Public Benefit Ratio Appeal of
Water Storage Investment Program Public Benefit Ratio Review for
The Kern Fan Groundwater Storage Project

APPENDIX E:
M.CUBED TECHNICAL MEMORANDUM
Estimate of Benefits from the Kern Fan Groundwater Storage Project
FEBRUARY 23, 2018
February 23, 2018

To: Fiona Sanchez, Irvine Ranch Water District

From: Richard McCann, Partner

RE: Estimate of Benefits from the Kern Fan Groundwater Storage Project

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 grant application for the Water Storage Investment Program (WSIP). It includes specific responses to concerns raised by the California Water Commission in its Economic Review and a description of all adjustments made to the analysis in response to Commission comments.

Overview

The Kern Fan Integrated Groundwater Storage Project (Project) will provide ecosystem benefits for the Delta and its tributaries and other benefits by recharging and storing up to 100,000 acre-feet (AF) of unallocated State Water Project (SWP) Article 21 water in the Kern County groundwater basin for subsequent extraction and recovery to offset SWP Table A 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 via 12 new extraction wells and conveyed to points of use in DRWD, IRWD and Rosedale’s service areas. Approximately 25% of the stored water would be held as SWP system water that would be used for ecosystem benefit purposes. 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 several public and non-public benefits, including water supply, groundwater improvement, environmental benefits, and emergency response benefits. Based on guidelines provided in the California Water Commission’s WSIP Technical Reference (TR) and project information provided by IRWD, Cramer Fish Sciences and MBK Engineers, M.Cubed completed estimates of the economic benefits in these four benefit categories. Estimates of the net present value (NPV) of total benefits in 2015 dollars are outlined in Table 1.
Table 1. Summary of Benefit Estimates

<table>
<thead>
<tr>
<th>Category</th>
<th>Type of Benefit</th>
<th>NPV of Benefits (2015$ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-public Benefits</td>
<td>Water Supply Benefits</td>
<td>$50.4</td>
</tr>
<tr>
<td></td>
<td>Groundwater</td>
<td>$3.5</td>
</tr>
<tr>
<td>Public Benefits</td>
<td>Environmental Benefits—Salmon recovery</td>
<td>$30.8</td>
</tr>
<tr>
<td></td>
<td>Environmental Benefits—Incidental Wetland Habitat</td>
<td>$98.2</td>
</tr>
<tr>
<td></td>
<td>Emergency Response—Extended drought</td>
<td>$18.6</td>
</tr>
<tr>
<td></td>
<td>Emergency Response—Delta failure</td>
<td>$28.5</td>
</tr>
<tr>
<td>Total Benefits</td>
<td></td>
<td>$230.0</td>
</tr>
</tbody>
</table>

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 3.5%, as directed in the WSIP TR.

Benefits

Non-Public Benefits—Water Supply

Water Supply benefits are non-public benefits that will accrue to IRWD, Rosedale, and Dudley Ridge, and their service area customers. According to updated modeling results from MBK Engineers, non-public benefit water supply from the project is less than originally estimated. Originally, the project was expected to provide an expected value of 4,500 acre-feet of additional water supply in the 2030 future condition, and 4,100 acre-feet in the 2070 future condition. **Under the revised model, the project will provide 2,700 acre-feet of water in the 2030 future condition and 3,000 acre-feet in the 2070 future condition.** 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.

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. We use the Delta Export unit value provided in the TR 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. These weights are available for 2030 and 2070. 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 to find unit values for 2026 to 2075, according to the methodology laid out in the TR. **The Commission review noted on page 5 that a conveyance cost, initially not included in this analysis, should be added to Delta Export unit values.** To address this oversight, we use data provided by Dudley Ridge, which includes monthly conveyance cost data from 2001 to 2017.\(^1\) We convert this data to 2015 dollars and find an average of $17.10. We use this value, based on a complete record of actual data as the conveyance cost, rather than the $12.07 conveyance cost suggested by the Commission review, which relies on a single year of data.

\(^1\) Data from Dudley Ridge WD included the Appeal Supplement.
For 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. The Commission review found this value appropriate but raised some questions about the basis for escalating this rate over time. We adjust the MWDSC rate throughout the analysis so that only the Tier 1 rate and no other charges and penalties are escalated over time. As an escalation rate, the original analysis assumed that MWDSC rates would increase in line with Delta Export unit values, however, the Commission review claimed that this approach was not appropriate, noting on page 5 of its review that the analysis did not provide sufficient rationale and documentation. For a more appropriate escalation rate, we use MWDSC’s forecast of Tier 1 prices as found in their Ten-Year Financial Forecast provided at a 2/9/2016 MWDSC Board Meeting. 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 price escalation.

Applying the 3.5% 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 $50.4 million.

Non-Public Benefits--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. For the accounts, 9% of water in the urban account and 4% of water in the agricultural account are considered to 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 6.56% in 2030 and 6.5% in 2070 and use these shares to calculate the total groundwater level benefit.

As in the Non-Public Water Supply benefit above, we also added SWP conveyance costs to Delta Export costs, as outlined by the Commission in response to the initial groundwater benefit on page 7 of their Economics Review. We use the same conveyance cost of $17.10 in 2015 dollars based on 2001-2017 conveyance cost data provided by Dudley Ridge. For the purpose of recharging groundwater, we consider the alternative cost to be the Delta Export costs provided in the WSIP TR. We weight those costs according to water year type frequency according to the San Joaquin River Water Year Index to arrive at 2030 and 2070 future condition values. Interpolating between these points, we find a net present value of $3.5 million at the project start, in 2015 dollars.

Public Benefits--Environmental—Salmon Recovery

We use the benefit value for two runs of Chinook salmon provided in the WSIP TR to calculate the environmental benefit of salmon recovery based on a willingness-to-pay valuation.

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

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2 Board meeting minutes with forecast summary included in the Appeal Supplement.
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 (which are considered separately in the supplemental section at the end of this Technical Appendix). In the initial analysis, the total number of pulse flows was reduced to account for water used in a Delta Emergency. However, under the updated water modeling using the November 2, 2016 CalSim II model and revised spreadsheet model, MBK Engineers found that there would be sufficient water to meet a Delta emergency response without adversely affecting pulse flows for environmental benefit. Therefore, in this updated analysis there are a total of 7 pulse flows available. Cramer Fish Sciences modeled the number of fish that would be restored in the 2030 and 2070 future conditions. We calculate 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 TR recommends a benefit of $100,000 per fish per year for winter and spring-run Chinook. We apply this value to the stream of future additional Chinook to calculate a net present value of $48.9 million.

We also used the alternative cost approach to calculate the environmental benefit of Salmon recovery. This approach is based on the cost of procuring a similar volume of water in dry and critical years for environmental flows. The initial analysis assumed that the project participants would need to purchase water at the urban supply price to exchange for environmental water north of the Delta. California Water Commission reviewers took issue with this approach in its economic review. We adjusted this methodology to use Sacramento Valley unit values from the TR, as suggested on page 3 of the Commission’s review, weighted by the years in which pulse flows would be available from the project.

However, while we rely on the Commission’s assessment that voluntary water transfers in the Sacramento Valley could be used to provide the same timing and amount of water as provided by the Kern Fan Project, there remains significant uncertainty as to 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, 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.

To provide these flows in April and May of a Dry or Critically Dry year with a similar amount of certainty, an option agreement would need to be in place with suppliers in the Sacramento Valley. 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 similar guarantee as storage that water supply can be called every year on relatively short notice, given that the conditions driving that decision 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

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3 Based on DWR’s updated Water Supply Index at http://cdec.water.ca.gov/water_supply.html.
investments in their fields. 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 GCID, et al-MWDSC transfer in 2005 and the $50.00 option from the Butte Water District-SDCWA transfer in the 2008 contract, both converted to 2015 dollars, or $46.24 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, we find a benefit of $30.8 million.

According to the TR, the lesser value from the willingness-to-pay approach and the alternative cost approach should be used as the final benefit calculation. We use the lesser benefit estimate of $30.8 million from the alternative cost approach as the final benefit number.

Supplemental Benefits from Steelhead Trout Recovery

The initial analysis did not quantify benefits to Steelhead Trout due to lack of sufficient information, however, Cramer Fish Sciences noted that steelhead smolts from the Feather River will also benefit from the pulse flows (Application IRWD_Tab4_Attach 1_Priority 2_FINAL.pdf). Although it is not a topic brought up in the Commission’s review, changes to the water model, and particularly the greater volume of water available for environmental benefits make Steelhead worth considering in this version. While the Commission’s review was clear that only those topics raised in the initial review should be addressed in applicants’ additional information, it is not possible to change one part of the modelling without affecting many other areas. Since Steelhead Trout are now a significant benefit, we consider them here in a supplemental section. See the supplemental section at the end of this Technical Appendix for a full description of the benefit to Steelhead Trout. Note however, that the benefits detailed above are independent of the Steelhead benefit.

Public Benefits--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 Article 21 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 our initial analysis we assumed that the project participants would need to purchase the land outright to create wetlands. The Commission disagreed with this assumption, stating on page 4 of the Economic Review that it is not necessary to purchase the land outright and that instead land could be flooded that is already dedicated to groundwater recharge, or a limited easement could be acquired at a lower cost.

It is not appropriate to use a short-term easement or land lease for this use, because it would require significant construction and changes to the land use to create a recharge basin or a free-standing wetland. Orchards and irrigated agriculture using water-efficient modern methods are not appropriate

4 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.
for temporary wetlands, nor are petroleum-production lands, because of existing infrastructure. Additionally, because agricultural land requires preparation such as berm construction to be ready for inundation as wetlands. The land preparation must be completed before it is possible to know whether the water supply will be available in January, and therefore the land cannot be used for any agricultural activity other than grazing. Annual conversion costs are likely to make any other agricultural use uneconomic. Thus, costs must reflect a long-term easement.

It is also not feasible to use existing recharge basins to provide the same benefit as flooding in wet years under the project. Existing recharge basins are already in use during periods when Article 21 water is available. The Commission suggests on page 4 of its review that the inundation could take place in any 24 months. However, this is not the case. First, the wetland benefit is particular to winter and spring months when migratory birds would be present. And second, existing water banking recharge basins would typically be in use during other months recharging sources of water other than Article 21 water during years of normal hydrology. During dry and critical dry years when surface water is reduced, water banking entities are typically recovering previously stored water. Operationally, when water banking entities are recovering water through extraction wells they would not also be delivering water for recharge. They would use the surface recharge water in-lieu of groundwater. During dry years, the recharge basins would typically be dry and used for livestock grazing. As a result, during dry and critical years, there would not be water delivered to the basins for recharge.

Regardless of these feasibility issues, we did estimate the potential benefits of creating wetlands on leased agricultural land, which the project’s assessors confirmed is the only land available within 5-10 miles of the California Aqueduct. The Commission’s review did not specify in which years the alternative wetlands would be created except to note that inundation would not necessarily need to occur during the same years and months that the Kern Fan project would take flows. On this basis, we assume that the 21 months of recharge (from MBK Engineers revised modeling from CalSim II) take place in the first 7 years of the project (i.e., 3 months over 7 years totaling 21 months). We use only winter months so that the benefits to migratory birds will be similar to those created by the project. We assume that the entire 220,000 AF that would be recharged over the course of the project would be recharged instead over these 21 months, an average of 31,429 AF per year. As the cost of water, we use the weighted average cost of Delta export water across all water year types plus conveyance. As the cost of land, we use the cost of leasing agricultural land in Kern County, according to the project participants’ assessor, or $300 per acre, deflated to 2015 dollars. We also include the costs of constructing berms and conveyance from the canal as a minimal representation of preparing wetlands, as well as removal costs to restore land to conditions for agricultural use, including leveling, berm and rip rap removal. We have not included any additional costs that are required to restore wetland conditions on land previously used for agriculture. Using this approach, the total benefits are $111.8 million.

Based on the feasibility concerns with the above approach, we also estimated the cost of an alternative dedicated wetlands that delivers benefits in the same years as Kern Fan and requires construction of infrastructure to deliver water from the California Aqueduct to the wetland site. To estimate the land value, we use the cost of a permanent easement rather than outright purchase in response to Commission feedback. Based on the Project cost estimates (other than land purchase) in the Application (Tab 6-A8_IRWD_Total Project Cost_FINAL.pfd), the cost of a long-term easement, suitable for constructing water conveyance facilities on would cost $10,750 per acre in 2017, or $10,199 in 2015 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

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5 We have updated this to 21 months to correspond with updated model results.
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 and do not include any costs associated with recharge and recovery. Similar to the first approach, we 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 original Application. For this approach, since the alternative project would only take Article 21 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 interpolate between these values and leave prices beyond 2045 at $414 to be conservative. The Commission Review also pointed out that conveyance costs should be included along with the Delta Export unit value throughout the various benefits. Therefore, to these unit values we also add the Dudley Ridge SWP conveyance cost from the period from 2001 to 2017, $17.10 per acre-foot. Taking the net present value of this stream of benefits results in a total benefit of $98.2 million at the project start.

We consider the second approach to be more appropriate as well as least cost at $98.2 million.

