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STATE OF CALIFORNIA

STATE WATER RESOURCES CONTROL BOARD

Hearing in the Matter of California Department of Water Resources and United States Department of the Interior, Bureau of Reclamation Request for a Change in Point of Diversion for California Water Fix	**DR. JEFFERY MICHAEL'S WRITTEN SUMMARY OF TESTIMONY**

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I. WaterFix Will Harm Delta Agriculture and Related Economies.

The WaterFix will reduce agricultural production in the Delta in two ways: a) water quality degradation, and b) land loss. Higher salinity in the Delta could reduce yields for Delta farmers, prevent them from planting more lucrative but salt-sensitive crops, or shift existing fields to lower-revenue crops with higher salt tolerance over time. Farmers who own land taken out of production due to WaterFix construction should be fairly compensated through eminent domain, but the decreased production that results will still decrease employment and economic activity on agriculture-related businesses in the County.

A. Delta Agricultural Production Can Decrease Even if WaterFix Maintains D-1641 standards.

There is substantial evidence that salinity impacts associated with operating the WaterFix will cause economic harm to Delta agriculture, even if the WaterFix operates in compliance with D-1641 standards. Significantly, this finding is included in a report prepared by Petitioners' consultants ICF and the Brattle Group entitled the *Draft Bay Delta Conservation Plan Statewide Economic Impact Report.*[1] The model was originally developed for the Delta Protection Commission's Economic Sustainability Plan (ESP)[2] project for which I served as principal investigator, and worked collaboratively with the Brattle Group to develop the model. An independent panel of experts for the Delta Science Program reviewed the ESP and praised this approach for measuring salinity impacts, stating "We commend the authors for using this approach," and that it was "state of the art."[3]

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[1] Draft Bay Delta Conservation Plan Statewide Economic Impact Report. August 2013. Jonathan Hecht, ICF International and David Sunding, The Brattle Group. http://baydeltaconservationplan.com/Libraries/Dynamic_Document_Library/Draft_BDCP_Statewide_Economic_Impact_Report_8-5-13.sflb.ashx

[2] http://www.pacific.edu/Documents/school-business/BFC/Econ%20Sustain%20Plan%20PDFs/Final%20ESP%20Executive%20Summary_2012_01_19.pdf

[3] Adams, R., J. Chermak, R. Gilbert, T. Harris, and W. Marcuson III. Independent Panel Review of the Economic Sustainability Plan for the Sacramento-San Joaquin Delta. December 2, 2011. Retrieved from http://forecast.pacific.edu/DESP/other/Review%20of%20Sustainabilty%20Plan_Final.pdf

The model used in the *Draft BDCP Statewide Economic Impact Report* and the ESP is an econometric, multinomial logit model that estimates the sensitivity of cropping patterns in the Delta to salinity and other factors over a nearly 10-year period. It utilized data from 6,000 crop fields and measured salinity at 50 points in the Delta. The model controls for a variety of physical (e.g., elevation, soil type, temperature, field size, irrigation water salinity) and market variables (e.g., prices) that impact crop choices. The results showed that the salinity of irrigation water had statistically significant effects on cropping patterns in the Delta at the 99% confidence level, even when examining data over a time period that Petitioners' describe as in compliance with D-1641. Thus, the model shows that change in water quality from the WaterFix is likely to create economic harm to Delta farmers even if it is able to maintain salinity below the D-1641 standard. The *BDCP Statewide Economic Impact Report* examines a scenario in which the Delta tunnels cause a 1.1% increase in average salinity from 347 mS/cm to 351 mS/com, a modest change that would seem to be in compliance with D-1641 standards and of the scale described as insignificant by Petitioners. Nevertheless, the *BDCP Statewide Economic Impact Report* estimates that this small change in salinity due to the tunnels would result in a $1.8 million decrease in crop revenue in the Delta just from shifts to lower-value crops over time. Larger changes in water quality could lead to much larger impacts on agricultural production.

