Analyzing Southern California Supply Investments from a Human Right to Water Perspective

The Proposed Poseidon Ocean Water Desalination Plant in Orange County

UCLA Luskin Center for Innovation

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Authorship

Gregory Pierce, Associate Director of Research, UCLA Luskin Center for Innovation

Nicholas Chow, Project Manager, UCLA Luskin Center for Innovation

Kyra Gmoser-Daskalakis, Graduate Student Researcher, UCLA Luskin Center for Innovation

Peter Roquemore, Graduate Student Researcher, UCLA Luskin Center for Innovation

Nichole Heil, Graduate Student Researcher, UCLA Luskin Center for Innovation

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For More Information

Contact Gregory Pierce at gpierce@luskin.ucla.edu or (310) 267-5435.

www.innovation.luskin.ucla.edu

Executive Summary

In 2012, California Governor Brown signed Assembly Bill 685 into law, confirming California's unique commitment among U.S. states to ensuring a Human Right to Water (HRW) for every individual in the state. This bill recognizes that "every human being has the right to safe, clean, affordable, and accessible water." As many water systems consider investing in new or enhanced sources of water supply to meet their own water security goals, it is more important than ever to assess the household-level Human Right to Water (HRW) impacts of these investments.

This report analyzes the likely impacts of one proposed strategy for greater local water security on environmental justice and HRW concerns in Orange County. We examine the likely impact of desalinated ocean water supply on the county's disadvantaged households based on a proposed agreement for Poseidon Resources LLC (Poseidon) to sell 56,000 acre feet of desalinated ocean water per year to the Orange County Water District (OCWD) for a period of 30 years.[1] We assess this potential agreement in the context of a broader suite of water security and local water reliance strategies currently being pursued by nearly all major water suppliers across the Southern California region. This analysis can be used not only to inform public knowledge regarding the likely impacts of the Poseidon agreement, but also to evaluate the costs and benefits of various water security and local water reliance strategies in similarly water-scarce regions.

Our analysis of the likely impacts of the Poseidon agreement on disadvantaged households includes an assessment of: a) how this new source of supply would impact the landscape of existing HRW outcomes in Orange County; b) short-term and medium-term projections of the expected cost of Poseidon agreement water (Agreement Water) as compared to imported water and other locally generated water supply options; and c) the role the county's water systems will likely play via their rate-making decisions in either passing through or shielding the greater costs of new supply to low-income households consuming modest amounts of water.

While potential positive HRW benefits from desalinated ocean water can occur in certain contexts, we find that no such benefits can be plausibly realized by the Poseidon agreement in Orange County. Nearly all of the county's households are connected to community water systems which already provide high-quality, reliable water service and thus would not see supply improvement from ocean desalination. Those served by the county's small underperforming systems, whose lower-quality water might be improved through new desalinated supply, will not be served by the proposed agreement to purchase desalinated water. The only plausible impact of Agreement Water on disadvantaged households in the county will be a decrease in affordability due to higher system rates.

The final aggregate cost of water from the Poseidon agreement is not yet determined and we do not independently estimate the aggregate cost impact of the agreement on ratepayers. We do find that all available reputable sources—including Orange County Water District (OCWD),

1 From here forward we use the terms "Poseidon agreement" as shorthand for this agreement, and "Agreement Water" to describe the water that would be provided to the OCWD via this agreement.

Municipal Water District of Orange County (MWDOC) and Irvine Ranch Water District (IRWD)—show the upfront unit cost of water from the agreement to be substantially more expensive than the unit cost of all other local supply options. Our own analysis also yielded no evidence to reasonably project that Agreement Water will be cost competitive with any incremental supply investments for the next several decades. After this time, cost projections (and potential water supply options) are inherently uncertain. Moreover, the comparison between the cost of Agreement Water and imported WaterFix supply depends on several assumptions given recent changes in cost estimates. Only in an unlikely scenario where alternative water supply costs rise rapidly, Agreement Water costs grow minimally, and the Metropolitan Water District authorizes a proposed $450 million subsidy to the project, could the Poseidon agreement yield a cost-competitive water supply. Among other reasons, its cost risk has led several independent expert assessments to judge Agreement Water to be the least desirable supply option for the county.

We next outline the potential scope of pass-through rate increases stemming from the Poseidon agreement on the county's disadvantaged households. We use data on each of the county drinking water systems' existing rate structures and levels, as well as a review of existing rate cases in Orange County, and provide a retrospective assessment of the pass-through rate changes arising from a separate, finalized Poseidon agreement in San Diego County. Progressive rate restructuring could theoretically shield low-income households, with only basic household water use, from any system-level cost increases resulting from the Poseidon agreement. However, we find that such equitable rate restructuring in the event of supply cost increases is uncommon and discouraged by rate consultants, partly due to concerns with Proposition 218 requirements.

Accordingly, we conclude that the Poseidon agreement will likely make drinking water for disadvantaged households in Orange County moderately to severely less affordable. It would yield no offsetting HRW benefits as compared to the continued pursuit of alternative local water supplies and demand management options which have historically proven to be more efficient and affordable. We also conclude that more research and policy innovation must be undertaken to enable and encourage water systems to make progressive rate structure reforms to shield disadvantaged households from the impact of water supply portfolio-related cost increases in Southern California over the coming decades.

Introduction

Drinking water systems across Southern California face increasing risk from, and pressure to move away from, their historical reliance on imported water supply. This is due primarily to the rising cost of imported water as well as the related risk factors of drought, climate change, seismic risk, rising energy costs, and changes in regulation and court rulings. In response, wholesale water suppliers and retail drinking water systems—many systems in the region—are aiming to enhance their own water security by increasing their reliance on local or regional water resources and reducing their exposure to imported water.

This research aims to advance the understanding of the likely impacts of the pursuit of one strategy of greater water security, ocean desalination, on environmental justice outcomes for households in the Southern California region. In particular, we examine how a proposed agreement for Poseidon Resources LLC (Poseidon) to sell 56,000 acre feet per year to the Orange County Water District for a period of 30 years would affect the county's disadvantaged households. This water will be delivered to OCWD's retail water systems, which in turn sell water to their ratepayers—residential households and others—throughout much of Orange County. A similar agreement to provide water from ocean desalination was recently finalized in San Diego and a decision-making process for the construction of an ocean desalination plant is expected to occur in Los Angeles County in the near future (Los Angeles Times, 2017).

Our analysis of the likely impacts of the Poseidon agreement on disadvantaged households assesses[2]:

- How this new source of supply would impact the landscape of existing household-level HRW outcomes in Orange County;
- Short-term and medium-term projections of the expected cost of desalinated ocean water as compared to imported water and other local water supply options; and
- The role the county's water systems will likely play via their rate-making decisions in either passing through or shielding the greater costs of new supply to low-income households consuming modest amounts of water.

Despite heated political debates across Southern California regarding the potential effects of greater desalinated ocean water reliance on vulnerable populations, little independent, rigorous research demonstrates how desalinated water supply will likely impact—positively, negatively or neutrally—existing drinking water-related environmental justice (EJ) issues. We use the state

2 We do not explicitly consider the pure environmental externalities of desalination, which are considerable. We refer the reader to the following resources, on this topic: Sadhwani et al 2005, Einav et al 2003, Younos 2005. Moreover, we note, but do not independently assess, that the Irvine Ranch Water District has raised concerns about the Poseidon plant's potential to introduce boron and chloride contamination into the Orange County Groundwater Basin, and the cost associated with remediating this contamination before delivering water to its customers (IRWD, 2018a).

of California's legislated Human Right to Water (HRW) framework to assess EJ outcomes of interest for disadvantaged households. The language of the state legislation states that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking and sanitary purposes" (CA Assembly Bill 685, 2012). We also compare the most likely environmental justice impacts stemming from ocean desalination vis-à-vis other water security strategies, focusing on estimated differences in household affordability impacts which consider variation in system-level water rate structures.

Even less evidence addresses the specific affordability impacts of water security strategies on low-income, and/or minority drinking water ratepayers in the region. Our work provides a transparent, data-driven method and empirical results showing how different water systems' rate levels and structures will likely pass-through the costs of water supply portfolio changes to low-income households.

The report will have relevance for projecting the equity incidence of new supply projects across the region, now and in the coming decades. This analysis can be used to inform the public debate and formal decision-making process around the costs and benefits of various water security and local water reliance efforts in the Southern California region. This analysis can also be used to assess the costs and benefits of various new or enhanced water supply strategies in similarly water-scarce regions.

Data and Methods

The findings described in this report cover three core research activities, each using different sources of publicly available data. For the HRW outcome analysis, we rely on data of the following specific indicators, obtained for each of Orange County's 43 active community water systems:

- ***Quality-*** the number of MCL (health-related) violations (compiled from the California State Water Board's State Drinking Water Information System or SDWIS)
- ***Accessibility/Reliability***- systems' sole reliance on groundwater, and contamination of groundwater (compiled from SDWIS and State Water Board reports)
- ***Affordability***- the necessary expenditure for water at modest household consumption levels (compiled from rate structure sheets obtained directly from water systems)

Employing spatial join methods in ArcGIS, we then use data from the 2011-2015 American Community Survey to characterize the income, poverty and racial-ethnic profile of the population served by each water system. We do not independently estimate the aggregate cost impact of the Poseidon agreement on ratepayers. Instead, we use available cost estimates from the most credible sources—including OCWD, MWDOC, IRWD and the Pacific Institute—to assess quantity and cost projections for different water source types. We compare the aggregate cost impact of Poseidon agreement water, imported water, and recycled and enhanced groundwater recharge water in Orange County (and Southern California more broadly) over short-term and medium-term time horizons.

Finally, we assess the impact of aggregate cost increases from Agreement Water and whether and how these cost increases are passed through to disadvantaged households in Orange County. To undertake this analysis, we determine existing single-family retail drinking water rate levels and structures for the county's active systems which rely on water from OCWD (for instance, see our work for Los Angeles systems in DeShazo, Pierce and McCann, 2015). We then explore the rate amendment processes of publicly- and privately-controlled water systems—using cost of service and general rate case review documents, respectively—to evaluate systems' abilities and demonstrated efforts to shield certain rate tiers or customer classes from rate increases due to new supply costs. In addition to an examination of the existing rate review processes of several Orange County water systems, we draw on the recent experience of San Diego's desalinated water agreement to study the cost/affordability impacts to systems and households that result from recoupment of water security investment costs.