Public Benefits—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. The WSIP TR outlines that emergency response benefits should be monetized using avoided costs or alternative costs. Here we use the alternative cost approach. According to the WSIP TR an emergency is defined as a critical year that occurs in the 3rd or later year of consecutive drought.

The new water modeling results show a slight increase in the available drought emergency supply. In the original analysis, drought emergency supplies of 4,500 and 4,100 acre-feet were used to calculate benefits under the 2030 and 2070 future conditions, respectively. With updated modelling, available drought emergency supply is estimated to be 4,750 in both the 2030 and 2070 future conditions. Using these values, 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. The Economic Review raised concerns with both values. On the agriculture side, the analysis initially used $800 per acre-foot, as a typical price paid for an acre-foot of water during the recent multi-year drought according to Rosedale. Prices for agricultural water have reached as high as $2,000 in the Central Valley in the recent drought. However, the Commission’s Economic Review argues on page 5 of its review that because the $800 price represents a single observation it is not justified and recommends using the Delta Export value in a critical year as the value of water.

We do not find evidence that the $360 unit value for Delta exports in a critical year is an accurate value for water in a drought emergency. Per the WSIP TR, water for emergency response extended drought is defined as a critical year that occurs in the 3rd of later year of consecutive drought. The CWC reviewers confirmed in our Economics Review meeting that the unit values provided in the TR do not include water prices specific to the 3rd year or later of an extended drought. Instead, TR unit values are only appropriate for single dry and critically dry years. Page 5-16 of the TR states that the provided unit values” may be too low and may not be appropriate”, “especially under shortage conditions.” Since a

drought emergency counts as shortage conditions, we consider that the TR unit values are inappropriate for this benefit.

Instead, 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 pay during an extended drought period. 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 average of these offers in 2015 dollars is $925 per acre-foot. The Economic Review also noted that conveyance cost should be included in the agricultural valuation. 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. The Commission agreed with this alternative valuation in its Economics Review. However, it raised concerns on page 5 about how this price was escalated over time, pointing out that there is no justification for escalating an M&I rate at the same rate as TR values that are escalated to account for the effects of SGMA. To address these comments, as outlined above in the section on Water Supply Benefits, in this analysis we use 10-year projected escalation in 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.

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 3rd 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 $18.6 million.

Public Benefits—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 water project deliveries. We analyze this benefit using an alternative cost approach.

The WSIP TR explains that an emergency response to Delta Failure should be assumed to occur once, 30 years into the project operation period—2056 for this project. According to the updated 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.

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. The CWC reviewers, on page 6 of its Economics Review agreed that these values were appropriate. In the original analysis, we escalated these costs in step

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8 Data from Dudley Ridge available in “Other Supporting Documentation Uploaded” section of the Appeal letter.
9 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.
with the Delta Export unit values in the TR. However, the Commission’s review found this inappropriate and removed the escalation factor. In this analysis, as outlined in previous sections, we instead use an escalation factor based on Metropolitan’s projected rates increases over a 10-year period, as presented to the MWDSC Board in 2016.\textsuperscript{10} 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.

In the original analysis we also assumed that the alternative cost of water to agricultural users in Rosedale and Dudley Ridge would be the urban rate because agricultural users would need to outbid urban suppliers for available agricultural water. However, the Economics Review found on page 6 that the original analysis did not justify that agricultural users would be willing to pay the urban emergency rate. Instead, they suggest using the Delta Export unit value of $1,056 per acre-foot plus a conveyance fee of $12.07. However, we contend that it is not reasonable to apply a Delta Export value in a scenario when the Delta cannot be used to convey water south to agricultural users in the San Joaquin Valley—that option is foreclosed by definition. In addition, page 5-16 of the TR states that “the unit values may be too low and another method may be appropriate”, “especially under shortage conditions.” A Delta failure represents extreme shortage conditions under which the unit values would be inappropriate.

To address this, 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 $925 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 SGMA 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 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 the 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 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 $28.5 million.

MBK Engineers also explored how using the Delta Emergency supplies 30 years into the project life would affect other project benefits. In their initial analysis they found that the only impact is that environmental pulse flows north of the Delta would be reduced from 6 pulses over the life of the project, to 5. However, in updated model results, they find that the 23,500 acre-feet of water is available for Delta emergency response without impacting other project supply accounts.

\textsuperscript{10} Summary forecast included in Appeal Supplement
Supplemental Benefits

Steelhead Trout

Steelhead Trout were not considered in the initial economic analysis, which focused only on Spring- and Winter-run Chinook Salmon. While the Commission was clear that no new topics should be introduced in the revised analysis, we find that Steelhead are worth considering as the pulse flows produced from the Project is expected to provide significant environmental benefits to the juvenile Steelhead under the new water modelling results.

According to modelling carried out by Cramer Fish Sciences, environmental pulse flows provided by the project would result in the survival of 95 additional steelhead trout under the 2030 future condition, and 62 trout under the 2070 future condition. Valuing these fish at the $100,000 per fish as provided in the TR results in a benefit of $4.0 million over the life of the project.

Considering this benefit along with the Salmon benefits outlined in this memo, we find a total environmental benefit of $42.9 million using the willingness to pay approach.
Appeal Supplement

2. Metropolitan Water District of Southern California: Ten-Year Financial Forecast
3. Woods Institute for the Environment, Stanford University: Option Contracts in Practice: Contractual and Institutional Design for California Water Transfers
5. Buena Vista Water Storage District 2014 Water Auction
6. Email from Alliance Ag Services: Least Cost Alternative - Lease for Wetland Creation
1. Dudley Ridge Water District

Historical Summary of Monthly Variable OMP&R Charges 2001-2017

This data set, provided by Dudley Ridge Water District, includes historical variable O&M Power and Variable Transmission Charges for its State Water Project deliveries from January, 2001 to November, 2017.
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State of California  
California Natural Resources Agency  
DEPARTMENT OF WATER RESOURCES  
Post Office Box 942836  
Sacramento, California 94236-0001  

STATE WATER RESOURCES DEVELOPMENT SYSTEM  

INVOICE FOR  

DUDLEY RIDGE WATER DISTRICT  

OFF-AQEUDUCT POWER FACILITIES  
MINIMUM OMP&R COMPONENT OF THE TRANSPORTATION CHARGE  
IN 2015  

Mr. Joe Macllvaine, President  
Dudley Ridge Water District  
286 West Cromwell Avenue  
Fresno, California 93711-6162  

Invoice No: 15-008-O-(Revised)  
Date: July 1, 2015  
Contract No: 160250  

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TERMS: As provided under Article 32 (b) of the contract, interest shall accrue at the Pooled Money Investment Fund Rate per month on delinquency payment if the delinquency continues for more than 30 days.

Attachment 1-1
State of California  
California Natural Resources Agency  
DEPARTMENT OF WATER RESOURCES  
State Water Resources Development System  

ESTIMATED VARIABLE O.M.P.R. COMPONENT CHARGES FOR WATER DELIVERIES DURING  

Calendar Year 2015  
For  

DUDLEY RIDGE WATER DISTRICT  

<table>
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<tr>
<th>DESCRIPTION</th>
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<th>UNIT CHARGE 1/</th>
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<td>Sub total</td>
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<td>Net adjustment per redetermination of pre-2015 charges 2/</td>
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<td>Estimated Year 2015 Replacement Accounting System (RAS) Charges 2/</td>
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<tr>
<td>Prior years RAS over and under adjustments 2/</td>
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<tr>
<td>Total Estimated 2015 Charges</td>
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<td>490,228</td>
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</table>

1/ Derived by dividing column (4) by column (2).  
2/ Will be applied 1/12 monthly to the actual 2015 water delivery billings.
2. Metropolitan Water District of Southern California: Ten-Year Financial Forecast

This report was presented to the Metropolitan Board on 2/9/2016. The table on page 4 of this report includes a forecast of Tier 1 rates for the period from 2016 to 2026.
TEN-YEAR FINANCIAL FORECAST

The ability to ensure a reliable supply of high quality water for Metropolitan’s 26 member agencies depends on Metropolitan’s ongoing ability to fund operations and maintenance, maintain and augment local and imported water supplies, fund replacements and refurbishment of existing infrastructure, and invest in system improvements. This ten-year plan builds on the biennial budget to support long range resource, capital investment and operational planning. As such, it includes a forecast of future costs and the revenues necessary to support operations and investments in infrastructure and resources that are derived from Metropolitan’s planning processes while conforming to Metropolitan’s financial policies. These financial policies, which address reserve levels, financial indicators, and capital funding strategies, ensure sound financial management and fiscal stability for Metropolitan.

Projected Financial Indicators

The figure above summarizes the financial metrics of the ten-year financial forecast. Metropolitan projects that the fixed charge coverage ratio will meet the board-established targets throughout the ten-year period. Revenue bond coverage will meet target in FY 2021/22. Reserve levels will be above minimums as established by board policy; PAYGo expenditures are set at a level that is consistent with the board policy adopted in 2014 that PAYGo expenditures would be funded from revenues, with the proposed amount set at
60 percent of the Capital Investment Plan (CIP); and projected rate increases are adequate to cover costs with moderated changes from one year to another.

The estimated overall rate increases result from increasing investments for the State Water Project (SWP) and the California Water Fix, investments in reliability through conservation and local resources, investments to maintain the conveyance and distribution system, and increasing operating and maintenance costs. Annual expenditures are expected to increase from $1.7 billion in FY 2016/17 to $2.4 billion by FY 2025/26, or an annual average increase of about 4.0 percent. Metropolitan’s share of the costs for the California Water Fix is expected to increase to about $246 million by FY 2025/26. During this same period, capital investments are expected to be about $2.1 billion. To finance these capital investments, the ten-year forecast anticipates funding $1.2 billion of the CIP from water sales revenues, or PAYGo. The balance of the CIP, or $0.9 billion, would be financed by issuing revenue bond debt, either fixed or variable.

Planning is necessary for Metropolitan to successfully fund the many investments necessary to meet the challenges facing the region over the next ten years with manageable rate increases. Among the more significant challenges are:

- Investing in the elements of the 2015 IRP Update to ensure reliable water supplies for Metropolitan’s service area and preparing for uncertainty.
- Continuing to provide supply reliability through a diversified portfolio of actions to stabilize and maintain imported supplies.
- Meeting future growth through increased water conservation and the development of new local supplies, while protecting existing supplies, to achieve higher retail water use efficiency, in compliance with state policy.
- Pursuing a comprehensive transfer and exchange strategy.
- Building storage in wet and normal years to manage risks and drought.
- Funding an estimated $2.1 billion capital program that provides projects meeting water quality, reliability, stewardship and information technology directives.

**ASSUMPTIONS FOR THE TEN-YEAR FORECAST**

The following table summarizes key assumptions that underlie the ten-year forecast.

<table>
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<tr>
<th></th>
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<td>1.75</td>
<td>1.75</td>
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<td>2.25%</td>
<td>2.25%</td>
<td>2.25%</td>
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<td>2.25%</td>
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<tr>
<td>Interest on investments, %</td>
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<td>1.30%</td>
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<td>1.70%</td>
<td>1.70%</td>
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<td>1.20%</td>
<td>1.20%</td>
<td>1.20%</td>
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Metropolitan's principal sources of water supplies are the SWP and the Colorado River. Metropolitan receives water delivered from the SWP under State Water Contract (SWC) provisions, including contracted supplies, use of carryover storage in San Luis Reservoir, and surplus supplies. Metropolitan holds rights to a basic apportionment of Colorado River water and has priority rights to an additional amount depending on availability of surplus supplies. The Supply Programs supplement these SWP and Colorado River supplies. The SWP and Colorado River sources derive from two different hydrologic regions, which have helped buffer shortages. The ten-year forecast assumes an average hydrology on both regions. Together with Metropolitan’s Supply Programs, dry periods in either region can be managed.

The CIP has been further reduced from prior forecasts to maintain affordability throughout the ten-year period, reduce debt service, and provide headroom to absorb the additional costs of the California Water Fix. CIP projects have been carefully reviewed, scored and ranked to ensure that only the projects necessary to deliver water reliably and safely while meeting all regulatory requirements are included.

The inflation factor is based on forecasts by economists and is applied to Metropolitan’s O&M expenses, including labor, chemicals, and other O&M expenses. The interest rate applicable to Metropolitan’s investment portfolio is based on an analysis of the current forward curve for investments over a ten-year period. This interest rate forecast informs the interest rate applicable to variable rate bonds. The interest rate for fixed rate bonds is also based on forecasts.

**WATER SALES FORECAST**

Water sales revenue provides approximately 80 percent of the revenues necessary to support Metropolitan’s capital and operating costs. The 2015 IRP Update provides the basis for the water sales forecast over the ten years. It is expected that demand for Metropolitan supplies will remain relatively flat over the ten-year period, from 1.70 million acre-feet in 2016/17 to 1.85 million acre-feet by 2025/26. This forecast includes the San Diego County Water Authority exchange agreement (exchange agreement) water deliveries. The 2015 IRP Update contemplates continued investment in local resources and retail and regional conservation measures to meet state policy regarding water use efficiency. By 2025/26, conservation and water efficiency initiatives will result in a further reduction of regional water use by an estimated 163,000 acre-feet, which reflect efforts to meet state policy to reduce per capita retail water use by 20 percent by 2020. Local resource augmentation will result in approximately 157,000 acre-feet of additional local supply, including production already anticipated from existing programs. These local supplies and increased conservation and water use efficiency reduce the need to import water and reduce expected water sales by Metropolitan.