The impacts predicted by the econometric model only looks at crop shifts over time, not yield decreases which can cause economic harm in the short-run even if it does not result in a planting change. The impact of salinity on crop yields depends critically on the leaching factor of the soils which varies across the South and Central Delta. According to data provided by Terry Prichard, salinity levels at or below 0.7 EC do not affect yields of the most common crops in the Delta as long as the leaching fraction is 10% or above. However, studies by Michelle Leinfelder of alfalfa irrigation and soil salinity in the Delta have found a median leaching fraction of 5.5%, half of the Delta locations in her study sample had leaching fractions

at or below 5%.[45] The table below, provided by Terry Prichard, shows percentage reductions in yield for important crops in the Delta at various levels of irrigation water salinity at a leaching fraction of 5%.

Percentage Reduction in Yield For Leaching Fraction of 5%.

ECi	Ece	Bean	Corn	Alfalfa	Tomato	Almond	Grape
0.2	0.65	0.00	0.00	0.00	0.00	0.00	0.00
0.3	0.97	0.00	0.00	0.00	0.00	0.00	0.00
0.4	1.3	9.38	0.00	0.00	0.00	0.00	0.00
0.5	1.62	19.38	0.00	0.00	0.00	4.00	1.88
0.6	1.95	29.69	5.00	0.00	0.00	15.00	7.03
0.7	2.27	39.69	11.40	3.38	0.00	25.67	12.03
0.8	2.6	50.00	18.00	7.50	1.69	36.67	17.19
0.9	2.92	60.00	24.40	11.50	7.12	47.33	22.19
1	3.25	70.31	31.00	15.63	12.71	58.33	27.34

To illustrate the potential impact on crop revenue in San Joaquin County from the WaterFix, I developed a simple scenario using this table and data from the agriculture chapter of the Delta Protection Commission's Economic Sustainability Plan (ESP).[6] The ESP estimated $429.5 million in crop revenue in the Delta portion of San Joaquin County in 2009, and shows the revenue by crop type. Truck crops such as tomatoes and asparagus were the most valuable at $249 million, followed by field crops such as corn and alfalfa at $107 million. More salt sensitive crops like grapes and nuts were only $32 million and $25 million respectively, an interesting finding in itself since these two lucrative crops dominate crop production in the non-Delta areas of San Joaquin County. The scenario assumes these crops

[4] Leaching Fractions Achieved in South Delta Soils under Alfalfa Culture 2014 Year-End Report (February 1, 2015) Michelle Leinfelder-Miles

[5] Leaching Fractions Achieved in South Delta Soils under Alfalfa Culture Project Report Update (August 2016) Michelle Leinfelder-Miles

[6] http://www.pacific.edu/Documents/school-business/BFC/Econ%20Sustain%20Plan%20PDFs/Chapter_7.pdf

are distributed uniformly across areas where the baseline ECi ranges from 0.4 to 0.6, and that with the WaterFix salinity increases by 0.1 across the region. This scenario reflects a relatively modest increase in salinity that could likely still maintain compliance with the D-1641 standard, and is thus similar to the predicted water quality impacts and proposed performance standards for the operations described in this Petition. The table below shows the decrease in agricultural revenue in this scenario.

Decrease in San Joaquin County Revenue From Crop Yield Loss for Scenario of 0.1 EC increase in salinity to base EC ranging from 0.4 to 0.6.

		0.4	0.5	0.6	Total
Almond	Deciduous	$ 167,453	$ 627,950	$ 1,074,632	$ 1,870,035
Corn/Alfalfa	Field	$ 0	$ 445,838	$ 1,319,679	$ 1,765,517
Grape	Vineyard	$ 100,577	$ 376,093	$ 643,585	$ 1,120,255
	Total	$ 268,030	$ 1,449,881	$ 3,037,896	$ 4,755,807

The results show a $4.76 million decline in agricultural revenue from reduced yields, even in a modest salinity scenario unlikely to result in violations to D-1641.

Both of these models will predict even larger crop losses for larger changes in salinity. The water quality modeling presented by Thomas Burke shows that some locations could experience a greater than 25% increase in salinity in some years due to the WaterFix and even greater increases when analyzed over shorter durations during irrigation season. Mr. Burke's testimony containing his data and conclusions is submitted as part of SDWA et,al,'s case in chief. It is important to note risks that could lead to salinity increases that are even higher, and thus create even higher agricultural damage. First, proposed revisions to D-1641 standards would increase the allowed level of salinity in the Delta to increase by 41%, from 0.7 EC to 1.0 EC in the growing season. Second, as noted elsewhere in this testimony, the proposed operations for the WaterFix are not economically feasible – which will lead to tremendous

economic pressure to increase exports and relax water quality standards in the future, either permanently or through the use of TUCPs.