Results: Drinking Water Justice in Orange County

We first assess the feasible household impacts of desalinated water on drinking water-related environmental justice issues in Orange County. We quantitatively examine the HRW dimensions of drinking water quality, affordability and reliability for each of the county's 43 active community water systems. We draw on established methods we previously employed to study environmental justice issues in mobile home park water systems across California (Pierce and Gonzalez, 2017).

How desalinated ocean water might positively affect disadvantaged households in certain arid contexts

In theory, the supply of desalinated ocean water to water systems could positively affect disadvantaged households. The reliability benefits of desalinated ocean water are particularly relevant to consider in arid contexts where water supply is very scarce with no other viable sources of supply, such as conditions experienced in parts of the Middle East and the Mediterranean region of Europe (Hafez & El-Manharawy, 2002; Kaldellis & Kondili, 2007). In such contexts, desalinated water might even be cost competitive compared to other sources, although it is still unlikely to be affordable.

Desalinated ocean water may also yield a positive net benefit in terms of quality and affordability in contexts where the quality of alternative water sources is very low and small water systems lack adequate treatment capability. In such cases, disadvantaged households may rely heavily on very expensive bottled or packaged water. There may be benefits to serious consideration of new infrastructure to deliver desalinated water to disadvantaged communities in some parts of California, even though this effort would be high cost.

Relevant contexts for consideration may include where the state of California currently provides, or has recently provided, bottled and vended water to communities served by public water systems which ceased operation due to endemic pollution or absolute shortage issues (SWRCB, 2015). For instance, Meng, Chen and Sanders (2016) estimate that the cost of desalinating and transporting produced water from oil and gas operations to a disadvantaged community in the San Joaquin Valley is on par with the cost of some local water systems' operations in the San Joaquin Valley and substantially lower than the per unit cost of trucking in bottled water. As outlined below, however, Orange County does not have communities in such dire straits with respect to water supply, and the prospect of transporting Agreement Water from the Poseidon plant to communities in need outside of the county appears cost-infeasible.

How desalinated water might positively affect disadvantaged households in Orange County

In the context of Orange County, few of the potentially positive benefits from desalinated ocean water seem plausible. The county's population is almost entirely served by community water systems (CWS) and thus does not face the types of severe water supply reliability and quality concerns or risks that a new source of desalinated water might help to improve. Community water systems are the fundamental building blocks of the U.S. drinking water supply network, and household outcomes with respect to drinking water-related environmental justice, with few exceptions, are mediated by system-level factors.

2015 United States Geological Survey data (and 2018 SDWIS data) estimates that 99.36% of the population of Orange County is served by publicly-regulated water supply systems with only 20,275 out of over 3 million people using unregulated well supplies (USGS, 2015). The county's water systems are also large and tend to be professionally operated. Only 8 CWS in Orange County serve a population smaller than 3,000. By contrast, as of 2015, Los Angeles had about 100 systems serving fewer than 3,000 customers (DeShazo, Pierce and McCann, 2015).

Water system sprawl often engenders HRW concerns for disadvantaged households (for instance, see Pierce, Lai and DeShazo, 2018). The consolidation of water systems in Orange County, however, stands in contrast to the system sprawl evident in most other metropolitan areas in California, as seen in Table 1.

Table 1. *Number of drinking water systems and average drinking water system size in Southern California's most populous counties*

County	Number of systems	Average system population served
Los Angeles	228	43,393
San Diego	78	40,234
Orange	43	67,817
Riverside	116	19,211
San Bernardino	151	13,622

Source: SDWIS database and ACS county population figures

More particular to the proposed desalination agreement in Orange County, OCWD does not serve the county's smallest systems. Any benefits from ocean desalination, if they occurred, would not accrue to these systems' customers unless they were consolidated with larger systems served by OCWD. To the best of our knowledge, no system consolidations are proposed to take place as a result of desalinated ocean water availability in Orange County.

The county's disadvantaged households also appear fairly evenly distributed across the systems potentially impacted by the Poseidon desalination agreement. Just less than 29% of the county's households have incomes below 200% of the Federal Poverty Level (FPL), lower than the state average of 34%. The 200% of FPL threshold is a commonly used eligibility criterion for household-level affordability programs offered by utilities in California.

About 35% of the county's population identified as Hispanic, slightly lower than the state average of 39%. Looking at the proportion of customers who are low-income and/or Hispanic at the system level, neither group appears clustered in particular types of systems, much less in systems served by OCWD which would be impacted by the finalization of the Poseidon agreement. A higher proportion of lower-income households are served by the county's eight smallest systems but OCWD does not serve any of these systems; there is again no reason to believe these households would be impacted by the proposed Poseidon agreement.

Reliability and Quality

In regard to drinking water quality, Orange County has the lowest number of drinking water system health violations per capita in the state.[3] Using SDWIS data which tracks water system violations back to 1993, it appears that nearly half of the county's systems have never incurred a violation of any kind. Of 139 total violations incurred across the county, 60% were monitoring and compliance-related rather than health-related. Among the small number of systems which incurred repeated health-related violations, most were small mutual water systems or mobile home parks, types of systems which past research identifies as the most likely violators (Pierce and Gonzalez, 2017). Again, OCWD does not serve these systems.

Like others across the state, drinking water systems and regional suppliers in Orange County are actively planning for water supply reliability. The magnitude of acute water reliability problems in Orange County, however, is very small compared to elsewhere in the state. Only 5 small systems in the county reported reliance on a sole water supply, leaving them dependent on a single source of imported water or groundwater aquifer. Each of these systems serves less than 1,000 people (Water Board, 2013).

Moreover, the northern portion of Orange County served by OCWD is already much better positioned in terms of water supply reliability than the southern portion of the county (MWDOC, 2018). Households in the southern portion of Orange County might experience modest water supply reliability benefits from the construction of a separate Doheny Ocean Desalination Plant proposed to be built in Dana Point. We note that the particular advantages of the Doheny project contrast with the circumstances and terms of both the Poseidon agreement and most other ocean desalination projects. A full analysis of the Doheny plan, however, is outside the scope of this study (for more information on this project, see South Coast Water District, n.d.).

3 For instance, see County Health Rankings & RoadMaps: A Robert Woods Johnson Foundation Program, http://www.countyhealthrankings.org/app/california/2015/measure/factors/124/map

In short, Orange County has relatively few systems with severe quality and reliability deficiencies compared to the rest of California. None of the small systems with the worst quality and reliability issues in Orange County are served by OCWD, and thus households with the worst HRW outcomes in the county would not experience any impact from the Poseidon agreement. Unless other water security and local water reliance strategies explicitly aim to incorporate well owners or households served by underperforming water systems, they are similarly unlikely to positively affect HRW outcomes.

Affordability

Affordability impacts differ from quality and reliability outcomes because they depend more equally on both system-level factors (retail water rates) and household-level factors (income levels). Even well-performing water systems can face affordability concerns because they are likely to serve substantial numbers of low-income households who struggle to pay their water bills. While exact definitions of water affordability remain a subject of debate, we assess affordability by measuring the necessary expenditure by households to purchase 12 CCF of water per month from their water system.[4] This level of consumption corresponds to enough water for households with 4 people to consume 55 gallons per capita per day (the state standard specified in guidance on implementation of the HRW) and to allow for a modest amount of outdoor irrigation, as outlined in a recent State Water Board report (2019).

We find less of a concern regarding drinking water affordability at this consumption level in Orange County than elsewhere in the region or the state. Based on our calculations, the median necessary monthly expenditure for 12 CCF across Orange County's systems was $51.85 (mean=$53.82), with rates substantially lower and less variable across systems than the most recently estimated state average (Water Board, 2019), or typical rates for 12 CCF paid in Los Angeles (DeShazo, Pierce and McCann, 2015). There also appears to be no correspondence between Orange County systems which charge the highest monthly rates for 12 CCF of water and higher levels of disadvantaged households (whether low-income or racial minorities) among those systems.[5]

On the other hand, we note that households residing in high cost of living areas such as Orange County have less disposable income to spend on drinking water service (for instance, see Feinstein et al., 2017). While currently adequate quality and reliability outcomes are unlikely to improve due to the finalization of the Poseidon agreement in Orange County, the affordability impacts for disadvantaged households served by water systems which purchase water from OCWD are worth further consideration.

4 We were able to obtain this data for 35 systems serving 98% of the County's total population.

5 Varying consumption levels upward or downward does not change the above analysis substantially.

Results: Projections of expected quantity and cost of various water sources vis-à-vis Poseidon agreement water

We compare short-term and medium-term projections of the expected cost of Poseidon agreement water (Agreement Water) to quantities and cost projections for other Orange County water supply options including local enhanced groundwater, recycling, and water imports. Our analysis yielded no evidence to expect Agreement Water to feasibly be cost competitive with any supply option except under the most expensive imported water cost scenarios. Even these unlikely scenarios, which employ assumptions favorable to the Poseidon plant, do not project Agreement Water to be cost competitive for more than a decade, after which time cost projections (and potential water supply options) are inherently uncertain.

This finding coheres with recent expert, and independent reports by the California Department of Water Resources (DWR), Municipal Water District of Orange County (MWDOC), and California Coastkeeper, which all indicate that Agreement Water will not be cost effective for Orange County. For instance, the favorable analysis of the two-tunnel WaterFix performed by the DWR states that "the costs to urban agencies of preserving SWP supplies by investing in WaterFix are significantly below the costs of available alternative water supplies such as desalination" (Sunding, 2018, p. 35). MWDOC's independent assessment of feasible regional water supply strategies also rated the Poseidon agreement at the bottom of a list of alternatives, including a separate ocean desalination project, from a cost-benefit perspective (MWDOC, 2018). Furthermore, a recent expert report performed on behalf of the California Coastkeeper Alliance, which focuses on the technical and economic feasibility of sub-surface intakes for the proposed Poseidon plant, broadly states that, in comparison to Agreement Water, "it is likely that there are many cheaper sources of water for Orange County" (Hanemann, 2018, p. 13).