The figure below shows historic and forecast water sales, including the exchange agreement water. Long-term, Metropolitan’s sales have averaged just under 2.0 million acre-feet. As noted above, expected sales are forecast to be below this average at 1.85 million acre-feet by 2025/26. Under changed economic, climatic and hydrologic conditions, sales over the next ten years could range between 1.5 million acre-feet and 2.0 million acre-feet 80 percent of the time.
Water Sales, MAF

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Fiscal Year Ending

Sources of Funds

Revenues

Through 2025/26, receipts from rates and charges, which include the RTS, Capacity Charge and water sales revenues, collected from the member agencies will account for approximately 92 percent of total revenues. Total revenues are projected to increase from about $1.6 billion in 2016/17 to $2.5 billion in 2025/26. This increase is almost entirely attributed to increases in water rates and charges.

Water Rates and Charges

The table below shows the estimated unbundled water rates and charges under the current rate structure. Components of the rate structure may increase at different rates depending on the costs recovered. The full-service treated Tier 1 water rate is estimated to be approximately $1,344 per acre-foot by January 1, 2026, compared to $942 per acre-foot on January 1, 2016, an average increase of 3.6 percent per year over the ten-year period.

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<td>Full Service Untreated Volumetric Cost ($/AF)</td>
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<td>Treatment Surcharge ($/AF)</td>
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<td>Full Service Treated Volumetric Cost ($/AF)</td>
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<td>Capacity Charge ($/cfs)</td>
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The following figure shows the volumetric cost per acre-foot for Tier 1 Full Service untreated water and Tier 1 Full Service treated water. A proposal will be presented to the Board for consideration to address fixed cost recovery of Treatment costs which are currently recovered through a volumetric rate.

**Volumetric Cost, $ AF**

![Graph showing volumetric cost per acre-foot for Tier 1 Full Service untreated and treated water over the years 2016 to 2026.]

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**Property tax revenue** is expected to increase from $98.3 million in FY 2016/17 to $120.1 million in FY 2025/26. This projection assumes the Board maintains the ad valorem tax rate at .0035 percent of assessed valuations, by suspending the limit under MWD Act Section 124.5, and assessed value increases by 2.5 percent per year. By FY 2025/26 almost all of the revenues are used to pay SWP costs, which would include Metropolitan’s share of the California Water Fix costs.

**Power sales** from Metropolitan’s hydroelectric power recovery plants are projected to average about $18.5 million per year over this ten-year period. Metropolitan has 16 small hydroelectric plants on its distribution system. The combined generating capacity of these plants is approximately 122 MW. These revenues are dependent on the amount of water that flows through Metropolitan’s distribution system and the price paid. Power from some of the plants is sold under existing contracts that are priced significantly higher compared to the prices currently being offered for renewable power.

Benefits from the hydroelectric plants’ environmental attributes including the Renewable Energy Credits (RECs) are included in the existing contracts and for the Etiwanda Power Plant. Renewable Portfolio standard (RPS) California Energy Commission certification for the DVL units was received in 2009; the associated RECs are sold on an unbundled basis.

**Interest income** is projected to increase from $13.6 million in FY 2016/17 to $28.3 million in FY 2025/26 as a result of increased balances and higher average returns of 1.25 percent to 1.7 percent from FY 2016/17 to FY 2025/26. Metropolitan earns interest on invested fund balances and uses this income to reduce the costs that must be recovered through rates and charges. These invested funds also act as a partial hedge against changes in interest rates on Metropolitan’s variable rate debt obligations. Interest income will vary over the ten-year forecast period as interest rates and cash balances available for investments will fluctuate. Miscellaneous income includes items like leases and late fees and is forecasted to increase from $12.0 million in FY 2016/17 to $15 million in FY 2025/26.
Forecasted revenues by major category are shown in the figure below.

**Revenue Forecast, $ millions**

![Revenue Forecast Chart]

**Other Funding Sources**

Other sources of funds include withdrawals from bond construction funds, Refurbishment and Replacement (R&R) Fund, General Fund, Water Stewardship Fund (WSF), Treatment Surcharge Stabilization Fund (TSSF), Water Rate Stabilization Fund (WRSF), Revenue Remainder Fund, and working capital borrowing.

**USES OF FUNDS**

Over the next ten years, total annual expenditures are projected to range from $1.7 billion to $2.4 billion.

**Expenses**

Expenses are grouped into six major categories: SWP, O&M, demand management programs, CRA power costs, supply programs, and capital financing. The first figure below illustrates the general trends in expenses over the ten-year period from FY 2016/17 to FY 2025/26. The second figure following shows the comparison of FY 2016/17 to FY 2025/26 in terms of the contribution of expenses to the total.
Expenditure Forecast, $ millions

Expenditure Forecast, Contribution by Major Area

FY 2016/17: $1.65B
- Capital Financing $448.5M (27%)
- SWP $582.3M (35%)
- O&M $417.7M (26%)
- Other $200.4M (12%)

FY 2025/26: $2.35B
- Capital Financing $444.6M (19%)
- SWP $1131.3M (48%)
- O&M $504.1M (22%)
- Other $267.9M (11%)
State Water Project

Metropolitan is one of 29 agencies that contract with the State of California for service from the SWP. Metropolitan is obligated to pay its share of the capital and minimum operations, maintenance, power, and replacement charges of the SWP regardless of the amount of water actually received. In addition, Metropolitan pays the power costs to convey the water. The ten-year forecast assumes that SWC annual costs, including power, will increase from $582 million in FY 2016/17 to $1,131 million in 2015/26, as shown in the figure below. SWC costs account for 35 percent of Metropolitan’s expenditures in FY 2016/17, growing to 47 percent in FY 2025/26, primarily due to the California Water Fix costs. These costs account for $246 million in FY 2025/26. Water supply benefits from the California Water Fix are realized outside the ten-year period of the forecast, as are operations, maintenance and energy costs. The remainder of the fixed costs is based upon information provided by the Department of Water Resources, and is associated with Transportation Capital and Minimum Operations & Maintenance, and the Delta Water Supply Capital and Minimum Operations & Maintenance. Variable SWP power costs are projected to gradually increase over the ten-year period.

Power costs will vary depending on the price of electricity, total system deliveries, storage operations, and the amount of water pumped on the SWP. SWP variable power costs are projected to increase about 6.2 percent per year over the ten-year forecast period. Increasing costs affecting the SWP include the cost of emissions allowances, adding renewable energy to the SWP power portfolio, and using the California Independent System Operator grid to transmit power from generation sources to the SWP load locations. The SWP owns generating resources, including the Hyatt complex, recovery generation units on the Aqueduct, and a contract for power from the Kings River Conservation District’s Pine Flat generating facility. The SWP is a participant in the Lodi Energy Center, a natural gas-fired combined cycle generating facility located in Lodi, California, and operated by the Northern California Power Agency. The SWP has acquired renewable resources. Additional resources necessary to meet the balance of the project’s energy requirements are obtained from the wholesale energy market, which exposes the SWP to wholesale energy market price volatility. Net flows through the SWP that incur power are expected to average about 1.0 MAF per year.

The total SWC costs are shown in the figure below. The SWP is described under the General District Requirements section of the Biennial Budget.

SWP Forecast, $ millions

![SWP Forecast Graph]
Operations and Maintenance

O&M costs in FY 2025/26 are projected to be $504 million. This represents an average annual increase of 2.1 percent from FY 2016/17. During this time frame, inflation is assumed to be 2.25 percent. The ten-year forecast assumes Metropolitan continues to fully fund the annual required contribution to meet future retiree medical costs (Other Post-Employment Benefits, or OPEB) and retirement benefits.

Figure 14. O&M Forecast, $ millions

Demand Management

Demand management costs include funding for the Local Resource Programs (LRP) and the Conservation Credit Program (CCP) and are projected to increase from $75.1 million in FY 2016/17 to $84.5 million in FY 2025/26. The LRP costs are projected to be fairly flat over the ten-year period at about $45.0 million per year. As the yield from existing LRP projects receiving incentives decreases, new projects are expected to receive funding. The CCP costs are projected to increase from $27.0 million in FY 2016/17 to $38 million in FY 2018/19, and remain flat through the remainder of the ten-year period. This program provides continued funding of residential, commercial, and outdoor conservation programs.

Demand Management programs are described under the General District Requirements section of the Biennial Budget.

CRA Power Costs

CRA Power costs are projected to increase from $46.6 million in FY 2016/17 to $89.7 million in FY 2025/26. Power costs will vary depending on the price of electricity, Metropolitan’s resource portfolio to meet electricity needs, storage operations, and the amount of water pumped on the CRA. Due to the expiration of the SCE Service and Interchange Agreement, Metropolitan will be buying more supplemental power and will have exposure to market prices.

Power costs are described under the General District Requirements section of the Biennial Budget. Colorado River diversions are expected to average about 1.0 MAF over the ten-year period, slightly more than deliveries as water is stored.
Supply Programs

Supply programs increase slightly over the ten-year period from $78.7 million in FY 2016/17 to $93.7 million in FY 2025/26. The estimates represent expenditures for expected conditions. If extreme weather conditions are experienced, these cost estimates could be much higher or lower. If higher than normal demand is coupled with lower than normal supply, supply program costs could be significantly higher.

A description of Metropolitan’s Supply Programs is provided under the General District Requirements section of the Biennial Budget.

Capital Investment Plan

The ten-year projected CIP through FY 2025/26 is estimated at $2.1 billion. The CIP continues to reflect the deferral of facility expansion projects. The CIP focuses on projects that enhance reliability while focusing on necessary refurbishment and replacement of aging infrastructure. The following figure shows the funding source for the ten-year CIP.

CIP Ten-Year Forecast and Funding Sources, $ millions

![CIP Ten-Year Forecast and Funding Sources](chart)

Capital Financing Options

The CIP will be funded from a combination of bond proceeds and operating revenues. In order to mitigate increases in water rates, provide financial flexibility, and support Metropolitan's high credit ratings including maintaining revenue bond debt service and fixed charge coverage ratios, it is proposed that 60 percent of the CIP be funded from current revenues, or PAYGo. This level of PAYGo funding is appropriate given that a significant portion of future CIP projects has been identified as R&R projects. This level of PAYGo also ensures that Metropolitan meets its coverage targets by generating a margin of revenues over operating and debt expenditures. The additional revenue required to meet Metropolitan’s revenue bond debt service coverage target of 2.0 times and fixed charge coverage of 1.2 times is available to fund the CIP. PAYGo funding throughout the ten-year horizon of the planning period ensures that current customers are always contributing funds towards the capital investments they are benefiting from, and not deferring these costs entirely to future generations of ratepayers.
Bond funded expenditures will include a combination of variable and fixed rate debt. Debt has been structured to mitigate near-term rate impacts and smooth out long-term debt service. The principal advantage of variable rate debt is the opportunity for a lower interest cost. Normally, short-term interest rates are lower than long-term interest rates for debt of comparable credit quality. If interest rates remain constant, Metropolitan will generally have significantly lower interest costs on variable rate debt than on fixed rate debt, even after remarketing and liquidity facility costs. Also, if interest rates decline, Metropolitan will benefit from lower interest costs without the necessity or cost of a refunding. If interest rates rise, variable rates could stay lower than the fixed rate originally avoided, and the longer the variable rate debt is outstanding at favorable spreads, the higher the break-even point becomes on fixed rate debt. Variable rate debt is used to mitigate interest costs over the long term, and provides a natural hedge against changes in investment earnings: when interest rates are high, interest costs on variable rate debt is higher but so are earnings from Metropolitan’s investment portfolio. When interest rates are low, interest earnings are lower, but so are variable rate interest costs.

Fixed rate debt holders generally require some form of “call protection.” Typically, fixed rate bonds are only redeemable a given number of years after their issuance and if the issuer pays a prepayment premium. Because the interest rate on variable rate debt is periodically reset, call protection is not important to variable rate debt holders. Variable rate debt, therefore, may generally be prepaid without premium on any date on which the interest rate is changed or on any interest payment date.

However, variable rate debt does have risks. These risks include:

- Rising interest rates. Because future interest rates are unknown, the costs of capital improvements financed with variable rate debt are more difficult to estimate for revenue planning purposes. Significant interest rate increases could cause financial stress.
- Liquidity facility renewal risk. Variable rate debt normally requires a liquidity facility to protect the investors and issuers against “puts” of a large portion or all of the debt on a single day. Liquidity facilities generally do not cover the full term of the debt. If an issuer’s credit declines or the liquidity facility capacity is not available, the issuer runs the risk of not being able to obtain an extension or renewal of the expiring liquidity facility. In that event, the issuer may have to retire the debt or convert it to fixed rate debt.

