

Agricultural Impact

The Kern Fan Storage Project provides a greater degree of reliability for agricultural water supply, which creates benefits to local agriculture that go beyond the value of the water supply itself. According to Rosedale Rio Bravo Water Storage District the Kern Fan project would prevent approximately 600 acres of field crops from being fallowed in critically dry years when supplies are low. With increased reliability, they estimate that this acreage could instead be converted to higher value permanent crops, such as fruit or nut trees. While the value of agricultural water to the existing mix of crops is already included under the calculation of agricultural water supply benefit, the impact of crop conversion is a separate benefit.

To estimate the effects of crop conversion we use IMPLAN data for Kern County. IMPLAN is an input-output modeling software that allows users to estimate how economic changes in particular sectors impact the local economy. IMPLAN is an industry standard in modeling local economic impacts.

We first gathered agricultural data from the Kern County Department of Agriculture and UC Davis Agricultural Extension's Cost and Return Studies. Using these data we estimate the per acre impact to agricultural output from a 600 acre increase in fruit and nut crops and a 600 acre decrease in field crops. Cotton accounts for the largest share of field crops both in terms of acreage and income. We therefore assume that cotton is the most likely field crop to be fallowed during drought years. We also include an assumption that the cotton would be fallowed only in critically dry years, which occur approximately 20% of the time, according to historic water year type data for the San Joaquin River. Permanent tree crops would add economic benefits in every year. We use the overall output value for these two crop categories as an input into the IMPLAN model. Based on this scenario, IMPLAN estimates direct impacts of crop conversion at $872,000 per year in 2015 dollars on a value added basis. To be conservative we do not scale this number up over time. We use the future stream of these economic impacts to estimate an NPV of $25.8 million over the life of the project in 2018 dollars.

Though not covered in this analysis, the expected crop conversion will also result in secondary economic impacts. Indirect and Induced Effects of the additional agricultural output account for the economic boost from the agricultural industry's increased purchase of goods and services from other local industries, and the impact on the local economy from an increase in household spending due to an increase in jobs, respectively. While we do not include these secondary impacts in this analysis, we estimate that the Indirect impacts would be approximately $432,000 and Induced Impacts would be $269,000 annually over the life of the project, based on IMPLAN modeling (both in 2015 dollars).