Projected Cost of Poseidon Agreement Water

The cost of Agreement Water is difficult to conclusively determine due to the lack of verified, quantitative supporting data surrounding the project. The Orange County Water District's (OCWD) 2018 Updated Term Sheet for the Poseidon Desalination Project (OCWD 2018 Term Sheet) provided a Water Reliability Agreement which primarily suggests that a specific cost of service will be negotiated in the future. The agreement states cost will be assessed "based on the expected cost to permit, design, procure, construct, startup, …finance, operate, maintain, repair, own and manage the Plant and Delivery System, …and to deliver to the Delivery Point the required amounts of Product Water at the quality, quantity and performance levels required by the Contract. Such Cost of Service will be negotiated and finalized prior to the Financial Close …. All such expected costs will be provided in an agreed upon model." (Water Reliability Agreement, 2018).[6]

6 See page 20-21 of latest term sheet for full description

Given the vague language the agreement employs surrounding cost terms, we must rely on estimates. Our primary source for this information is the OCWD July 18th 2018 Board Meeting Notes (OCWD Meeting Notes), which includes a 2022 unit-cost estimate for the project. To our understanding, these values are non-binding estimates and represent one possible outcome for Agreement Water. In order to better examine the range of possibilities across the project period, we also use values from the Irvine Ranch Water District's (IRWD) analysis of the effect of Agreement Water on IRWD customers, and additionally consider likely rates of cost projection. Our estimates of cost outcomes over time rely on four factors: 1) initial cost, 2) rates of cost increase, 3) the Local Resource Program (LRP) funding, and 4) the timing of LRP funding. These factors each have two or more feasible possibilities, resulting in over 40 possible cost estimates. Given this wide range of possible outcomes, we focus our analysis on the most likely outcomes of each of the four factors, which are discussed below.

Initial Cost Estimates

The OCWD Meeting Notes estimate the initial cost of Agreement Water at $1,791 per acre-foot, while the IRWD analysis predicts a range of between $1,641 and $1,941 per acre-foot (IRWD, 2018c). These values result from uncertainty in the cost of distribution spanning $300-$500 per acre-foot. For our analysis, we have chosen to consider all three of the initial price points. The OCWD Meeting Notes provides an intermediate cost while the IRWD values present a range both above and below the OCWD Meeting Notes' value. We note that this range of costs (and all projected costs for Agreement Water) factors in a substantial subsidy from MWD of $475 per acre-foot. In the absence of this subsidy, projected per acre-foot costs would be about 25-30% higher. To contextualize these estimated Agreement Water costs, Table 2 shows unsubsidized desalinated water cost estimates derived from both recent literature and recent ocean desalinated facilities in similar climates.

Table 2. *Estimated Costs per Acre Foot of Desalinated Ocean Water from other studies and agreements*

Desalinated Water Cost Estimate ($/AF)	Source
$2,141	SDCWA, 2018
$2,100-2,500*	Cooley and Phurisamban, 2016
$1,876- $2,097	San Diego Coastkeeper, 2012
$1,800-$2,330	Raucher and Tchobanoglous, 2015
$3,400	St. Marie, 2016

** For projects greater than 10,000 Acre-Feet (AF)*

Local Resource Program Funding

The potential subsidy provided by the Local Resources Program (LRP) is a crucial component of this project.[7] The subsidy supresses the true initial price of desalinated water and influences the project's relative cost effectiveness, especially in the short term prior to LRP funding depletion. Notably, the use of the LRP subsidy commits limited MWD funds toward the Poseidon project, thus limiting the opportunity for other potentially more cost-effective local water reliance projects in the region to secure similar funding.

Though likely to be secured if the project moves forward, the LRP funding for this project has yet to be fully negotiated and is uncertain due to the range of strategies for its implementation. While the LRP subsidy is offered at differing dollar amounts over various timelines, and for distinct volumes of water (MWD, 2018a), both the OCWD Meeting Notes and the independent IRWD estimates appear to assume a subsidy of $475/acre-foot. Accordingly, we treat this as the most likely scenario and make our primary cost estimates using this assumption. Following the example of the OCWD Meeting Notes, we primarily model this $475 per acre-foot subsidy to last for 10 years.[8]

Rates of Cost Estimate Increases

In addition to the initial price, the rate at which costs are escalated strongly influences the viability of the project. To determine reasonable rates of increase we utilized the OCWD Meeting Notes, Metropolitan Water District's own projections, and sector-relevant indices. The OCWD Meeting Notes estimate a rate of increase for Agreement Water of 2.2%.[9] Recognizing that large infrastructure projects are endemically prone to cost overruns beyond their pre-construction estimates (Flyvbjerg, 2007; Plummer Braeckman, Disselhoff and Kirchherr, 2019)

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7 Our analysis assumes that the subsidy is provided as a nominal value, and therefore remains unscaled over the project period.

8 Without public information describing the terms and extent of this subsidy, we defer to the shape of the graph displayed in the OCWD Meeting Notes. At 2031, this graph shows a significant increase in unit cost that is roughly consistent with the amount of subsidy expected, and we've chosen to replicate this timeline in our analysis as the end of the LRP subsidy. Although unconfirmed, this cost increase before the 15-year maximum extent for the LRP subsidy could come as a result of the facility meeting the contractual maximum volume of water available for subsidy.

9 This 2.212% rate was determined from the increase across the 2034-2052 project period, which excludes the sudden increase in cost due to the LRP funding depletion. While these values were not directly provided, they were calculated based on the biennial cost estimates that were available within the same OCWD Meeting Notes using a standard compounding interest calculation as shown below:

$$Rate\ of\ Annual\ Increase = \left(\left(\frac{Final\ Cost}{Initial\ Cost}\right)^{\frac{1}{Period\ of\ Increase}} - 1\right) \times 100$$

and that 2.2% is below even typical annual inflation estimates[10], we have chosen to also model two other rates of increase: 3.4% as a reasonable rate considering historical and projected inflation of electricity costs, construction, and wages[11]; and 5.6% to match MWD's historic rate increases[12] (OCWD Meeting Notes, 2018).

Figure 1: *Poseidon Agreement Water Cost Range*

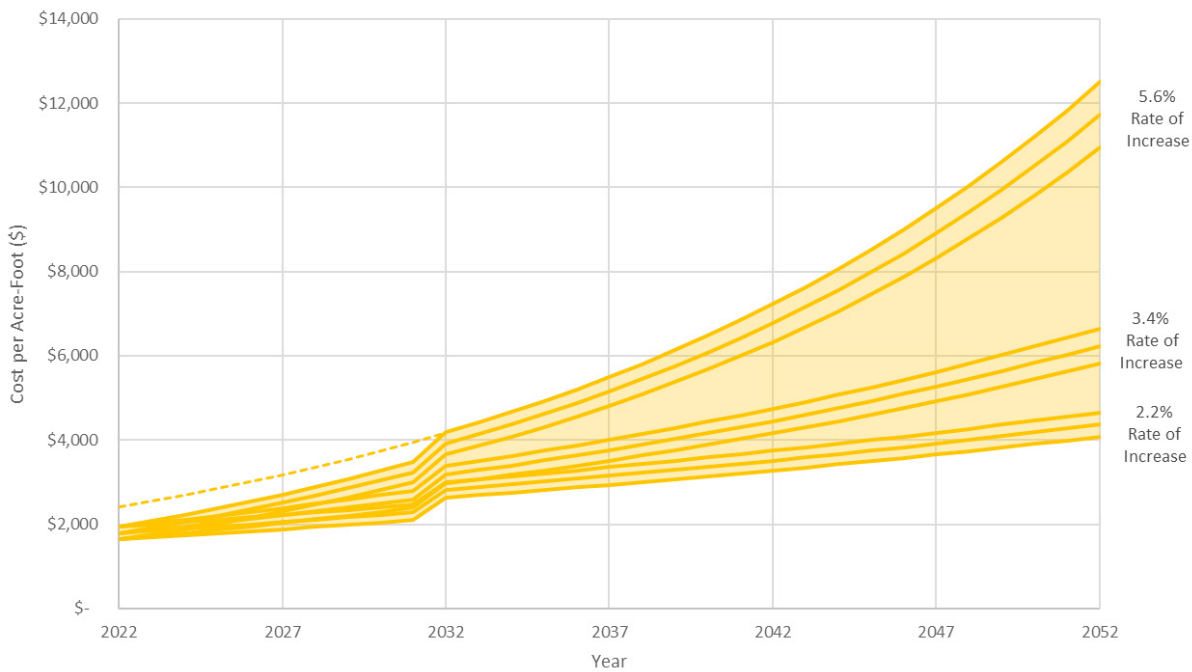


Figure 1 shows the range of nine cost estimates considered in our analysis. The dashed line demonstrates the high unsubsidized cost of Agreement Water, should the LRP funding be unavailable over that period.

10 There are different methods and standards used to calculate inflation, which often vary by sector. Our decision to classify Poseidon's 2.2% estimated rate of increase as low, and to consider higher alternatives, was motivated by a span of common economic indices uniformly showing higher rates of increase. For more information please see the Appendix for Indices Informing Likely Annual Cost Increases.

11 This value was calculated as the simple average of the ranges of annual inflation described across the human, electrical, and engineering and construction indices described in the Appendix (Indices Informing Likely Annual Cost Increases).

12 Originally, OCWD and Poseidon proposed that the price of Agreement Water would be tied to that of imported water, in the form of a cost premium above MWD's cost of water. This 5.6% represents the highest reasonable projected increase in MWD water costs and is included to model the maximum cost of Agreement Water, should they re-adopt this financing structure. This proposed arrangement would inarguably be the most expensive route toward local water reliance (Water Reliability Agreement, 2015).

Groundwater Supplies

Groundwater from the Orange County basin, managed by OCWD, is the least expensive large source of water available in the county. Currently, OCWD sets rates which charge water systems for the pumping and use of groundwater in order to sustainably manage the aquifer and implement projects for aquifer recharge (Kennedy 2018). Each year OCWD sets a Basin Production Percentage (BPP), which is a ratio of groundwater demand to total water supplies (groundwater and supplemental sources like imported water). Agencies which pump up to this BPP (in 2017-2018 this was 75% of their demand) pay a Replenishment Assessment (RA) of $445/acre foot. When agencies pump above this BPP they must pay both the RA and an additional Basin Equity Assessment (BEA) of $539/acre foot. The BEA is set so that the cost of this water will be close to the cost of imported water (Kennedy, 2018).