B. Decreased revenue from Delta farming has broader negative economic impacts on Delta Counties, especially San Joaquin County.

Agriculture is the economic base of the Delta, and the impacts of decreased agricultural production go beyond a loss of income to the farmers. It would affect employees, suppliers, tax revenues and ripple through the community through decreased spending on consumer goods, services, and agricultural inputs. These impacts would accrue not just due to decreased production from water quality changes generated by the WaterFix, but also due to land lost to agricultural production due to construction of the tunnels. While farmers who lost land due to construction should be justly compensated through eminent domain, the larger community would still suffer an economic loss from the reduced economic activity from land that was no longer farmed due to the surface impacts of WaterFix construction. The BDCP RDEIR/SDEIS, Table 14-8, estimates 3,909 acres of agricultural land would be permanently lost due to facility construction, and 1,495 acres would be temporarily stop producing during the construction period. In 2009, the areas of the Delta where construction impacts would occur averaged $1,949 per acre which equates to about $7.8 million in permanently decreased agricultural revenue in 2009 dollars. Combined with the water quality impact described in the previous section, a conservative estimate of lost Delta agriculture revenue from the WaterFix at the operations described in this Petition is about $12 million per year in 2009 dollars. In the Delta Protection Commission Economic Sustainability Plan, I used the IMPLAN model to estimate that each million dollars of Delta agricultural output supported 12.2 jobs and $859,000 in income (i.e. value added) in the Delta Counties. Thus, implementing WaterFix and operating it as described in the petition would permanently reduce agricultural-related employment in the Delta by about 146 jobs and reduce income by $10.3 million in 2009 dollars or about $11.6 million in current dollars.

II. The WaterFix could negatively impact other critical components of the Delta economy identified in the Economic Sustainability Plan (ESP).

The ESP identified three primary drivers of the Delta economy: a) agriculture, b) recreation and tourism, and c) infrastructure services. Infrastructure services is a broad label that captures economic activity related to critical transportation, energy and water infrastructure in the Delta including the movement of goods and people through roads, rail and ports; the transmission, storage and production of electricity and natural gas; and the diversion and conveyance of water. Perhaps most importantly, the ESP found "The levee system is the foundation on which the entire Delta economy is built." The WaterFix could negatively impact all of these areas. Agriculture impacts were discussed in detail earlier, and this section briefly discusses the risks created by the WaterFix for these other aspects of the Delta economy.

A. WaterFix Is Likely to Result in Reduced Investment in Delta Levees And Increase the Risk of Large Economic Loss in the Delta.

Construction of WaterFix could affect Delta levees. Perhaps more importantly, the WaterFix could also reduce future funding for levee maintenance and improvement since it would reduce the dependence of the SWP and CVP on the levee system. If a Delta Levee Assessment District is implemented in the future as recommended by the California Water Plan, the Delta Stewardship Council and others, implementation of the WaterFix could reduce assessments on the water agencies south of the Delta. Although the negative impact to the levee system from the WaterFix is very uncertain, it is important to take note of any increase to risk because the consequences of failure are so large.

Petitioners cite the risk of a catastrophic flood, triggered by an earthquake or other event, as a key reason for the WaterFix project, and often cite billions of dollars in economic losses from such a flood estimated in the Delta Risk Management Study (DRMS). However,

the ESP reviewed the detailed results of the DRMS study and found that 80% of the economic loss from such an event was not from losses to the water projects – but from damage to other property and infrastructure in the Delta itself. In other words, the total cost of the catastrophic flood scenario in the Delta itself is four times larger than the economic cost from a lengthy interruption to water exports. DRMS also found hundreds of lives could be lost in the flood, all in the Delta itself. Petitioners have chosen to focus investment on protecting water exports alone through the WaterFix rather than to address this risk through a collaborative approach to strengthen Delta levees and simultaneously protect water exports, Delta communities and the Delta economy, and other critical statewide infrastructure. Thus, the WaterFix increases the risk of the Delta economy suffering a multi-billion dollar catastrophe.