In the last several years, Metropolitan has issued self-liquidity debt. Metropolitan is irrevocably committed to purchase all self-liquidity bonds tendered pursuant to any optional or mandatory tender to the extent that remarketing proceeds are insufficient and no standby bond purchase agreement or other liquidity facility is in effect. Metropolitan’s obligation to pay the purchase price of any tendered self-liquidity bonds is an unsecured, special limited obligation of Metropolitan payable from net operating revenues. In addition, Metropolitan’s investment policy permits it to purchase tendered self-liquidity bonds as an investment for its investment portfolio. So, while Metropolitan is only obligated to purchase tendered self-liquidity bonds from net operating revenues, it may use the cash and investments in its investment portfolio to purchase tendered self-liquidity bonds. Metropolitan has not secured any liquidity facility or letter of credit to pay the purchase price of any tendered self-liquidity bonds; however, Metropolitan has entered into revolving credit agreements with which it may make borrowings for the purpose of paying the purchase price of self-liquidity bonds.

Sales of variable rate debt issues are more complex than fixed rate debt issues. Larger issuers often issue a portion of their debt as variable rate debt. Also, if construction costs are uncertain a borrower can use variable rate debt initially and convert to fixed rate debt in the amount needed after construction is completed.
Debt Financing

It is anticipated that there will be about $2.1 billion of capital expenditures over the ten-year period. Of this, $0.9 billion, or 40 percent of future capital expenditures, are anticipated to be funded by debt proceeds. Outstanding bond debt, including revenue and GO bonds, as of December 31, 2015 is $4.35 billion. The net assets of Metropolitan at June 30, 2015 were $6.9 billion. Metropolitan may not have outstanding revenue bond debt in amounts greater than 100 percent of its equity. As of June 30, 2015, the debt to equity ratio was 63 percent.

Total outstanding debt is illustrated below. Total outstanding debt is estimated to be $3.6 billion by FY 2025/26.

Outstanding Debt, $ billions

Metropolitan’s variable rate debt as a percentage of total revenue bond debt is projected to increase to 31 percent over this time period as fixed rate debt is retired and new variable rate debt is issued. The appropriate amount of variable rate debt will continue to be monitored and adjusted depending on market rates, financing needs, available short-term investments, and fund levels in the investment portfolio with which variable interest rate exposure can be hedged. GO bond debt will decrease as voter approved indebtedness matures.
FUND BALANCES AND RESERVES

As shown in the figure below, over the next ten years total fund balances are projected to increase to $1.8 billion in FY 2025/26. The Exchange Agreement Set-aside designated fund is no longer needed after 2018 by which time all appeals in the SDCWA litigation are expected to be decided.

End of Year Fund Balances, $ millions

![Chart showing fund balances over ten years]

* Includes Water Rate Stabilization Fund and Revenue Remainder Fund. Working capital borrowings have been used, in part, to replace revenues that have been deposited to the Exchange Agreement Set-aside Designated Fund.

** Includes Water Stewardship Fund and Treatment Surcharge Stabilization Fund.

FINANCIAL RATIOS

Revenue bond debt service coverage is one primary indicator of credit quality, and is calculated by dividing net operating revenues by debt service. Revenue bond debt service coverage measures the amount that net operating revenues exceed or "cover" debt service payments over a period of time. Higher coverage levels are preferred since they indicate a greater margin of protection for bondholders. For example, a municipality with 2.0 times debt service coverage has twice the net operating revenues required to meet debt service payments. The ten-year forecast projects that Metropolitan's revenue bond coverage ratio achieves 2.0 times during the last half of the period. Metropolitan’s minimum coverage policy is vital to continued strong credit ratings and low cost bond funding.

In addition to revenue bond debt service coverage, Metropolitan also measures total coverage of all fixed obligations after payment of operating expenditures. This additional measure is used primarily because of Metropolitan’s recurring capital costs for the State Water Contract. Rating agencies expect that a financially sound utility consistently demonstrate an ability to fund all recurring costs, whether they are operating expenditures, debt service payments or other contractual payments. The ten-year forecast projects that Metropolitan’s fixed charge coverage ratio is at least 1.2 times over the ten-year period. These levels help maintain strong credit ratings and access to the capital markets at low cost, and provides PAYGo funding for the CIP.
### Fiscal Year Ending

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**Ten-Year Financial Forecast, Sources and Uses of Funds, $ millions**

** SOURCES OF FUNDS **

- **Revenues**
  - Taxes: 98.3
  - Interest Income: 13.6
  - Hydro Power: 15.3
  - Fixed Charges (RTS & Capacity Charge): 182.3
  - Treatment Surcharge Revenue: 272.9
  - Water Sales Revenue: 1,033.3
  - Miscellaneous Revenue: 12.0
  - Bond Proceeds: 89.6
  - Working Capital Borrowing: 46.6
  - Total Revenues: 1,763.0

**USES OF FUNDS**

- **Expenses**
  - State Water Contract: 582.3
  - Supply Programs: 78.7
  - Colorado River Water: 46.6
  - Debt Service: 328.5
  - Demand Management: 75.1
  - Treatment Chemicals, Solids & Power: 24.3
  - Other O&M: 34.7
  - Sub-Total Expenses: 1,528.8

**Fiscal Year Sales & Exchange (MAF)**

- 1.68

**Increase in Required Reserves**

- 65.1

**Increase in Water Rate Stabilization Fund**

- 51.8

**Sub-Total Uses of Funds**

- 1,977.2

**TOTAL SOURCES OF FUNDS**

- 1,968.5

**TOTAL USES OF FUNDS**

- 2,086.6

**Fund Withdrawals**

- 214.2

**Fiscal Year Ending**

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**Ten-Year Financial Forecast, Coverage Ratios and Fund Balances, $ millions**

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**RATIOS**

- Fixed Charge Coverage
- Revenue Bond Coverage
- Var Rate Debt as % of Rev Bond Debt

**RESTRICTED FUNDS E&Y balance**

- General Fund
- Other
- Sub-total Restricted Funds

**UNRESTRICTED FUNDS E&Y balance**

- Reserve Funds (1)
- Treatment Surcharge Stabilization Fund
- Water Stewardship Fund
- B&I Fund
- General Fund
- Exchange Agreement Set-aside
- Sub-total Unrestricted Funds

**TOTAL FUNDS**

- 1,452.3

**Notes:**
- Includes Water Rate Stabilization Fund and Revenue Remainer Fund.
- Totals may not foot due to rounding.
- *Not affected by treatment rate structure

**Biennial Budg**

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<th>Year</th>
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3. Woods Institute for the Environment, Stanford University: Option Contracts in Practice: Contractual and Institutional Design for California Water Transfers

This policy brief, published by the Woods Institute in October, 2008, gives a detailed history of options contracts and their use in California, including the terms and prices of every contract in place by 2008.
Executive Summary

In 2003, the Metropolitan Water District of Southern California (MWD) introduced option contracting in the California water market, signing 11 contracts with Sacramento Valley agricultural water districts for access to a total of 146,230 acre-feet (af) of water. The option contracts gave MWD the right, but not the obligation, to purchase water several months in the future. Contracting was repeated with three of the larger agricultural districts in 2005, for a supply of just over 100,000 af. In March of 2008, the San Diego County Water Authority entered the option market. Option contracting could prove an important aspect of water market development, facilitating temporary transfers of water at a time when the state’s supply is under increasing pressure and demand continues to grow.

A look at past contracting suggests that gains associated with individual trades have been significant, leading to an increase in joint payoffs to the seller and buyer of 70-85%. Expected losses from urban water shortages in the MWD service area were estimated at $49M in 2003 and decreased to $18M under contracting. The magnitude of the total gains from trade in 2003 and 2005 is estimated at between $29M and $34M.1 Future contract design should address the following points: (1) inefficiencies in the current price structure, (2) flexibility with regard to renegotiation, and (3) policies for community mitigation. Past contract prices have been structured as two volumetric charges: a base price, or reservation fee, and an exercise price to be paid if delivery is taken at a future date. Levying a volumetric reservation fee can lead the buyer to purchase an inefficiently small number of options. A change in the price structure, introducing a non-volumetric contracting fee can remedy this. Renegotiation clauses can aid efficiency by allowing one party to effectively buy out the other if its valuations for water rise significantly. Finally, the administration and effective use of community mitigation funds, which have become a standard element of contracts, requires review.

Institutions designed to support option trading in the water market need to address two existing barriers to trade: (1) matching (where potential buyers and sellers pair up), and (2) access to infrastructure. The matching phase is currently complicated by the lack of a centralized system for signaling willingness to trade. An online marketplace to connect buyers and sellers could help address the matching barrier. Online platforms have been successfully instituted in a number of markets, including timber, electricity, and e-commerce. Infrastructure access is another barrier. Under the current system, the Department of Water Resources controls the critical north-south infrastructure and grants priority access to State Water Project contractors based on their size. Infrastructure rights cannot be freely bought or traded. For smaller parties or non-contractors there is a considerable risk that infrastructure will be unavailable for delivery at a given date. A system of tradable infrastructure rights would help address this issue. Preapproved block permits for infrastructure rights, issued by region and auctioned off sequentially to qualified districts within the region, would establish such a system. Block permits have the advantages of repeatability (they can be reissued) and adjustability in the face of changing ambient conditions.
Policy Insights

1. Standardized option agreements are an important step in the transition from nonmarket relational contracting, in which select parties draft custom contracts, to an active market for standardized contracts. The drafting of standardized contracts should consider a new price structure, implementing a fixed contracting fee in place of the current volumetric (per acre-foot) reservation charge, and clauses both to allow renegotiation and to address the appropriate use of mitigation funds.

An option contract specifies two prices—an option price and a strike price—and an exercise date, on which the buyer decides whether or not to take delivery of the contracted water (sometimes referred to as calling or exercising the option). The strike price is that which the buyer will pay per acre-foot (af) of water if he elects to exercise the option, e.g., the price per af of water taken on delivery. There is also an upfront charge (or reservation fee) paid by the buyer in order to secure the right to exercise the contract at a future date. The terms of option agreements signed to date in the water market have varied, typically involving detailed operational provisions and differing prices. The contracts signed by MWD in 2003 have served as a template of sorts. Contracting remains, nonetheless, essentially a nonmarket transaction characterized by time spent in the matching, valuation, and negotiation phases. To the extent that standard agreements can be drafted and implemented, water transfers will come to resemble market transactions rather than nonmarket transactions. The drafting of standard agreements raises a number of issues, including that of price structure.

Past contract prices have been structured as volumetric charges. There is an initial per-af reservation charge for the water under contract and an exercise price to be paid per af of water taken on delivery at a future date (the exercise date). Given that the buyer may not exercise all, or even any, of the options that he holds, the reservation charge induces him to hold a conservative number of options. This is inefficient from an economic standpoint. Rather, the buyer should be able to hold as many options as he would conceivably need at the exercise date. Maximum flexibility is economically efficient, as long as the seller’s opportunity cost of providing this flexibility vanishes. The latter holds true, at least approximately, in the California water market. A fixed contracting fee would remove the incentive to under-contract while still allowing the seller to levy an upfront payment. As the seller can still extract a profit through the upfront fee, he faces no disincentive to switch pricing schemes. Charges for a number of services are structured this way, including billing for water, telephone, and electricity service. There is an upfront fee (sometimes referred to as a connection fee) to establish service. The volumetric charge is based on actual usage. This prevents under-usage.

2. Observed trends in the contract market include rising contract prices, additional buyer activity, and one-year durations. The latter will no longer be possible under more stringent environmental review guidelines, necessitating a shift in the market.

In five years, water option prices have risen from $10/af base and $90/af strike (in 2003) to $50/af base and $200/af strike (in 2008). One interpretation of the price hike is an increase in seller bargaining power possibly due to (1) a heightened
awareness (among sellers) of the high cost of urban water shortage and (2) the presence of more stringent buyer competition. One result of the higher prices is a more even distribution of gains from trade between sellers and buyers. A look at past contracts suggests that prices may have been highly favorable to buyers. The increase in buyer activity suggests the viability of one-year water transfer contracts as an approach to covering short-term water shortages. These transfers currently enjoy an expedited environmental review. A full review under the California Environmental Quality Assurance (CEQA), which generally takes in excess of six months, is required for long-term water transfers. If required for short-term transfers, it would render such contracting infeasible: the time required for review would exceed the time horizon of the water transfer. A lawsuit filed this past year in the Butte County Superior Court by Butte Environmental Counsel against Richvale Irrigation District seeks to eliminate expedited environmental review for short-term transfers. In the event of a decision in favor of Butte, a shift from one-year to multi-year option contracting would be required to keep the contract market alive. This may prompt new contract structures, e.g., flexible multi-year agreements.