When pumping below the current BPP of 75%, groundwater costs about $666/acre foot[13] (Olson and Tan, 2018), well below the cost of imported water ($1,015 per acre-foot) and any reasonable estimates of desalinated water (Kennedy, 2018). Even pumping above the BPP results in a cost roughly equal to current imported water with the addition of the BEA. This water is only available as a low-cost source because the basin is managed at sustainable levels by OCWD. OCWD operates many recharge projects to replenish the aquifer at the same time that member agencies pump water out. In Fiscal Year 2017-2018, these measures allowed OCWD to recharge 325,000 acre-feet (AF) into the aquifer while only pumping out 303,000 AF—correcting 22,000 AF of historic overdraft from past pumping (OCWD Board of Directors Meeting 2017).

The current sources of recharge are a mix of naturally occurring incidental recharge (~ 8% of total recharge) and the use of surface recharge and injection wells to replenish the aquifer with Santa Ana River surface water (~35%), stormwater (~8%), recycled water (~31%), and untreated imported water purchased from MWD (~ 17%) (Hutchinson, 2015). If OCWD continues to recharge the aquifer with low cost water, and expands the use of sources such as captured stormwater, the basin will continue to act as a form of storage that provides a sufficient source of lowest-cost water. With such a low cost and large, sustainably managed supply, we expect that this source will be viable into the near future and that desalinated water could not compete with it as a water supply.

13 This $666/AF estimate includes the Replenishment Assessment of $445/AF along with expected energy costs, capital expenses and O&M costs associated with groundwater use. The OCWD Report (Olson and Tan. 2018) compares this value to MWD's treated water rates implying that the $666/AF estimate encompasses requisite costs for treatment bringing pumped groundwater to deliverable quality.

Recycled Water Supplies

In terms of alternative sources, Orange County is home to one of the nation's largest water recycling facilities (Groundwater Replenishment System at OCWD), which produces 111,100 AF of recycled water per year. Other agencies also produce recycled water, though the process is not yet ubiquitous enough to realize total utilization of wastewater flows in the county. This means that there are still recycled water opportunities to be captured. Moreover, regulation which removes existing impediments to recycled water use, and thus increases the value of recycled water, continues to be passed and considered by the state (SB 332, AB 574). For instance, AB 574 was passed in 2017 and directs the State Water Board to complete regulations to expand and increase the use of potable recycled water by 2023 (AB 574, 2017). Meanwhile, the State Water Board also updated its Recycled Water Policy and goals in December 2018, suggesting a statewide move toward increased potable water recycling in the years to come (SWRCB, 2018b).

The cost of producing recycled water varies significantly depending on site-specific conditions like contaminants, but also particularly by the intended use of the water. From the literature, the price for producing potable recycled water, from plants of a comparable size to Poseidon's, ranges in cost from around $820-$2,000 per AF. As a local example, OCWD's cost of producing potable-quality recycled water is estimated to be $850 per AF without any subsidies. With distribution costs factored in, the cost per acre-foot increases to around $1,200. When compared to the OCWD Meeting Notes and IRWD estimates, water recycling is a more cost-effective alternative than Agreement Water. With the availability of wastewater in Orange County, this local water supply option may also be a preferential solution to meeting some of the anticipated increases in demand.

Imported Water

MWDOC is the Metropolitan Water District's (MWD) third largest member agency by water demand, and manages the majority of the imported water to Orange County (84% based on a ten-year rolling average from 2005-2015). MWD has separate agreements to provide water to the Cities of Anaheim, Fullerton, and Santa Ana independently, for the remaining 16% (MWD Rates and Charges, 2017). This regional reliance on MWD imported water implies that some portion of household costs are strongly influenced by MWD's prices.

There are a multitude of factors influencing the cost structure of MWD's wholesale water products, including its own capital and operations projects, but also its investments and programs across the western United States. With so many contributing factors, it is difficult to determine future imported water costs in order to compare Agreement Water with certainty. The OCWD Meeting Notes takes the approach of using long-term historical estimates. We consider these for our analysis and show a more comprehensive range of trailing year averages in Table 3.

Table 3: *Rates of cost increase for MWD imported water: forecasted and historical, with and without the California WaterFix project.*

	Annual Rate of Increase
MWD Expected 10-year Forecast of Existing Rates*	3.000%
5-year Trailing Average (2014-2018)**	3.690%
10-year Trailing Average (2009-2018) **	7.302%
20-year Trailing Average (1999-2018) **	4.509%
50-year Trailing Average (assumed 1969-2018) ***	6.250%
Historical Average (assumed 1941-2018) ***	5.630%
OCWD Forecast of MWD Rates with a Single Tunnel WaterFix***	3.000%
OCWD Forecast of MWD Rates with a Dual Tunnel WaterFix***	4.100%

*Sources: *(MWD, 2018b); **(MWD, 2018c); ***(Orange County Water District, 2018)*

This data shows that the historical average of MWD's rate of increase is roughly midway between the maximum and minimum projections, which gives us confidence in its use as a reasonable long-term rate of cost increase for MWD water. Given that recent rates appear to exhibit a falling trend (5-yr trailing average), and MWD has projected only a 3% annual increase rate over the next 10 years, we use the MWD historical average of 5.6% as an upper bound for reasonable increases across the project period. For our analysis, the 5-yr trailing average (3.7%) and projected 3.0% annual increase, are considered a reasonable intermediate and lower bound respectively.

In addition to the possible increases to MWD's baseline costs, their support of the WaterFix, if permitted, could significantly impact its water pricing in the near term. A major challenge in predicting these costs is the uncertain and constantly shifting form of the project. Currently (Early 2019), through observation of the public political discourse, we expect that the WaterFix project will take on a "Single Tunnel" form (Willon & Luna, 2019; Garcetti, 2019). Literature and public estimates have thus far only been explicitly quantified for the original "Dual Tunnel" form, with high and low estimated cost increases ranging from $148-$303 per acre-foot (Arakawa, 2018). Considering a recent presentation by MWD staff (Arakawa, 2019) broadly describing anticipated costs, our analysis uses the low estimate for the dual tunnel project ($148), which reasonably reflects the likely cost of the single tunnel WaterFix.[14] Without updated estimates for the single tunnel approach, our analysis uses the low estimate for the dual tunnel project assuming that it most reasonably reflects the likely cost of the single tunnel WaterFix. If approved, the funding of the WaterFix project and its debt could impact annual cost increases.

14 While quantity and cost estimates for a Single Tunnel Water Fix continue to evolve, we are confident in the estimates used here as it closely aligns to recently presented information at an MWD Board Workshop (Arakawa, 2019) on the topic. Anticipated cost reductions described in the meeting, range from 33%-54% in total, depending on which single tunnel WaterFix approach is adopted. Our modeled fixed cost increase of $148/acre-foot falls within the range of these reductions and closely matches the average expected cost of the 33% reduction alternative.

Following the OCWD Meeting Notes, we anticipate a 3% annual increase for a single tunnel project but, in keeping with our assumption that large infrastructure projects often overrun costs, we also consider both a 4.1% (Dual Tunnel Rate) and 5.6% (MWD Historical) increase as intermediate and upper bounds respectively.

Figure 2: *Cost Estimates for MWD Tier 1 Treated Water*

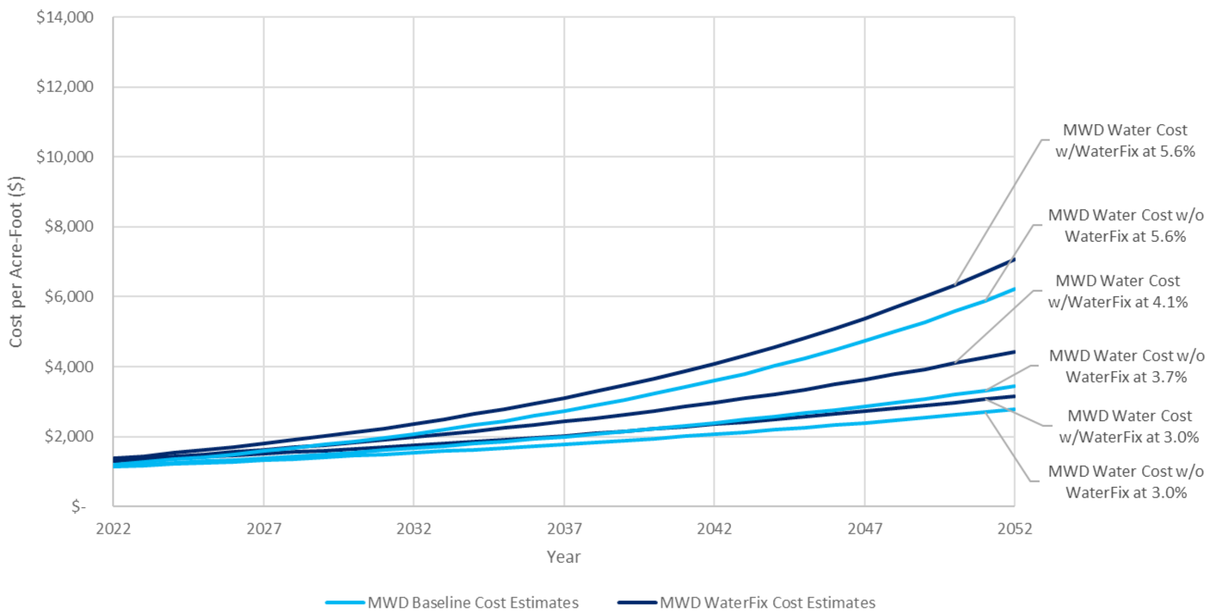


Figure 2 shows the MWD Tier 1 Treated Water costs over a range of assumptions, including that of MWD's investment in the single tunnel WaterFix project. For the purposes of comparison to Agreement Water, the above estimate of a 5.6% rate of annual increase reflects the upper bound price of water for both the MWD baseline and WaterFix costs.[15]

Cost Estimate Comparison: WaterFix and Agreement Water

Orange County serves as a model for sustainable groundwater management through recycling, and as demonstrated above, both groundwater and water recycling costs will be far lower than those of Poseidon agreement water. For our analysis we generated 45 cost estimates for Agreement Water based on the four factors influencing its price over the project period. Our analysis examines the nine which most closely reflect the OCWD Meeting Notes' assumptions, while also considering alternative rates of cost increase.[16]

15 For the WaterFix, this upper bound represents a very high estimate considering that our analysis applies a $148 fixed cost increase in addition to MWD's historic rate of increase, which itself already takes into account additional fixed cost increases incurred by MWD's historical projects.

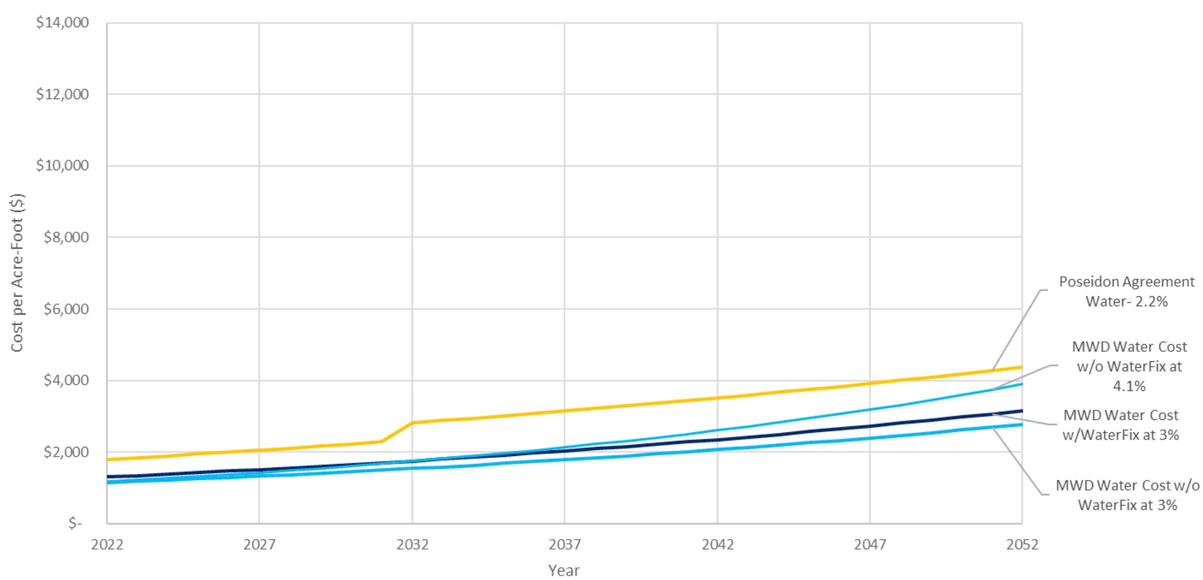
16 Data for all scenarios is available upon request.

We demonstrate the range of possibilities graphically below, starting with a recreation of the OCWD Meeting Notes analysis. Since the WaterFix project has evolved since the release of these notes, the likely cost estimates for MWD water are important to reconsider. We additionally show the intermediate, likely scenario and the best and worst bounding scenarios.

Scenario using OCWD's estimates with Single Tunnel Water Fix

Especially now that the WaterFix project has shifted to a single tunnel approach, the likelihood of very high rates of annual cost increases for MWD imported water is lower. Using the OCWD Meeting Notes' (2018) assumptions, we recreated the Notes' own cost analysis without the unlikely high rates of increase for MWD (considered in other analyses).

Figure 3: *Recreation of the cost analysis for Posiedon Agreement Water displayed in the OCWD meeting notes (2018)*



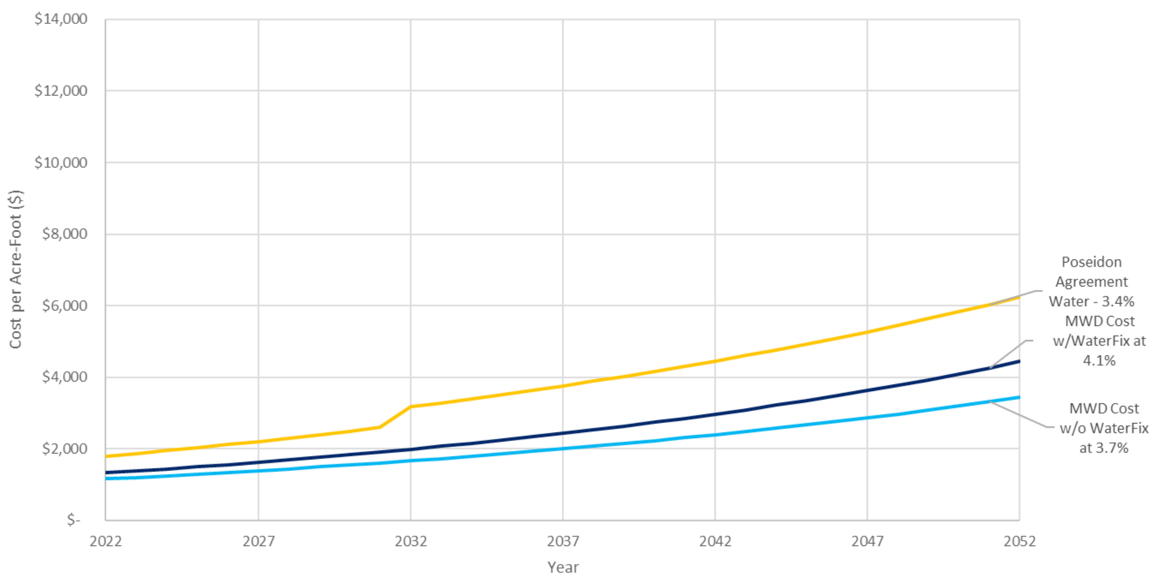
Even under the assumptions of the OCWD Meeting Notes that are favorable for Agreement Water ($1,791 initial cost, 2.2% rate of increase), Figure 3 demonstrates that without very high rates of increase for MWD water, the outlook for cost-competitive Agreement Water appears very unlikely. This reflects what is already shown in the OCWD's own Meeting Notes (2018).

Intermediate Cost Scenario

Given that large infrastructure projects are prone to cost overruns beyond their pre-construction estimates, a more realistic scenario considers moderate initial price estimates, accompanied by rates of increase slightly above those claimed for both Agreement Water and MWD imports.

The intermediate cost scenario (Figure 4) shown here uses the OCWD Meeting Notes' Agreement Water cost estimate ($1,791) with a 3.4% rate of increase. This is compared to intermediate MWD costs ($1,159-2,022 estimate without WaterFix; $1,329-2,022 estimate single tunnel WaterFix) escalated at rates above their expected minimum: 3.7%, consistent with MWD's 5 year trailing average; and 4.1%, their projected rate increase for a dual tunnel WaterFix. These rates reflect higher than projected increases for each water supply source with the expectation that true costs are invariably higher than predicted costs.

Figure 4: *Intermediate scenario considering moderate cost increases for all water supplies*

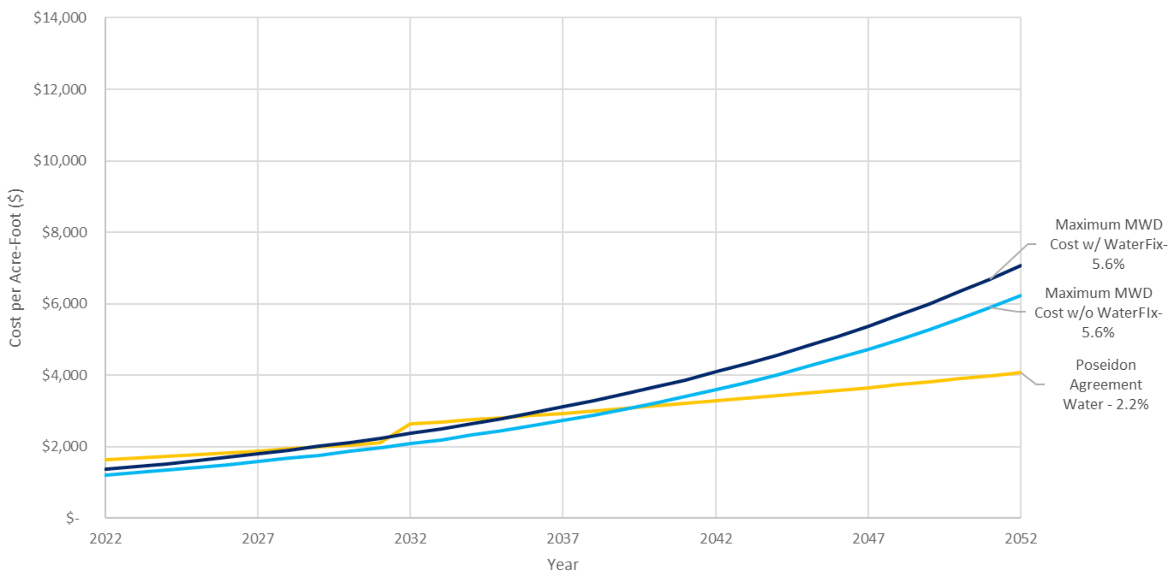


This intermediate scenario assumes that each water supply cost increases at a reasonable rate higher than its designed or existing projection. Here, Agreement Water costs start higher and escalate faster than MWD's, so costs are never competitive. Under these intermediate conditions, Poseidon's Agreement Water price increases to 1.3 times the price of MWD water in 2022, and to 1.4 times its price by 2052—an absolute difference of between $1,803 and $2,801 per acre-foot.

Best Case Cost Scenario for Agreement Water

The absolute best case scenario (Figure 5) for Agreement Water uses the lowest initial cost estimate ($1,641) with the lowest rate of increase derived from the OCWD Meeting Notes, 2.2%. This is compared to the highest possible MWD costs ($1,203-2,022 estimate without WaterFix; $1,368-2,022 estimate single tunnel WaterFix) both escalated at MWD's historical rate of cost increases, 5.6%.