The development of a flexible contract structure, under which two parties interested in trade can secure environmental review and approval for a multi-year period without being locked into the terms of trade for each year, would offer several advantages. First, it would encourage buyers and sellers to preemptively establish channels for trade. This increases the overall likelihood of a successful future transfer by ensuring completion of the matching phase in advance. Second, it would reduce the transaction cost associated with contract ratification. In effect, the two parties would be free to engage in repeated contracting upon receipt of an initial favorable environmental review. There is one example to date of a multi-year (35-year) option contract, signed between MWD and the Palo Verde Irrigation District (PVID) in 2003, granting MWD the right to call up to 100,000 af a year.

3. Preallocated block permits for infrastructure access would facilitate option trading by creating a system of tradable, or auctionable, conveyance rights. A central clearinghouse for matching buyers and sellers would further support market development.

Preallocated block permits have been used to establish markets for emissions trading of nitrogen oxide and sulfur dioxide in the United States, and carbon dioxide in Europe. A well-defined emissions right specifies a quantity, location, and time horizon. The block permit standardizes these features. Sulfur dioxide emissions permits, for example, are defined as a ton of SO$_2$ per annum anywhere in the U.S. Permits are issued by a government body to all stakeholders based on set criteria, such as size of operations or number of constituents. In the case of sulfur dioxide permits, grants were made to electricity utilities by the U.S. Environmental Protection Agency (EPA) and based on historical emissions.

In the California water market, block permits for infrastructure would need to specify a volume of water (total af) transferrable within a specific time window, possibly ranging from several days to months. Under such a system, permits are tradable, or auctionable. Preallocation of permits would allow parties arranging future transfers, e.g., under option contracts, to secure infrastructure access in advance. Under
the current priority-based system, parties with low-priority access wishing to trade are unlikely to be able to do so. Transfer permits issued at the regional level could be auctioned off sequentially to qualifying water districts, e.g., those within the region. Once allocated, permits could then be traded through a central clearinghouse (online marketplace).

**Prices and Terms from the 2003, 2005, and 2008 Contracts**

Option contracts have been signed in the California water market in 2003, 2005, and 2008. The contracts are typically signed in the early spring before hydrologic conditions for the year are known. MWD actively pursued contracts in 2003 following a two-year dry spell, during which storage levels had been drawn down. MWD did not actively pursue contracts in 2004. The agency did sign contracts in 2005, with dry conditions having persisted in 2004. The 2005 options were not called, as spring rains alleviated dry conditions. The dry conditions in 2007 and 2008 made option contracts appealing to MWD, but negotiations in 2008 fell through. SDCWA signed two contracts in 2008.

Past option contracts have specified, in addition to prices, a number of trade-related conditions. There are fees for conveying water on state-owned infrastructure, which the contracts signed to date specify will be paid by the buyer. There are also losses associated with using natural channels for conveyance (referred to as “carriage losses”), which the contracts again stipulate are to be borne by the buyer. These losses can represent up to 20% of the total volume transferred. In addition, San Diego County Water Authority assesses a 50% probability that infrastructure will be unavailable for conveyance: with limited pumping capacity at the south-Delta outtakes for conveyance of water north-south, transfers may be delayed or blocked. The contracts designate that the risk of non-conveyance is to be assumed by the buyer. Both parties agree, however, to work together to achieve a storage solution (with the U.S. Bureau of Reclamation (USBR)) such that water can be transferred at a later date. Environmental review costs incurred under CEQA are to be shared. The manner in which water is to be made available for transfer and the community-wide impacts of the transfer are dealt with explicitly in the contract. The buyer agrees to pay a mitigation fee in excess of the strike price per acre-foot (af) of water called, with the total fees paid comprising a mitigation fund to be disbursed at the seller’s discretion.

The first option contracts were initiated by MWD and signed in 2003, with 11 irrigation districts in the Sacramento Valley. MWD again entered into option agreements in 2005. MWD held options for 146,230 af and 112,495 af of water, respectively, in the two years – an amount totaling approximately 5% of MWD’s average annual deliveries (of 2.4 maf). The contracts were structured similarly, with the largest contract signed between MWD and the Glenn-Colusa Irrigation District (GCID), the biggest irrigation district in Glenn and Colusa counties, and one of the bigger statewide districts. The base price was $10/af and the strike price was $90/af, for up to 60,000 af of water. MWD paid a non-refundable $600,000 upfront. The option was indexed to the hydrologic conditions, a proxy for the value of water at the future date: if 2003 was designated a “critical” water year in accordance with an established index (the 40-30-30 Sacramento Valley Index), the strike price was to be incremented by
$25/af to $115/af. The contract specified that if the water was not made available by GCID at the time of exercise, MWD would receive a full refund plus interest. The option was set to expire on February 15, on which date MWD called all of the options. A $5/af mitigation payment was issued (and, in fact, requested) by MWD to “be deposited by GCID into a restricted interest bearing account to be administered and utilized by GCID for the purpose of monitoring and mitigating any and all adverse impacts, environmental and other associated with the GCID water transfers.” The contract also asserted the following: “… GCID contends that there are no third party economic impacts...associated with its transfer of pre-1914 water rights water.” A relatively small quantity of the total acreage in GCID was fallowed to supply the water. This policy of restricted fallowing is encouraged by the state’s water code. Under the Water Code, fallowing of acreage in excess of 20% of a district’s total landholdings requires public review.

There were several amendments to the MWD-GCID 2005 contract. Most notably the call date was pushed back from February 15 to April 1 and an extension clause was added, whereby the option could be extended from April 1 to May 2 for an additional option payment of $20/af. The clause also specified that the extension be for no less than 40,000 af, where the total number of options held amounted to 80,000 af of water. The hydrologic indexing was removed from the contract, and the new strike price of $115/af reflected an increase of $25/af. The initial fee remained at $10/af. The payout structure associated with the extendable option was slightly more complex: the total payment (option fee plus strike) was set at $125/af with an additional payment of $10/af (total $135/af) if the option had been extended after April 1 but called before April 16, and an additional payment of $20/af (total $145/af) if the option had been extended after April 1 and was called between April 16 and May 2. Hence, for an option called before April 1, the strike price would be $115/af – the $125/af minus the upfront fee of $10/af, with no extension fee.

In 2008, the San Diego County Water Authority (SDCWA) signed option contracts with two northern irrigation districts, the Butte Water District and Sutter Extension Water District. These contracts specified the same base fee of $10/af, with an extension clause for $40/af. The exercise price increased significantly to $200/af. San Diego paid the $50/af reservation fee per option (the $10/af base plus the $40/af extension fee) and ultimately exercised all of the options. The general terms of the contract closely match those of the MWD contracts, specifying that the buyer bear both the cost and losses associated with conveyance, as well as the risk of non-conveyance (with cooperation to secure north-of-Delta storage as an alternative to immediate conveyance). In two departures from the MWD contracts, the SDCWA contracts designate that the buyer pay all environmental permitting costs and forego the community mitigation fee. Significant detail regarding the actual crop fallowing or crop-shifting practices (to make water available for transfer) was omitted and payment details were simplified. The SDCWA contracts are a streamlined version of the MWD contracts.

**Magnitude and Distribution of Welfare Gains from Contracting**

Both parties have stood to gain from entering into option agreements. Both the magnitude and the distribution of the gains to each side are an important consideration from a societal perspective
and may impact parties’ willingness to trade in the future.

Generally, the economic gains from contracting depend on two key uncertain factors: (1) the seller’s opportunity cost of water and (2) the buyer’s potential shortage cost of water. If the seller elects not to transfer water, the alternative use of the water is application to a crop such as rice. The opportunity cost of transferred water is the profit expected from the sale of the rice. The buyer’s potential shortage cost of water depends on the potential magnitude of the shortage, e.g., how many acre-feet of residential demand an urban water agency must fulfill, as well the cost of either meeting this demand or declaring a shortage. For an urban water agency in Southern California, for instance, projected shortages could range from zero to 100,000 af in a given year at a cost of $1,347 af, where the latter is the penalty rate for additional supply (from MWD).

Under current assessments of the shortage cost for water in Southern California ($1,347/af) and historical commodity prices for rice, buyers have appropriated a disproportionately large share of the gains from trade. Over 90% of the total gains increasing to 30%. If the upward trend continues, it will likely result in a more even distribution of gains from trade.

Table 1 reports estimates of the seller’s and buyer’s valuations without contracting, where the buyer’s payoff is negative, reflecting the anticipated shortage cost of water. These are reported as the seller’s and buyer’s reserve values. The payoffs under contracting are also estimated. The magnitudes of anticipated losses from water shortage without contracting are estimated at $49M and $43M in 2003 and 2005, respectively. Contracting reduces the anticipated losses to approximately $18M in 2003 and $17M in 2005. The social welfare gains from contracting are $34M and $29M. The smaller welfare gains in 2008 owe to the reduced size of the contracts that year: approximately one-fifth the quantity of water was transferred.

The estimates in Table 1 are sensitive to a number of assumptions, notably those regarding the shortage cost of water, the commodity prices for the seller’s crop, and the seller’s and buyer’s actual valuations. The terms of the past contracts reveal neither expectations regarding the shortage cost of water nor expectations regarding commodity prices in the years that they were signed. The proxy for the shortage cost of water

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<td><strong>Buyer’s Reserve ($M)</strong></td>
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<td><strong>Buyer Payoff ($M)</strong></td>
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Table 1. Estimated Welfare Gain Under Contracting
assumed here is the aforementioned penalty rate charged by MWD (to SDCWA, for instance) for supply in excess of the base contracted amount. If the shortage cost of water were in reality lower than that estimate, then the reduction in the buyer’s averted shortage cost would yield a more even distribution of the gains. The shortage cost of water may be lower than the MWD penalty rate if, for example, lower-cost supplemental water sources or rationing are viable alternatives. Lower-cost supplemental groundwater may be made available via groundwater pumping, desalination or reuse technologies, or through other water transfer arrangements.

**Key Contract Parameters**

Option contracts are a form of coinsurance, where the value from contracting is derived from the ability of the buyer and the seller to share risk. The buyer faces a potential costly supply shortage, the magnitude of which depends on the future level of demand as well as the assessed cost of not meeting that demand. The future level of demand uncertain price on the commodity market for a crop under cultivation. The future price of the crop determines his opportunity cost of transferring water. These two key uncertainties – future commodity prices and potential urban water shortages – are critical to contract valuation and pricing. Both vary interannually.

There exist reasonably accurate data on historical commodity prices. The validity of historical data is, however, called into question by sudden and sharp price movements, as observed in 2007-2008 on the commodity exchange, with soybean, rice, and wheat prices hitting historical highs. For the purposes of contract-design, there are quotes openly available throughout the year for futures on all major commodities. In contrast, there are very limited data on the actual cost of urban water shortage for users in Southern California. The cost of a secondary supply serves as a proxy for the cost of shortage when the utility intends to cover any unmet demand. A 1993 survey by CIC, Inc., an economic consulting firm hired by SDCWA to assess water outage costs

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<td><strong>Average cost per acre</strong></td>
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<td><strong>Profit per af of applied water</strong></td>
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Table 2. Rice Production Data (Per hundred-weight, or cwt)  

depends on a number of parameters, including climatic conditions, and remains uncertain. The seller, a farmer, faces an uncertain price on the commodity market for a crop under cultivation. The future price of the crop determines his opportunity cost of transferring water. These two key uncertainties – future commodity prices and potential urban water shortages – are critical to contract valuation and pricing. Both vary interannually.

There exist reasonably accurate data on historical commodity prices. The validity of historical data is, however, called into question by sudden and sharp price movements, as observed in 2007-2008 on the commodity exchange, with soybean, rice, and wheat prices hitting historical highs. For the purposes of contract-design, there are quotes openly available throughout the year for futures on all major commodities. In contrast, there are very limited data on the actual cost of urban water shortage for users in Southern California. The cost of a secondary supply serves as a proxy for the cost of shortage when the utility intends to cover any unmet demand. A 1993 survey by CIC, Inc., an economic consulting firm hired by SDCWA to assess water outage costs
Table 2 reports production data for rice used to calculate the farmer’s opportunity cost of transferred water. The consumptive use of water per cultivated acre of rice, for example, is 3.3 af of water. Only water consumptively used is eligible for transfer, where consumptive use is defined as the quantity absorbed by the plant or evaporated from the plant or soil surface.

Assessing the buyer’s potential shortage cost of water requires an estimate of the potential magnitude of the shortage, and then the associated cost of shortage. A distribution of potential future shortages can be estimated based on historical deliveries, firm supply, and projected demand scenarios. The supply is comprised of both available storage water and annual flows into the system.

**Design of Standardized Contracts**

The issuance of standardized contracts reduces both the uncertainty and the overhead associated with contract negotiation. Drafting such contracts raises a number of questions. *What price structure should be adopted? Also, what contractual clauses are desirable? And, how should contracting costs, including environmental review cost and conveyance, be allocated?*

An efficient two-part price structure implements (1) a fixed fee for contracting and (2) a strike price equal to the seller’s opportunity cost plus the marginal cost of conveyance. As discussed, past contracts have implemented a volumetric price structure, charging a per-option (per-af) reservation fee and exercise fee, or strike price. In general, this price structure results in the buyer holding too few options from a social welfare perspective. By charging a fixed fee for contracting in place of the volumetric reservation charge, the seller still collects an upfront payment but does not bias the buyer’s decision.