Figure 5: *Best case scenario for Agreement Water*

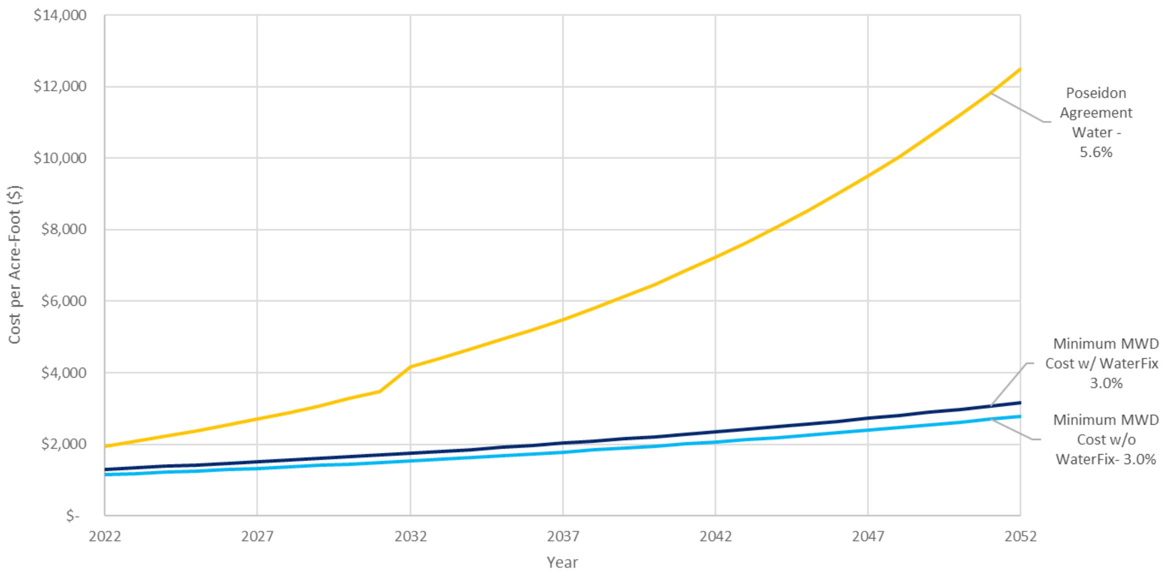


In the best case scenario for Agreement Water, high annual increase estimates push MWD's water costs above those of Agreement Water. In this scenario, Agreement Water shows a brief advantage over MWD's WaterFix imported water within the first decade (2029-2031). This is short-lived, and a result of the artificially-suppressed water costs enabled by the LRP subsidy. Sustained benefit relative to MWD's water is not realized until 2036 for WaterFix imports and 2040 for MWD's costs without a WaterFix. Under this scenario, Agreement Water will be significantly (34-42%) cheaper than MWD's by 2052, an absolute benefit of between $2,141 and $2,995 per acre-foot. Even then, this relies on an unlikely and favorably low estimated rate of cost increase for Agreement Water and an unfavorably, and very unlikely, high rate of increase for MWD's water.

Worst Case Scenario for Agreement Water

The absolute worst case scenario (Figure 6) for Agreement Water uses the highest cost estimate ($1,941) with the highest rate of increase, 5.6%. This is compared to the lowest possible MWD costs ($1,144-2,022 estimate without a WaterFix Project; $1,301-2,022 estimate single tunnel WaterFix) escalated at MWD's projected rate of cost increases, 3%.

Figure 6: *Worst case scenario for Agreement Water*



In the worst case scenario for Agreement Water, high annual increase estimates push Agreement Water far above those of conservatively rising MWD water costs. Here, Agreement Water costs start higher and escalate faster than MWD's, so their costs are never competitive. Under these unfavorable conditions, Poseidon's Agreement Water price increases from more than 1.5 times the price of MWD water in 2022, to about 4 times its price by 2052, an absolute difference of between $9,337 and $9,718 per acre-foot.

Likelihood of Scenarios

Considering the inherent uncertainties in both the Poseidon and MWD water cost increases, we employ a range of assumptions to generate forty-five cost estimates in total[17]. Of those, we examine the nine which most closely adhere to the publicly available OCWD Meeting Notes (2018). Our results find that under the low, medium, and high initial Poseidon cost estimates, if costs increase at 4.1%, 3.9%, or 3.6% rates respectively, Agreement Water would be above even the highest imported water cost in 2052. Only in less than half (four of the nine) of these modeled scenarios is Agreement Water potentially cost competitive with MWD imports across the 30 year contract period. Even then, this is only true when using the most costly MWD estimates. Only two of the nine are cost competitive with MWD's intermediate cost estimates. Finally, even considering the most generous Agreement Water estimates for Poseidon, none of the scenarios are cost competitive to MWD's lowest cost estimates for imported water, with or without a WaterFix. While the best-case scenario for Poseidon shows a potentially significant cost advantage for Agreement Water compared to MWD imported water, the conditions under which this opportunity occurs are exceptional and unlikely.

17 Data for all 45 scenarios is available upon request.

We conclude that no reasonable set of cost increases would make Poseidon agreement water competitive with imported water within the next decade, at which point a project like ocean desalination could be revaluated considering the new water supply context. Our finding is consistent with other reports on the topic that also conclude that, for the region, Agreement Water has a low likelihood of being competitive (Sunding, 2018; Hanemann, 2018; MWDOC,2018). This is certainly true on a pure cost basis, and even more so when taking into account the environmental impacts and uncertainty in management performance of Poseidon vis-à-vis MWD.

Results: Impact of pass-through costs of Poseidon agreement water supply on low-income households

Given that water from the Poseidon agreement is projected to result in substantial water supply costs for many of Orange County's water systems over the next several decades, we outline the potential structure of the pass-through rate increase impacts on the county's disadvantaged households. We first illustrate the limited potential buffering effect of rate stabilization funds and low-income rate assistance programs. We next explain how system rate structures can mediate the household affordability impacts of aggregate cost increases. We then show, using both San Diego and Orange County rate structures and studies, that cost increases from the agreement will likely result in higher rates paid by disadvantaged households.

The Limits of Rate Stabilization Funds and Low-Income Rate Assistance Offerings

In the case of San Diego, both rate stabilization funds and low-income rate assistance were used or suggested as a means to ameliorate pass-through of water supply costs to ratepayers (Black & Veatch, May 2016). Rate Stabilization Funds (RSFs) are reserves maintained by some water systems to mitigate the short-term impact of revenue shortfalls on ratepayers. They can be used both to smooth out rate increases over time (to prevent sharp increases during fiscal emergencies) and to cover unanticipated utility costs like legal fees or variable bond rates when revenues are unexpectedly low (Pacific Institute, 2013). For instance, the SDCWA drew on their existing Rate Stabilization Fund for the past several years to mitigate some of the wholesale rate increases that resulted from rising water supply costs, which included desalinated water. SDCWA used between $5 to $20 million a year for the last four years, resulting in ratepayer relief ranging from $13/AF in 2018 to $50/AF in 2017 (SDCWA, June 20, 2018; May 17, 2017; June 15, 2016; June 17, 2015).

However, since most RSFs are ultimately financed via rate revenue, they lack long-term potential to mitigate consistent rate increases. Even if water systems in Orange County and the OCWD themselves bolstered existing, or established new, rate stabilization funds to buffer cost increases from ocean desalination, they are fiscally infeasible as a long-term solution and would be unable to prevent eventual price increase impacts on low-income households.

More specific to disadvantaged households, some water systems offer rate assistance (LIRAs) to low-income ratepayers, typically with maximum discounts equivalent to 20% of an average low-income ratepayer's bill. The ongoing Proposition 218 limitations to such LIRA offerings by publicly-owned water systems (which constitute the vast majority of systems in Orange County) makes the potential for LIRAs in Orange County to buffer pass-through impacts of Agreement Water also appear quite limited.

Rate Structure Components and Household Impacts

How water systems structure their retail rates can mediate the household affordability impacts of aggregate water supply cost increases. There is no "typical" rate structure or residential water bill type across the county (or the state). Water rate structures can generally be classified into three categories: only fixed fees, fixed fee and variable quantity rates, and only variable quantity rates (which may be either uniform or tiered based on quantity thresholds). A fixed or flat fee rate structure charges customers the same amount regardless of how much water they use, which does not incentivize conservation or enable customers to adjust their expenditure by altering water consumption. On the other hand, an exclusively variable rate charges customers exactly in proportion to how much water they use, which provides customers the largest opportunity to reduce their water cost (by as much as they can reduce consumption). Yet variable rates also leave the water system vulnerable to revenue shortfalls.

Drinking water systems generally have discretion over the structure of their retail rates and billing components. In California, however, public entities providing retail water service must also comply with cost of service requirements to remain compliant with Proposition 218. Proposition 218 restricts local governments attempts to raise funds from property owners to four methods: 1) an ad valorem property tax, 2) a special tax, 3) an assessment, and 4) a 'fee' or 'charge' for property related services. It also requires that rates be set at the cost of providing service (see Mukherjee et al., 2016). The restrictions of Proposition 218 mean that water systems could not, even if they wanted to, set designated discounted rate structures for low-income customers to minimize the cost impact of Agreement Water. Investor-owned utilities, which must instead comply with separate California Public Utilities Commission (CPUC) regulations and rate-making review procedures, have also never employed such types of rate structures.

Despite the lack of precedent for direct differences in rate setting for low-income customers, an opportunity remains for water systems, which some have seized, to reduce the financial burden to customers—particularly to low-income households—by placing greater emphasis on the variable versus fixed components of their water bills. Generally, rate structures which place a greater emphasis on recovering revenue through the variable component of the bill and charge lower variable rates for lower levels of consumption (increasing block rates) are classified as progressive rate structures.

Even though they are applied to all ratepayers and not low-income ratepayers per se, well-designed progressive rate structures may lessen or even eliminate the need for direct affordability assistance by keeping rates low for low-income households which typically consume low levels of water. On the other hand, only mildly progressive rate structures may not yield enough potential rate relief to low-income households to be deemed a sufficient means of affordability assistance.

We examine whether the introduction of Agreement Water to Orange County water systems is likely to lead to progressive rate reform or regressive pass-through impacts. “Pass- through” of system cost increases to customer rates is explicitly authorized by CA Assembly Bill 3030. We accomplish this by drawing on a review of existing rate cases in Orange County, and on the pass-through impacts stemming from a comparable Poseidon agreement which affected ratepayers across San Diego County. Without a detailed cost proposal between Poseidon and OCWD, our analysis of cost of service and rate studies for SDCWA and OCWD member systems provides the best indication of how the cost burden of this new supply source would likely be distributed to Orange County ratepayers in the event of a finalized Poseidon agreement.

San Diego Cost of Service Studies

The San Diego County Water Authority (SDCWA) began receiving full delivery of desalinated water in 2016 from its agreement with Poseidon via the Claude “Bud” Lewis Desalination Plant in Carlsbad. SDCWA passes on the costs of desalinated water from its agreement with Poseidon via several charges levied on its member water systems: a variable supply rate, transportation rate and several fixed charges (Storage, Customer Service, Capacity, and Infrastructure Access Charge) (Carollo Engineers, May 2015).

The trajectory of SDCWA rates from 2014 through 2019 suggests that desalinated water, which began full delivery in 2016, accounts for an increasingly larger share of SDCWA costs to water systems over time. As Table 4 shows, the overall trend in the rates is a steady annual increase in the share of water costs attributed to desalinated water, accompanied by a drop in the share of costs attributed to MWD imported water purchases. When the plant first came online at the end of 2015, desalinated water was about 8% of total water costs for SDCWA, while 74% of costs were attributed to MWD (Shank, 2014). Projected rates for 2019 suggest ocean desalination will be 24% of total costs and MWD only about 46% (Harris, 2018).

SDCWA also calculates an average household monthly rate based on 0.5 AF of consumption. This monthly cost has steadily increased each year, as has the amount of the costs attributed to desalination (it is bundled with Imperial Irrigation District and the Quantification Settlement Agreement (QSA) charges in the calculations). For the 2018 proposed rates, the average $72.51/month rate included $17.31 for desalination and QSA. Overall costs for desalinated water have also increased from $80 million in 2016 to $92.5 million in 2019 (SDCWA, June 20, 2018; May 17, 2017; June 15, 2016; June 17, 2015) (Shank, 2013; Shank, 2014; Harris, 2015; Harris, 2016; Harris, 2017; Harris, 2018).

Table 4. *Summary of SDCWA member cost increases and desalinated water production*

Year	Total Rate Increase (over previous year)	Percent Increase of Rates (over previous year)	Household Cost for Desalination	Total Annual Desalination Costs
2019	$38/AF untreated $14/AF<?> treated	2.9% untreated 0.9% treated	Data not provided	$92.5 Million
2018	$47/AF untreated $57/AF treated	3.7% untreated 3.7% treated	$17.31 of $72.51/month	$85 million
2017	$76/AF untreated $86/AF treated	6.4% untreated 5.9% treated	$14.56 of $70.62/month	$82.4 million
2016	$72/AF untreated $74/AF treated	6.6% untreated 5.4% treated	$14.10 of $66.07/month	$80 million
2015	$30/AF untreated $34/AF treated	2.9% untreated 2.6% treated	$8.38 of $61.47/month	$28.1 million
2014	$26/AF untreated $44/AF treated	2.6% untreated 3.5% treated	None for Desal of $54.30/month ($5.72 for QSA and IID only)	No desalinated water yet

How is this aggregate cost of SDCWA water ultimately borne by households served by SDCWA member water systems? In each of the ten rate cases reviewed for this study (see Table 5), the water systems explicitly stated that they directly passed through greater charges from SDCWA to their customers. SDCWA increases were ultimately passed through to customers in several ways. Most systems, however, instituted both a higher fixed charge (mirroring SDCWA's increase to its Infrastructure Access Charge (IAC)) and higher variable rates (mirroring SDCWA's increase to its variable rate) at all tiers.

For instance, Rainbow Utility District notes in their rate study that "The District relies entirely on purchased water from SDCWA, therefore purchased water costs are spread over all units of water irrespective of customer class or tier" (Raftelis Financial Consultants, January 2018). Meanwhile, Olivenhain Municipal Water District's board of directors passed an ordinance in 2015 stating that the district would increase both its fixed charge, to reflect the SDCWA IAC increase, and its volumetric charge, to reflect higher SDCWA prices to the district, each year for the next five years with no more than 15% annual increases (Olivenhain Municipal Water District, February 11, 2015). The City of San Diego caps their annual pass-through increases at 7% through 2019 (Razak, 2015). Their study anticipated increases of 2.5% in 2017 and 3.0% in 2019 (Razak, 2015). The City of San Diego historically passed through increases to customers but utilized $32 million in their Rate Stabilization Reserve to avoid rate increases in 2012 and 2013. The City could not continue this practice due to financial infeasibility and they began to pass-through rate increases again in 2014 (Razak, 2015).

Table 5. *How San Diego systems passed desalinated ocean water cost increases through residential rate structures*

Water Systems	Most Recent Study	Percent Reliance on SDCWA	Rate Structure	Which Rate Components Received Pass-Through Increase
City of Escondido	Jan 2017 (RFC)	70%	1 Fixed charge (FC), 1 Volumetric Charge (VC) which is 3 Tiered for Single Family Residential (SFR) and Multi Family Residential (MFR)	IAC (in the FC) + Volumetric
Olivenhain MWD	Dec 2014 (RFC)	100%	2 FC, 1 VC 4 Tiered Residential	IAC + Volumetric (15% cap)
Rainbow MWD	Jan 2018 (RFC)	100%	3 FC, 1 VC Uniform Commodity Rate	IAC + Volumetric
City of San Diego	Sept 2013 (B&V)	85-90%	1 FC, 1 VC 3 Tiered SFR	IAC + Volumetric
Vallecitos WD	2017 (District Staff)	100%	1 FC, 1 VC 3 Tiered Residential	Split between FC + VC
Helix WD	October 2015 (RFC)	95%	1 FC, 1 VC 3 Tiered Residential Rate	IAC+ Volumetric (15% cap)
San Dieguito WD	December 2015 (RFC)	Roughly 60%	1 FC, 1 VC 4 Tiered SFR and MFR	IAC + Equal % Increase to FC & VC (for all classes/tiers)
Sweetwater Authority	June 2018 (RFC)	Roughly 34%	4-6 FC, 1-2 VC [3 FC and 1 VC are Proposed for 2018] 4 Tiered SFR (Single Tier MFR)	IAC+ New Proposed SDCWA Volumetric Charge for 2018

Table 5 cont. *How San Diego systems passed desalinated ocean water cost increases through residential rate structures*

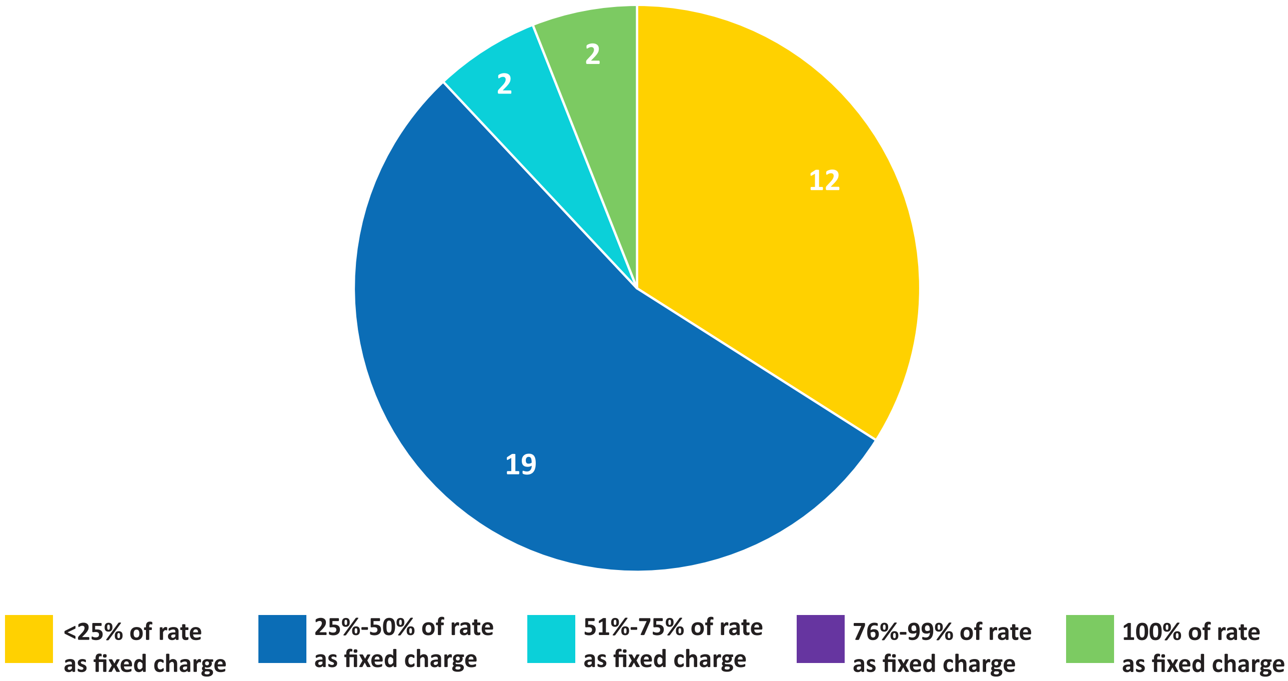
Water Systems	Most Recent Study	Percent Reliance on SDCWA	Rate Structure	Which Rate Components Received Pass-Through Increase
Rincon Del Diablo MWD	June 2015 (RFC)	100%	3 FC, 1 VC 3 Tiered Residential	IAC+ Volumetric
Padre Dam MWD	May 2017 (Carollo)	100%	2 FC, 1 VC 4 Tiered SFR (Single Tier MFR)	IAC+ Volumetric

We identified one example of very progressive pass-through charges which purports to be Proposition 218 compliant. Vallecitos Water District uses the delineation of supply tranches to send lower cost water to lower variable consumption tiers; only Tier 2 and Tier 3 pay the higher costs for desalinated ocean water delivery (Vallecitos Water District, 2017). Moreover, several utilities have policies which prioritize lower-cost water (and rates) to certain users. For example, the City of Escondido allocates 60% of their local water supplies to agricultural users so those users do not have to pay all of the SDCWA costs and can have lower water costs "in recognition of their benefits to the city" (Raftelis Financial Consultants, January 2017). Overall, however, increases in purchased water costs appear, with few exceptions, to be substantially passed through to households served by SDCWA member systems in the form of rate increases which are unavoidable regardless of consumption choices.

Existing Orange County Water System Rate Structures

Next, we analyze current rate structures in Orange County and show how, much like in San Diego, the Poseidon agreement would likely result in OCWD increases passed through directly to customers. There is no reason to assume that pass-through of costs will be different than in San Diego, except that Orange County systems have more progressive rates overall. 88% of Orange County's systems have fixed charges that represent less than 50% of the total bill at the 12 CCF consumption level, and of those, a majority are between 25-50% of their bill.