Contracting incurs both fixed costs and marginal costs. The cost of undergoing environmental review is a fixed cost and can be allocated to the buyer through the fixed contracting fee. The conveyance charge for moving water on state-owned infrastructure is a marginal cost and should be rolled into the strike price.

A second issue is the design of standardized option clauses to address renegotiation and community mitigation funds. Renegotiation clauses have not been standard to date but would help ensure that delivery on contracts is avoided when uneconomical. If the buyer must take physical delivery of the water to which he has a contractual right, as opposed to reselling it or keeping it, there is a potential efficiency loss. Delivery of goods under contract is rare in financial markets, where the contracted good is (re)sold to the party with the highest value at the exercise date, often through an external spot market, and money changes hands. There is no spot market for water as yet in California. In its absence, the renegotiation clause encourages the buyer and seller to fully consider the alternative to delivery, e.g., that of resale to the seller. It may also encourage sellers to look for outside buyers in the intervening period.

An alternative to the renegotiation clause is a strike price indexed to the seller’s market conditions. Specifically, the price is indexed to the seller’s profit from crop cultivation as a function of the prevailing commodity prices. This ensures that the buyer only exercises options up to the point where the value of water in an urban setting exceeds that for agricultural applications. Historical prices for crops such as rice have remained significantly below estimates of the urban shortage cost of water. However, the record high prices...
for commodities this past year, in the face of global crop failures and rising demand, call this assumption into question and make indexing even more appropriate.

The issuance and use of a community mitigation fund is a third issue in contract design. Mitigation funds have become a standard element of contractual water transfers. The funds have been established in recognition of negative community-wide impacts due to falling programs associated with water transfers, including reduced farm employment and farming-related equipment sales. Size and designation of mitigation funds have varied considerably; a generally-accepted fair and successful precedent has yet to be established. Funds that are structured to disburse individual compensation, such as that established under the Imperial Irrigation District (IID) transfer with the San Diego County Water Authority (SDCWA), generate concerns akin to those facing the welfare systems – namely that dependencies will be encouraged and a precedent for high levels of compensation will be established. At the same time, such programs may be necessary to provide assistance during a transitional period. Funds that are either tied to community development and aimed at diversifying the local economy or, alternatively, set aside for active water management programs, may prove more sustainable.9

The viability of temporary water transfers as a mechanism for covering supply shortages hinges on their continued acceptance by farming communities. Water rights sales, or permanent transfers, have met with considerable institutional resistance by farming communities in the past. Although water transfers at the district level typically require approval only by the irrigation or water district board, community sentiment is likely to be fully taken into account. For instance, the GCID board of directors, elected by proportional vote based on landholdings in the irrigation district, ultimately made the contracting decisions in the MWD-GCID transfer. However, the board would have been aware of both the possibility of organized community resistance to prevent future water sales and its accountability to its constituents. The careful design of mitigation funds can help win this approval and also ensure that temporary transfers don’t threaten the sustainability of agricultural practices in the future.

An alternative to the establishment of mitigation fees would be the introduction of contractual clauses specifying retainers, or side payments, for community farming enterprises and laborers. The advantage of retainers is a guarantee that the infrastructure, e.g., operation of the mills and marketers, vital to farming activity remains solvent. Closure of these enterprises due to low volume over a period of successive years would be disruptive to future farming practices. In years when transfers are not desirable, e.g., when crop prices are high or water supply is plentiful, farms must remain operable. Given that transfers under falling are currently restricted to a less than 20% of a district’s total cultivated acreage, the fluctuation in crop volume due to transfers may not be great enough to threaten local business. There is a natural fluctuation in annual volumes due to favorable/unfavorable growing conditions, for which the system is already attuned. As with individual payments from a central mitigation fund, the question arises as to whom exactly qualifies for a retainer fee. Also at issue is the appropriate fee level.
Design of Institutions to Support Contractual Water Transfers

High search costs and limited infrastructure access pose serious barriers to the formation of a more active contracting market. A centralized clearinghouse to match buyers and sellers would reduce search costs. The Drought Water Purchase Program operated by the DWR in dry years is a model of this concept. DWR purchases water from willing sellers, typically agricultural districts, and then makes the water available to interested buyers, typically urban water districts. The limited operation of the market – in select dry years – curtails the ability of buyers to tailor their water management programs. Such management might, for instance, require transfers during non-drought years to replenish storage. There are hundreds of water districts in California, each potentially with an incentive to become involved with water transfers. Under the current system, these districts have limited ability to initiate trade. An online marketplace could effectively match willing buyers and sellers. Online platforms have been vetted in a number of sectors, including popular commerce (eBay), timber (eTimber), and electricity (APX). Timber auctions match logging companies and mills. Auctions can be initiated by either side at any point – buyers initiate reverse auctions or sellers initiate forward auctions.10 Similarly, in online electricity markets, wholesale and commercial electricity buyers and sellers are matched anonymously based on bids and offers, with each party specifying a reserve price which it will not go above (or below).

DWR’s existing role as market-maker is a natural one in light of its control of the major north-south water artery, the State Water Project. Water sold through the Drought Water Purchase Program can be conveyed on state infrastructure under DWR’s first-priority rights. Opening the market, as proposed under the adoption of an online trading platform, first requires that infrastructure rights be accessible. Otherwise market participation will be restricted to several large players with high-priority rights. Under a system of tradable, or auctionable, conveyance permits, parties wishing to arrange water transfers could simultaneously set transfer contracts and bid on conveyance rights. Preallocated block permits would accomplish this and have the advantages of repeatability and adjustability, where permits can simply be reissued or adjusted by a proportionality factor, to account for changes in ambient conditions and new claims.

The initial allocation of block permits – with each block consisting of a standardized volume, location (access and delivery point), and time window – for infrastructure access could be granted at a regional level. Block size would be on the order of 10,000 af. The location would be tied to a capacity-constrained point, e.g., a pumping facility. The time window for the permit may range from a few days to a few months. Adjustments to block size could then be tied to ambient conditions, such as minimum flow levels. The final distribution of rights between individual districts wishing to engage in trade could then be decided through sequential auctions of the allotted regional blocks, with all districts within the initial region as qualifying auction participants. A double auction would be conducted through the central (online) clearinghouse, in which the holders of block permits (essentially infrastructure rights) and buyers wishing to transfer water submit electronic bids. If the permits are adjustable, e.g., can be uniformly decremented or even nullified due to legal
restrictions on conveyance, possibly under environmental statute, then the infrastructure risk remains. This notwithstanding, the issuance of defined permits reduces the uncertainty and creates the possibility of trade and hence active contacting.

A remaining issue for legislative review, is that of subsidies. The current structuring of subsidies under the Farm Bill is such that farmers are paid a subsidy per cwt for a given crop. In years that land is not cultivated, the subsidy is foregone. The subsidy distorts the value of water by assigning additional value to it when used to grow crops as opposed to used for urban use or transfers. This subsidy deserves review, keeping in mind that a simple transfer of the subsidy from crop cultivation to general water use (including transfers) may have the undesirable impact of increasing wasteful use.

Temporary water transfers could come to play an important role in managing the state’s water supply uncertainty. These short-term transfers have the advantages of flexibility, allowing parties to adjust to changing yearly conditions, and low transaction cost. Further reliance on option agreements as a water supply management tool, however, requires institutions to support trade. A centralized clearinghouse and standardized contracts to further reduce transaction cost – in particular matching and negotiation costs – as well as the introduction of tradable infrastructure permits, would support an active market-based system for water transfers. The design of these institutions in California will be of interest to the worldwide community, which also faces water supply pressure in the form of population growth, economic expansion, global climate change, and concern about environmental degradation.

Notes


5. The technical assumption is that the seller maximizes expected value.


7. Rice prices as quoted by the Farm Service Agency (FAS). Interview with Don Perez of FSA, Glenn Colusa County, December 27, 2007. Data on the cost of rice production from USDA, Research Team, Rice Briefing: data on the yield per acre of cultivated rice from Feed Grains Database:[http://www.ers.usda.gov]. Consumptive use of water for rice is approximately 3.3 af per acre according to the California Department of Water Resources (2007). Application is actually 5.89 af.


Authors

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James L. Sweeney is a Professor of Management Science and Engineering and Director of the Precourt Institute for Energy Efficiency and a Senior Fellow at the Stanford Institute for Economic Policy Research and the Hoover Institution. jim.sweeney@stanford.edu

Barton H. Thompson is the Robert E. Paradise Professor of Natural Resources Law and the current director of the Woods Institute for the Environment at Stanford University. buzzt@stanford.edu

Acknowledgements

The authors are grateful to the numerous individuals in the California water community who shared their expertise and their data, including Bob Campbell and Gordon Hess at SDCWA, Steve Hirsch at MWD, Tim Quinn at the Association of California Water Agencies, Paul Mendoza at the DWR, Ellen Hanak at the Public Policy Institute of California, and Gary Liebcap at U.C. Santa Cruz. Funding for this research was in part provided by Woods Institute EVP grant 1094280-1-WAKAB.
4. Dudley Ridge Water District:

Summary of Water Offers 2014-2016

This data set, provided by Dudley Ridge Water District provides a summary of the water transfer offers it received from 2014 through 2016, including their price, along with carriage losses, water source, and owner, where available.
### SUMMARY OF WATER OFFERS 2014-2016

<table>
<thead>
<tr>
<th>Date of Offer</th>
<th>Owner</th>
<th>Available (AF)</th>
<th>Water Source</th>
<th>Cost ($/AF)</th>
<th>Carriage Loss</th>
<th>Cost with Carriage Loss</th>
<th>Additional Delivery Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4/2014</td>
<td>Semitropic Water Storage District</td>
<td>6,000</td>
<td>San Luis/KWB</td>
<td>$1,200</td>
<td>30%</td>
<td>$800</td>
<td>$20/af (if from San Luis)</td>
</tr>
<tr>
<td>4/2/2014</td>
<td>DWR</td>
<td>6,000</td>
<td>SWP</td>
<td>$300</td>
<td>30%</td>
<td>$430</td>
<td>$85/af (if from KWB)</td>
</tr>
<tr>
<td>4/2/2014</td>
<td>DWR</td>
<td>6,000</td>
<td>SWP</td>
<td>$300</td>
<td>50%</td>
<td>$600</td>
<td></td>
</tr>
<tr>
<td>4/2/2014</td>
<td>DWR</td>
<td>6,000</td>
<td>SWP</td>
<td>$400</td>
<td>30%</td>
<td>$570</td>
<td></td>
</tr>
<tr>
<td>4/2/2014</td>
<td>DWR</td>
<td>6,000</td>
<td>SWP</td>
<td>$400</td>
<td>50%</td>
<td>$800</td>
<td></td>
</tr>
<tr>
<td>11/24/2014</td>
<td>*Seller not specified in offer</td>
<td>359 - 2,500</td>
<td>NOD</td>
<td>$1,050</td>
<td>15%</td>
<td>$824</td>
<td></td>
</tr>
<tr>
<td>2/18/2015</td>
<td>Dry Year Water Purchase Program</td>
<td></td>
<td>NOD</td>
<td>$700</td>
<td>15%</td>
<td>$941</td>
<td></td>
</tr>
<tr>
<td>2/18/2015</td>
<td>Dry Year Water Purchase Program</td>
<td></td>
<td>NOD</td>
<td>$700</td>
<td>30%</td>
<td>$1,000</td>
<td></td>
</tr>
<tr>
<td>2/18/2015</td>
<td>Dry Year Water Purchase Program</td>
<td></td>
<td>NOD</td>
<td>$800</td>
<td>15%</td>
<td>$941</td>
<td></td>
</tr>
<tr>
<td>2/18/2015</td>
<td>Dry Year Water Purchase Program</td>
<td></td>
<td>NOD</td>
<td>$800</td>
<td>30%</td>
<td>$1,143</td>
<td></td>
</tr>
<tr>
<td>2/18/2015</td>
<td>Dry Year Water Purchase Program</td>
<td></td>
<td>NOD</td>
<td>$900</td>
<td>15%</td>
<td>$1,059</td>
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</tr>
<tr>
<td>2/18/2015</td>
<td>Dry Year Water Purchase Program</td>
<td></td>
<td>NOD</td>
<td>$900</td>
<td>30%</td>
<td>$1,286</td>
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</tr>
<tr>
<td>2/18/2015</td>
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<td></td>
<td>NOD</td>
<td>$1,000</td>
<td>15%</td>
<td>$1,176</td>
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<tr>
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<td>NOD</td>
<td>$1,000</td>
<td>30%</td>
<td>$1,429</td>
<td></td>
</tr>
<tr>
<td>3/4/2015</td>
<td>Dry Year Water Purchase Program</td>
<td>130,000</td>
<td>NOD</td>
<td>$700</td>
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<td>$875</td>
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<tr>
<td>3/4/2015</td>
<td>Dry Year Water Purchase Program</td>
<td>130,000</td>
<td>NOD</td>
<td>$700</td>
<td>30%</td>
<td>$1,000</td>
<td></td>
</tr>
<tr>
<td>3/4/2015</td>
<td>Dry Year Water Purchase Program</td>
<td>30,000</td>
<td>NOD</td>
<td>$665</td>
<td>20%</td>
<td>$824</td>
<td></td>
</tr>
<tr>
<td>10/28/2015</td>
<td>Westside Water District</td>
<td>300</td>
<td>NOD</td>
<td>$925</td>
<td>Water Toll would be added</td>
<td>$36 (Water Toll rate)</td>
<td></td>
</tr>
<tr>
<td>2/25/2016</td>
<td>Dry Year Water Purchase Program</td>
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<td>NOD</td>
<td>$550</td>
<td>20%</td>
<td>$688</td>
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<tr>
<td>2/25/2016</td>
<td>Dry Year Water Purchase Program</td>
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<td>NOD</td>
<td>$550</td>
<td>30%</td>
<td>$786</td>
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<tr>
<td>6/21/2016</td>
<td>Sites (offer in todays dollars)</td>
<td></td>
<td>NOD</td>
<td>$1,000</td>
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<td></td>
<td></td>
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<tr>
<td>8/18/2016</td>
<td>Rosedale</td>
<td>5,000</td>
<td>NOD</td>
<td>$800</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
All,

The SWC Buyer group met to discuss the sellers’ pricing justification, the buyers’ pricing sensitivities and our counter offer to the sellers. This year, the SWCs hired M³ to do an economic analysis on 2014 rice prices. As a result, rice prices were estimated at $145/AF. SWC added $20/AF to get to the $165/AF NOD in our initial offer to the sellers. However, the sellers stated that they want to move away from rice economics. They said in past years, rice prices have been higher. Plus, the sellers noted that DYTP water went for $275/AF NOD in 2009 while going into year three of a drought. Therefore, they want $300/AF NOD.

In regards to litigation, there is rumor that the environmentalists are watching the 2014 transfers very closely and have asked the sellers to notify them of any CEQA that is drafted. Thus said, this is the sellers’ justification as to why they want the buyers to take on 100% of the liability. The sellers’ general thoughts are that they might as well just plant rice instead of getting sued. Additionally, the SWC General Counsel noted that since we have been doing a lot of NOD transfers lately, this could be viewed as a long-term transfer program, thus opening up more potential for litigation.

After discussion amongst the SWC buyer group, the following terms were agreed upon to go back as a counter offer to the sellers.
- $250/AF NOD
- CEQA/Admin $35K
- Litigation $50K then 50/50 split
- Crop idling call date April 18 (DWR operations capacity study out ~Apr. 16)

Additionally, it was emphasized by all the importance of coordinating with the CVP on the price/terms and offer schedule. The CVP’s goal is to counter offer their sellers before Christmas. Therefore, the SWC buyers will do the same.

Other
- Most of the M&I SWCs on the call and Oak Flat WD said that they would not purchase at $300/AF NOD. MWD’s pricing threshold is currently at $250/AF NOD. I relayed that DRWD has landowners dropping out at $225-$250/AF, but may still have some demand at $300/AF.
- It is estimated that there could potentially be 100-150 TAF (140 TAF fallow + 10 TAF GW sub) made available by 5-8 sellers. Please see attached DYTP Requests for potential allocations of up to 150 TAF (note that the quantities will change once the buyer pool is finalized).
- The negotiated DYTP water cost will most likely drive the 2014 Yuba C4 water price.
- 2014 Yuba water estimate ~80 TAF total (all components), split 50/50 with SLDMWA.
Please submit your 2014 Dry Year water transfer requests by water type (GW substitution, fallowing, or both) by Friday Jan 10. I will invoice you for the $5/AF SWC administration fee deposit on Monday.

Please don’t hesitate to call if you have any questions.

Thanks,

Rick Besecker
Dudley Ridge Water District
c/o Provost & Pritchard Consulting Group
2505 Alluvial Avenue
Clovis, CA 93611-9166
Phone: (559) 326-1100 Ext. 312
Fax: (559) 326-1090
E-mail: rbeseecker@ppeng.com
Website: www.ppeng.com

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Please consider the environment before printing this e-mail.
Kellie Welch - Potential water supply

From: "Rick Besecker" <rbesecker@ppeng.com>
To: <AndrewE@paramountfarming.com>, "Austin Ewell" <austin@ewellgroup.com>, ...
Date: 3/4/2014 4:50 PM
Subject: Potential water supply

Water Users:

Semitropic Water Storage District has up to 6,000 AF available for purchase. A portion of the water is in San Luis Reservoir (SLR) and the remainder would be pumped from the Kern Water Bank. Purchase price is $1,200/AF plus delivery costs of about $20/AF if from SLR, and potentially $85/AF if from KWB.

Please contact me or Dale before 3:00 PM Wednesday if you have interest in this water.

Rick Besecker
Dudley Ridge Water District
c/o Provost & Pritchard Consulting Group
2505 Alluvial Avenue
Clovis, CA  93611-9166
Phone: (559) 326-1100  Ext. 312
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Please consider the environment before printing this e-mail.
Kellie Welch - Water Purchases for North of Delta Water - RESPONSE REQUESTED BY 3:30 THURSDAY

From: "Dale Melville" <dmelville@ppeng.com>
To: <rpm@mccarthyfarms.com>, "Ana Mojica" <anam@paramountfarming.com>, "Andr...
Date: 4/2/2014 10:16 AM
Subject: Water Purchases for North of Delta Water - RESPONSE REQUESTED BY 3:30 THURSDAY
Cc: "Rick Besecker" <rbesecker@ppeng.com>, "Tom Glover" <tglover@ppeng.com>

All,

GOOD NEWS:
- The recent storms may be enough to allow the 50% cuts to Feather River contractors to be eliminated. If their full allocation is restored, they will be able to sell water this year via fallowing (larger amounts) and groundwater substitution (smaller amounts).
- MWDSC has dropped out of the program, so most of any water made available would go to KCWA (half) along with DRWD and a few other small districts.
- DWR has stated that carriage losses will be less than 50% this year.

BAD NEWS:
- Rice prices are high this year. Price for water North of Delta (NOD) could be $400/af (vs pricing discussions earlier this year at $275/af)
  - worst case, at 50% losses, equates to $800/af plus water toll charges to you.
  - Best case, at 30% losses, equates to $570/af plus water toll charges to you.

REQUEST:
- To provide DRWD’s input on a SWP Buyers call tomorrow at 4:00, we need to know what quantity of water you would be interested in purchasing under each of the following conditions. Please return via email to Rick no later than 3:30 tomorrow (Thursday, 4/3/14). This is not binding, but the SWP negotiators need this information in meeting with Sellers in the next few days.
  - Quantity at $300/af and 30% carriage losses = $430/af wet water: ___________ AF
  - Quantity at $300/af and 50% carriage losses = $600/af wet water: ___________ AF
  - Quantity at $400/af and 30% carriage losses = $570/af wet water: ___________ AF
  - Quantity at $400/af and 50% carriage losses = $800/af wet water: ___________ AF

Thanks....this will help in the negotiations; we can do some interpolation for intermediate numbers. We’ll also be pushing for a final call date (final quantity based on the negotiated price) to be in early-mid May when deposits will need to be made.

Dale K. Melville, Manager-Engineer
Dudley Ridge Water District
286 W. Cromwell Avenue
Fresno, CA 93711-6162
Phone: (559) 449-2700 x102
Fax: (559) 449-2715
Cell: (559) 355-5880

file:///C:/Users/welch.TRAIN-5/AppData/Local/Temp/XPgrpwise/533BE379IRWDFS1P... 1/24/2018
DUDLEY RIDGE WATER DISTRICT

July 1, 2014

Irvine Ranch Water District

PO# 520595

(1 of 2)

INVOICE

Invoice Number: 14137WT

This invoice is for supplemental water purchases incorrectly billed on the previous Water Toll invoice.

<table>
<thead>
<tr>
<th>Acre-Feet</th>
<th>Description</th>
<th>$/Acre-Foot</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Westside Districts Water Purchase</td>
<td>840.90</td>
<td>25,227.00</td>
</tr>
<tr>
<td>-29</td>
<td>Less Previously Paid</td>
<td>290.72</td>
<td>-8,430.88</td>
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<tr>
<td>30</td>
<td>Westside Districts Water Delivery</td>
<td>30.00</td>
<td>900.00</td>
</tr>
<tr>
<td>-29</td>
<td>Less Previously Paid</td>
<td>30.00</td>
<td>-870.00</td>
</tr>
</tbody>
</table>

RECEIVED
JUL 29 2014
PURCHASING

TOTAL AMOUNT DUE AND PAYABLE BY 8/1/14 $16,826.12

Delinquent Water Toll Charges shall be subject to a 5% penalty charge on the amount delinquent and interest charges on the amount delinquent at a rate of 11 1/2% per month from and after the delinquent date until the delinquency, penalties, and interest are paid in full. The District shall have the right to terminate deliveries of water to any land within the District which is delinquent in this charge.

Note: Invoice 14137WT $16,826.12 - Invoice 1401842 $3,677.18 = $14,149.94

Ant of full purf
Water Users:

We have received an offer for a minimum of 359 AF up to a maximum of 2,500 AF available for $1,050/AF, deliverable in 2015. Please email myself or Dale by Monday, December 1 if you have interest in this supply.

Rick Besecker
Dudley Ridge Water District
c/o Provost & Pritchard Consulting Group
286 W. Cromwell Avenue
Fresno, CA 93711-6162
Phone: (559) 449-2700
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Please consider the environment before printing this e-mail.
Kellie Welch - 2015 DYTP Requests

From: Rick Besecker <rbesecker@ppeng.com>
To: Ana Mojica <AnaM@paramountfarming.com>, Andrew Edstrom <AndrewE@paramount...
Date: 2/18/2015 11:21 AM
Subject: 2015 DYTP Requests

Water Users,

Negotiations for the 2015 Dry Year Water Purchase Program are underway, and we’ve been asked to provide our potential level of interest at various purchase prices. Please indicate your potential level of participation below and email back to me ASAP.

<table>
<thead>
<tr>
<th>NOD Purchase Price</th>
<th>Cost with 15% Carriage Loss</th>
<th>Cost with 30% Carriage Loss</th>
<th>NOD Purchase Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>$700</td>
<td>$824</td>
<td>$1,000</td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>941</td>
<td>1,143</td>
<td></td>
</tr>
<tr>
<td>900</td>
<td>1,059</td>
<td>1,286</td>
<td></td>
</tr>
<tr>
<td>1,000</td>
<td>1,176</td>
<td>1,429</td>
<td></td>
</tr>
</tbody>
</table>

Note that this is only for initial planning purposes—we will be asking for firmer commitments once the program details (price, volume, etc.) are finalized.

Rick Besecker
Dudley Ridge Water District
c/o Provost & Pritchard Consulting Group
2505 Alluvial Avenue
Clovis, CA 93611-9166
Phone: (559) 326-1100 Ext. 312
Fax: (559) 326-1090
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From: Rick Besecker <rbesecker@ppeng.com>
To: Ana Mojica <Ana.Mojica@wonderful.com>, Andrew Edstrom <Andrew.Edstrom@wo...
Date: 2/25/2016 1:17 PM
Subject: 2016 Dry Year Transfer Program

Water Users,

We have been working with other SWP Contractors to develop the 2016 Dry Year Transfer Program. The term sheets went out to potential sellers today with an initial offer of $550/AF. Estimated losses transferring the water through the delta will probably range between 20%-30%. With estimated losses of 30% the cost of this water in the California Aqueduct is about $786/AF (about $688/AF with a 20% loss) plus our water toll rate (currently $36/AF).

We must submit our request to participate in the 2016 Program by March 4, 2016 along with a $5/AF deposit based on our north of delta request. By April 15, 2016 we must submit the first 50% of the purchase price. The second 50% will be due June 1, 2016.

As in past years DWR will plan to move the 2016 Dry Year Water thru the delta during the July – September period. DWR staff currently estimates capacity will be available to move the water. DWR will be providing updated capacity estimates later this month. Delivery of the Dry Year water will be subject to delta pumping restrictions.

If you are interested in participating in the 2016 Dry Year Transfer Program we need your north of delta request along with a $5/AF deposit by 12 noon March 2, 2016. Early in April we will email invoices for the first 50% of the water purchase based on preliminary estimates of the District’s share of the program. Those payments will be due by 12 noon April 13, 2016. The remaining 50% plus DWR delivery charges will be due by May 27, 2016.

If you have questions feel free to either send me an email or give me a call.