__Figure 7.__ Number of Orange County systems by the proportion of their 12 CCF rate derived from a fixed charge[19]



We reviewed five rate cases from systems that purchase from OCWD: four member agencies (East Orange County Water District (EOCWD), City of La Palma, City of Westminster, and Yorba Linda Water District) and 1 non-member agency (El Toro Water District). Each of the systems used a combination of fixed and variable charges as a rate structure and used the Base-Extra Capacity method to assign costs to rates and remain Proposition 218 compliant. Not all the utilities, however, utilized the same variable rate structure. EOCWD has a flat commodity rate (one tier) for all its customers. The consultants on the La Palma study suggested, due to the Capistrano decision and Proposition 218 concerns, a shift from current tiered rates to a single uniform commodity rate like EOCWD (Willdan Financial Services, 2016). Yorba Linda also has a uniform commodity rate while Westminster has tiered rates for all its categories (e.g. SFR, MFR, Hotel, Commercial/Industrial, Irrigation) (TischlerBise, 2017). El Toro actually uses a water budget method which sets up 4 tiers based on usage (the final fourth tier is excessive water use) with different breakoff points for each customer based on their expected indoor and outdoor water use (calculated from formulas that incorporate landscaped area, dwelling size etc.) (Raftelis Financial Consultants, May 2016).

Three of the systems—EOCWD, Yorba Linda Water District, and El Toro Water District—already explicitly mention in their rate studies that they 'pass-through' increases to customers, assessed annually, to account for increases in purchased water costs (Raftelis Financial Consultants, June 2016; August 2015; May 2016). EOCWD progressively passes through all water supply

19 The numbers displayed here represent 35 of the 41 Orange County community water systems, for which usable rate data was readily available.

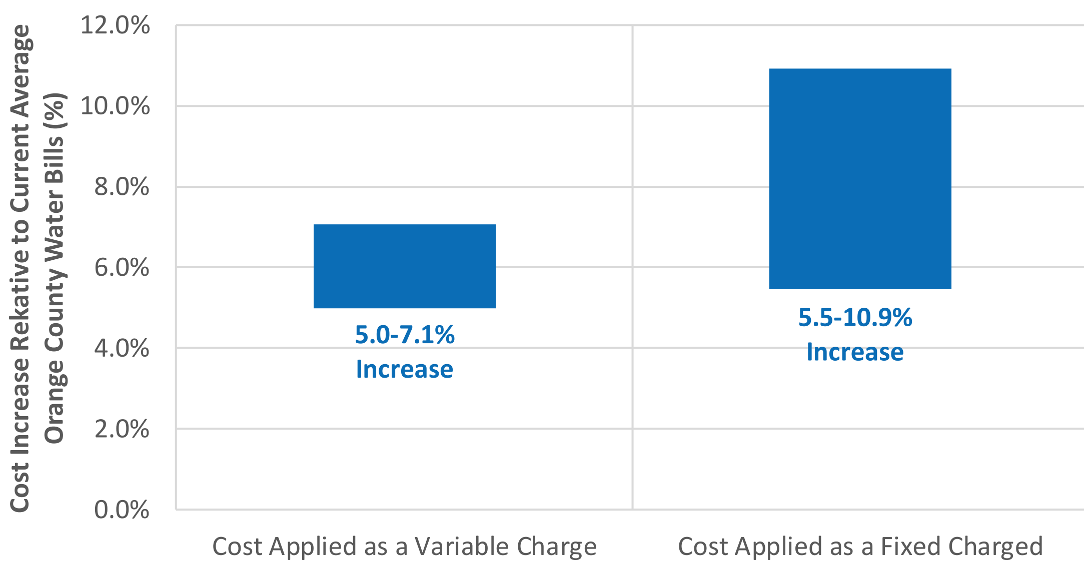
purchasing costs to its variable water usage rate (Raftelis Financial Consultants, June 2016). Yorba Linda allocates the entire rate increase to a fixed charge and leaves the water usage rate unchanged (Raftelis Financial Consultants, August 2015) and El Toro reports typically doing the same (Raftelis Financial Consultants, May 2016).

Like many of the systems purchasing from SDCWA in San Diego, Orange County systems are largely reliant on imported and purchased water and thus heavily affected by price increases for purchased water supply. These costs are typically passed through directly in the form of non-progressive rate increases to customers.

Estimated pass-through impacts of Poseidon agreement water on (disadvantaged) Orange County ratepayers

Finally, we model the potential structure of initial pass-through rate increases on the county's disadvantaged households. We use estimated rate increase estimates from both IRWD and OCWD to illustrate household-level impacts at the 12 CCF consumption level. As Figure 8 illustrates, the OCWD cost increase estimates range from \$3-\$6 per household per month (OCWD, 2018) while the IRWD (2018b) estimate ranges from \$0.228-\$0.323 per hundred cubic feet (CCF). These aggregate pass-through impacts represent a monthly rate increase between 5% and 11% on the average household bill for 12 CCF in the county. For a household of four below the federal poverty level, the impact of this rate increase at the 12 CCF consumption level would move the impact of water bills from around 2.5% of pre-tax income to 3% of pre-tax income.

Figure 8. *Range of water rate increases at 12 CCF dependent on new charges being applied as a fixed or variable cost*



Again, the extent to which low income households served by different water systems ultimately face increased rates depends not only on supply cost increases faced by systems, but also on existing systems' rate structures. If increased costs are passed through to ratepayers via a fixed fee or uniform rate structure, all households will face the same expenditure increase. By contrast, systems employing tiered rate structures, through progressive rate setting, could pass-through their cost on higher volumetric consumption tiers. This pass-through strategy would allow low-income households consuming modest amounts of water to be shielded from the full effect of substantial rate increases.

About one third of households in the county are highly unlikely to receive any relief from Poseidon agreement rate increases due to their systems currently employing uniform or fixed fee rate structures. On the other hand, those systems which already employ multi-tiered rate structures can shield households consuming modest amounts of water from the full effect of supply cost increases. If deemed Proposition 218 compliant, systems with multi-tier rate structures could pass-through additional costs to their existing highest rate tier to avoid any rate increases to low income households using 12 CCF or less. If supply costs increases were passed through to the highest 2 or 3 rate tiers (as opposed to only the top tier) among these same systems, the benefit to households consuming 12 CCF would be diminished. In these scenarios, only 43% or 6% (respectively) of households served by systems employing tiered-rate structures would avoid an additional rate increase due to the cost of the new desalinated ocean water supply.

In theory, Poseidon agreement water in Orange County or any similar investment in a new source of supply also allows water systems the opportunity to reform their entire rate structure more progressively and thus minimize affordability impacts on disadvantaged households. Extensive and progressive rate structure reform, however, also appears unlikely due to Proposition 218 concerns, political obstacles, and our review of existing rate change cases in both Orange County and San Diego.

Conclusion

This report analyzes the likely impacts on environmental justice concerns in Southern California of one proposed strategy for enhanced water security–a proposed agreement for Poseidon Resources LLC (Poseidon) to sell 56,000 acre feet per year to the Orange County Water District for a period of 30 years.

We find that none of the potentially positive Human Right to Water benefits from desalinated ocean water can plausibly be realized in Orange County by the Poseidon agreement. The only probable impact on disadvantaged households in the county will be moderate to severe rate increases which will make water less affordable for low-income households consuming modest amounts of water. Our analysis yielded no evidence to project water from the agreement to be cost competitive with other local supply options. Only unlikely scenarios suggest Agreement Water, when benefiting from a substantial MWD subsidy, will be cost competitive with only the most expensive imported supply in the near future, and independent assessments identify Agreement Water as the least desirable supply option for the county.

Despite the theoretical promise of rate reform to shield low-income customers from pass-through of cost increases, we found that systems previously grappling with new supply costs, including the recent ocean desalination plant in San Diego, did not often implement such a strategy. This suggests that finalization of the Poseidon agreement would moderately to severely worsen affordability concerns for disadvantaged households in Orange County over the next several decades. There are no apparent offsetting benefits of this arrangement for households in the region at the present time, although we note that the situation may be revisited in a few decades if ocean desalinated water production costs fall and other supply costs rise.

This research can inform efforts by nearly all major water suppliers across the Southern California region to pursue a broader suite of water security, local water supply and demand management investments. This analysis can also be used to evaluate the costs and benefits of various local water reliance strategies in similarly water-scarce regions. Finally, more research and policy innovation must be undertaken to enable and encourage water systems to make progressive rate structure reforms to shield disadvantaged households from the impact of water supply portfolio-related cost increases in Southern California over the coming decades.

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Appendix

Indices Informing Likely Annual Cost Increases

There are different methods and standards used to calculate inflation, which often vary by sector. Our decision to classify Poseidon's 2.2% estimated rate of increase as low, and to consider higher alternatives, was motivated by the span of indices uniformly showing higher rates of increase:

For the plant's human capital, we estimate a reasonable rate of increase to be between 3.5%-3.8% (1950-2018; 2018-2022 projections) based on the California Department of Finance's Consumer Price Indices (CPI) for both Wage Earners and Consumers in the Los Angeles Area.

Considering that desalination plants are very energy intensive, we estimate that a reasonable baseline rate of increase would match the projected cost increases for the supply of electricity. For California in recent years, this falls between 2.9%-3.5% (2007-2017; 10- and 5-year averages, respectively) (US Energy Information Admin¬istration Database), while the OCWD Meeting Notes assumes only a 2.5% rate of increase.

Lastly, for engineering and construction projects, the Engineering News Record's Building Cost Index (BCI) or Construction Cost Index (CCI) are industry standards used to forecast likely costs associated with building and construction. Historical estimates (1979-Sept 2018) show an annual increase rate of 3.3% and 3.6%, for BCI and CCI respectively.

In addition to these indices, we also anticipate that the project's construction will be financed with debt at a rate of 4.5% (OCWD Meeting Notes, 2018) assuming that Poseidon will not be accessing lower public sector rates through OCWD.

All of these sources indicate rates of increase higher than 2.2%, which suggests that the Poseidon estimate is a low one, if based on modeling, and that our analysis should incorporate a higher value.

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