Rick Besecker
Dudley Ridge Water District
c/o Provost & Pritchard Consulting Group
286 W. Cromwell Avenue
Fresno, CA. 93711-6162
Phone: (559) 449-2700
Fax: (559) 449-2715
E-mail: rbesecker@ppeng.com
Website: www.ppeng.com

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From: Rick Besecker <rbesecker@ppeng.com>
To: Ana Mojica <AnaM@paramountfarming.com>, Andrew Edstrom <AndrewE@paramountfarming.com>
Date: 3/4/2015 11:34 AM
Attachments: 15 DYTP.pdf

Water Users,

We have been working with other SWP Contractors to develop a 2015 Dry Year Transfer Program. We encountered additional challenges this year as a result of increased water broker activity in the Feather River service area. The Broker activity also drove the price of water up. However, we anticipate a maximum of 130,000 AF of water will be offered to the SWP Contractor group at a north of delta price of $700/AF. Estimated losses transferring the water thru the delta will probably range between 20%-30%. With estimated losses of 30% the cost of this water in the California Aqueduct is about $1,000/AF (about $875/AF with 20% loss) plus our water toll rate (currently $23/AF).

We must submit our request to participate in the 2015 Program by March 11th along with a $5/AF deposit based on our north of delta request. By March 25th we must submit the first 50% of the purchase price. The second 50% will be due May 5th.

Metropolitan WD has indicated it will participate in the 2015 Program—this will significantly reduce our allocation of the available water. Based on the this year’s interested contractors, we estimate the District’s share of this year’s program to be up to 1,900 AF north of the delta. The attached table illustrates projected water availability.

As in past years DWR will plan to move the 2015 Dry Year Water thru the delta during the July – September period. DWR staff currently estimates capacity will be available to move the water. DWR will be providing updated capacity estimates later this month. Delivery of the Dry Year water will be subject to delta pumping restrictions.

If you are interested in participating in the 2015 Dry Year Transfer Program we need your north of delta request along with a $5/AF deposit by 12 noon March 11th. Early the week of March 16th we will email invoices for the first 50% of the water purchase ($350/AF north of delta) based on preliminary estimates of the District’s share of the program. Those payments will be due by 12 noon March 25th. The remaining 50% plus DWR delivery charges will be due by May 5th.

If you have questions feel free to either send me an email or give me a call.

Rick Besecker
Dudley Ridge Water District
c/o Provoit & Pritchard Consulting Group
2505 Alluvial Avenue
Clovis, CA 93611-9166
Phone: (559) 326-1100 Ext. 312
Fax: (559) 326-1090
E-mail: rbesecker@ppeng.com
Website: www.ppeng.com

CONFIDENTIALITY NOTE
Kellie Welch - DYTP Allocation

From: Rick Besecker <rbesecker@ppeng.com>
To: Ana Mojica <AnaM@paramountfarming.com>, Andrew Edstrom <AndrewE@paramound...
Date: 3/17/2015 11:01 AM
Subject: DYTP Allocation

The district was allocated 1,561 AF of water through the Dry Year Transfer Program. The breakdown among landowners is as follows:

Paramount 811 AF
Sandridge 551 AF
Kings 107 AF
Utica 70 AF
Sibley 7 AF
Jackson 15 AF

Invoices for the purchase price ($700/AF) are going in the mail (and emailed) today—they are due on Monday, March 23.

Rick Besecker
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Kellie Welch - Water Operations Call

From: Rick Besecker <rbesecker@ppeng.com>
To: Ana Mojica <AnaM@paramountfarming.com>, Andrew Edstrom <AndrewE@paramoun...
Date: 3/25/2015 12:09 PM
Subject: Water Operations Call
Cc: Phillip Nixon <pnixon@lhwd.org>, "ghammett@belridgewsd.com" <ghammett@

Water Users,

Just finished today’s water operations call with DWR—here is the bad news:

- Statewide snowpack is at 9% of the April 1 average—this is the lowest on record. Temperatures are expected to rise this weekend, effectively melting the remaining snow. The 30-day precipitation forecast is non-committal, but April has produced significant rain events in the past.
- Allocation studies support 21% (at the most likely 99% exceedence) to 25% (at least likely 50% exceedence).
- Deliveries to Feather River Service Area Contractors will likely be curtailed—while this won’t impact the 2015 allocation it will reduce carryover storage in Oroville, and is likely to impact (reduce or eliminate) water available to the Dry Year Transfer Program.
- There is plenty of capacity in July through September to move non-Project water.
- There will be no Yuba Accord surface water available in 2015. Up to 30,000 AF of groundwater substitution water could be made available at $665/AF (north of the Delta).
- The dry conditions could result in additional losses for the Dry Year Transfer Program, but the contractors will push to delay imposing in 2015.

Let’s hope for some April showers—every little bit will help.

Rick Besecker
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▲ Please consider the environment before printing this e-mail.
Kellie Welch - End of year water supply

From: Rick Besecker <rbesecker@ppeng.com>
To: Ana Mojica <Ana.Mojica@wonderful.com>, Andrew Edstrom <Andrew.Edstrom@wo...
Date: 10/28/2015 3:24 PM
Subject: End of year water supply

Water Users,
We have a potential new supply of up to 300 AF available through the Westside Districts for $925/AF (plus our water toll). Water would be available mid- to late-November and can be delivered by the end of December. Please respond by end of week if you would like to purchase your allocated portion (or are not interested).

Rick Besecker
Dudley Ridge Water District
c/o Provost & Pritchard Consulting Group
286 W. Cromwell Avenue
Fresno, CA 93711-6162
Phone: (559) 449-2700
Fax: (559) 449-2715
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▲ Please consider the environment before printing this e-mail.
All,

Given the state of the SWP water supply (average 60% allocation, and trending downward), DRWD continues to look at short-term and long-term water supplies to supplement the SWP water. For the past eight years, DRWD has been procuring supplemental water supplies in concert with the “Westside 5” (DRWD and four Westside districts in Kern County) and we continue to investigate other opportunities to increase DRWD’s supply and/or reliability. Currently, a potential opportunity for supplemental water is the proposed Sites Reservoir, which the Board will be discussing at its July 13 meeting.

Sites Reservoir could provide additional dry year supplies to districts south of the Delta during times when pumping capacity is available (currently, typically at less than 50% allocations). Cost of the water is estimated to be near $1,000/af of yield. I have attached a recent Overview of the Sites project (prepared by the Sites Project Authority) and an analysis of yield from Sites that could be exported South of the Delta (prepared by the State Water Contractors); although review of these two documents are not critical to address the information I am requesting below, they do provide the most current information on the Sites project. The last slide on the SWC presentation indicates water costs at $969/af (at 3% interest) and $1,344/af (at 5.7%, the rate being assumed for the CA WaterFix...i.e., ‘tunnels’). For such large public projects under current conditions, the lower rate is more appropriate. The unit costs from the SWC presentation are for North of the Delta (and carriage losses across the Delta are typically 25%+-); however, the SWC analyst and general manager are convinced that there are ample opportunities to coordinate Sites releases with the SWP and CVP reservoirs to produce sufficient water savings that would exceed the Delta carriage losses. Thus, for purposes of this email, it is assumed that additional water supply savings would off-set the Delta losses and the cost to DRWD growers would be ~$1,000/af. It is also important to note that operations of the Sites project is at least 10 years away; the unit cost of ~$1,000/af is in today’s dollars.

REQUEST FROM DRWD WATER USERS:
The Board is in their review of what, if any, level of participation DRWD may want to request in the initial phase of the Sites project, please provide me no later than Monday, July 11, a preliminary (non-binding) estimate of the quantity of water your operation may be interested in at a cost of ~$1,000/af. Please indicate the quantity either as an average annual supply and/or as a dry year supply.
This request will also assist DRWD in evaluating other water supply opportunities through our arrangement with the Westside 5. Thx.

Dale K. Melville, PE
Manager-Engineer
Dudley Ridge Water District
286 W. Cromwell Ave.
Fresno, CA 93711-6162
559-449-2700 x102
559-449-2715 fax
559-355-5880 cell
Water Users:

Rosedale-Rio Bravo WSD has up to 5,000 AF of water available for purchase this year through the Westside Districts for $800/AF. Please respond by Friday, August 26 if you are interested.

Rick Besecker
Dudley Ridge Water District
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5. Buena Vista Water Storage District Water Auction 2014:

This data set, provided by Rosedale provides documentation of Buena Vista Water Storage District auction of water in 2014 which the median value buyers paid was $1,200 per AF.
RECOMMENDATION: Ratify Water Sales in the amount of 12,206 Acre-Feet

On January 15, 2014 the BOD approved the sale of 12,000 AF of water. Bids were received on February 5, 2014. The bid results are attached. Over 63,000 AF were requested at prices exceeding the minimum bid. During the bid process the State reduced the allocation on the SWP to zero. This combined with the BV’s bid created a bit of media circus. The district staff countered charges of “Price Gouging” and others with the message of assisting others in need and the need for action to reign in the subversion of the intended operations of the SWP by environmental regulation.

The process was also muddled by the fact that the KCWA revealed that a substantial portion of the “Carryover Water,” that local districts use as insurance in times like this, was trapped north of the Delta in Oroville Dam. Staff had to get a handle on DWR and KCWA accounting so that any sales made would actually be water that could be delivered. To make a very long a tedious story short the problem was alleviated by the largest buyers of the water notifying BV that they were willing to accept the water “In System” not in Kern County. This is a risk on their part and just underscores the seriousness of the drought, the need for a transfer facility across the delta and the adverse effects “Environmental Regulations” have on the operation of the project. This should not be taken as an endorsement of the delta tunnels known as BDCP.
The water BV is selling is characterized as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Carryover</td>
<td>10,839*</td>
</tr>
<tr>
<td>Backup</td>
<td>1,367</td>
</tr>
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<td>2013 State Water</td>
<td>12,206</td>
</tr>
</tbody>
</table>

*This water is comprised of the following:

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<table>
<thead>
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<th></th>
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<tbody>
<tr>
<td>2013 BV Table A</td>
<td>1,368</td>
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<tr>
<td>2013 BV/KD Exchange</td>
<td>3,613</td>
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<tr>
<td>2013 BV/CWD Exchange</td>
<td>5,858</td>
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<tr>
<td>Total</td>
<td>10,839</td>
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</table>

Staff increased the sale amount to 12,206 from 12,000. The board should ratify this action. This is so that BV can zero out this account as of 1/1/14 and start fresh.

The proceeds from this sale is $13.96mm.

Of the 12,206, 600 AF is being sold to Harris Ranch in Mettler via Arvin Edison/Wheeler Ridge. Harris Ranch will be responsible for coordinating the wheeling from Tupman. The other 11,606 will be sold through Belridge, Berrenda Mesa and Lost Hills (WS3). They are going to take the water “In the system.”

The allocation of the 11,606 AF to the WS3 is; Brenda Mesa 2.15%, Belridge 88.37% and Lost Hills 9.48%.
<table>
<thead>
<tr>
<th>Bidder</th>
<th>Quantity AF</th>
<th>Price $</th>
<th>Calculated Total $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harris Ranch-Mettler</td>
<td>1</td>
<td>$1,350.00</td>
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<tr>
<td>Starrh&amp;Starrh</td>
<td>2</td>
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<td>$2,500.00</td>
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<tr>
<td>Cal Heavy Oil</td>
<td>3</td>
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<tr>
<td>Starrh&amp;Starrh</td>
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<td>Primex</td>
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<td>$6,750.00</td>
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<td>$7,850.00</td>
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<tr>
<td>Starrh&amp;Starrh</td>
<td>8</td>
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<tr>
<td>Paramount Farming</td>
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<tr>
<td>Harris Ranch-Mettler</td>
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<tr>
<td>Starrh&amp;Starrh</td>
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<td>$1,100.00</td>
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</tr>
<tr>
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<td>Chapparel Industries</td>
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<td>$17,771,200</td>
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<td></td>
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<td>18</td>
<td>Wheeler Ridge-Maricopa</td>
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<td>29</td>
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<td>S&amp;H Ranch</td>
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<td>Virve Almonds</td>
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<td>Cawelo</td>
<td>$ 675.00</td>
<td>1,000</td>
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<tr>
<td>49</td>
<td>Kern Westside</td>
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<td>12,000</td>
</tr>
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</table>

**TOTAL ACRE-FEET BID**  63,850  $ 49,598,150.00
6. Alliance Ag Services  Email

Re: Lease Cost Alternative lease land for wetland creation
Kellie Welch - Least Cost Alternative

From: Mike Ming <mming@allianceappr.com>
To: "Kellie Welch (Welch@irwd.com)" <Welch@irwd.com>
Date: 2/23/2018 8:54 AM
Subject: Least Cost Alternative

The least cost alternative would incorporate a 7-year lease. The lease rate would begin at $300.00 per acre per year and escalate 2.50% each year of the lease.

Lands in the general area lease for 3-5 years so a seven year lease is not abnormal.

The availability of land could vary depending on large land owner and their respective growing seasons and cropping patterns.

Land that is available within 5 miles of the Aqueduct in Kern County is either farmland or already habitat. Any lease would also have a restoration clause. This would make sure the lands are returned to pre-lease condition.

I hope this answers the question.

Mike

Michael G. Ming, Broker
Alliance Ag Services, LLC
CalBRE #0951819
5401 Business Park South
Suite 122
Bakersfield, CA  93309

Agricultural Brokerage and Consulting

Local Knowledge - Global Reach

(661) 631-0391 Kern County
(661) 631-0392 Facsimile

(559) 408-5975 Central San Joaquin Valley

(805) 979-9495 Central Coast

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