While conducting research for the ESP in 2011, I identified an example from Phase 2 of the DRMS analysis that illustrates how the focus on isolated conveyance through BDCP and WaterFix has already led to decisions that increase flood risk in the Delta. DRMS phase 2 was commissioned to satisfy AB 1200 (Laird) which required a ranking of risk reduction strategies be provided to the legislature by January 1, 2008. In fall 2007, the DRMS phase 2 consultants provided DWR with the results of their analysis that showed that an "Improved Levees Scenario" with 100 miles of seismically improved levees had higher economic benefits and lower costs than a scenario based on an Isolated Conveyance facility like the WaterFix. The result is not surprising since isolated conveyance only addresses 20% of the cost of the catastrophic flood scenario in DRMS, whereas seismically improved levees provide protection against 100% of the costs of the scenario. DWR staff did not release these results,[7] and instead issued a qualitative ranking in the January 2008 report to the legislature in which the rankings were changed to show that Isolated Conveyance had the highest risk reduction ranking in alignment with the BDCP effort. Specifically, the AB 1200 report[8] stated that "These rankings were developed by DWR and DFG staff based on DRMS analyses, with

[7] They were not released publically until a request was made to support the ESP research in late 2011. http://www.pacific.edu/Documents/school-business/BFC/Econ%20Sustain%20Plan%20PDFs/Appendices/Appendix%20N.pdf

adjustments based on the BDCP analyses." Quantitative results from DRMS Phase 2 were not released until June 2011, and in the June 2011 report seismically improved levees had been removed from the strategies despite being identified as one of the three most promising strategies in the 2008 report to the legislature. This omission boosted the ranking of the isolated conveyance strategy. Had DWR presented the legislature with unaltered results of the DRMS Phase 2 analysis in 2008, rather than staff making "adjustments based on the BDCP", the State's risk reduction policy for the Delta may have taken a very different course. The relevance of this episode to the current proceeding is twofold. First, it shows a concrete example of how the focus on isolated conveyance strategies like the WaterFix can directly lead to reduced effort to minimize flood risk in the Delta. Second, it shows that increased investment in Delta levees is the logical and highly likely direction of risk-reduction investments in the Delta should the WaterFix proposal not go forward. As a result, expected flood damage in the Delta is higher with the WaterFix than without.

B. WaterFix Will Adversely Impact Recreation Oriented Businesses in the Delta.

The ESP estimated that the Delta attracted 12 million visitor days per year, directly or indirectly supporting 3,000 jobs and $329 million in economic activity in the five Delta counties. Water based recreation is the primary attraction, but scenic drives and land based visits to historic, natural and cultural attractions is also important – especially along the highway 160 corridor. Construction of the WaterFix will include significant disruptions to popular waterways, and disrupt traffic and tourist attractions along scenic highways. It is difficult to estimate the degree to which WaterFix construction will reduce tourism in the area. Economic impact to local businesses during public works construction is not unusual, and some road and transit projects include mitigation funds for this purpose. Three characteristics of the WaterFix construction will result in more serious and long-term economic losses than those resulting from a typical construction project. First, the construction period is

[8] http://www.water.ca.gov/floodsafe/fessro/levees/drms/docs/AB1200_Report_to_Legislature.pdf

exceptionally long, 14 years in the most recent estimate. Second, Delta recreation businesses are almost exclusively small independent businesses with limited resources to endure an extended loss in business. Third, the multi-layered regulatory environment in the Delta, described in the Chapter 10 of the ESP, makes new business investment after construction is over extremely challenging, if not prohibitively costly. All of these factors combine to make permanent economic damage to the local recreation economy from WaterFix construction much more likely than in most public works projects. Additional long-run damage to the recreation economy would occur if, as seems likely, WaterFix has negative environmental impacts, such as increased algal blooms.

C. WaterFix Could Impact Infrastructure Dependent Business in Delta Counties.

San Joaquin County's economy is being transformed by a rapidly growing transportation industry and increasing integration with the Bay Area. The County's economic growth is dependent upon efficient transportation of goods and people with the Bay Area. Several of the important transportation corridors are in the Delta, and their importance to the economy is likely to increase in the future. Critical transportation corridors include state highways (4 and 12), rail, and Stockton shipping channel. The *Draft BDCP Statewide Economic Impact Report* estimated that traffic delays resulting from tunnel construction could result in costs as high as $28 million per year. The worst impacts were estimated to occur on highway 4 between Stockton and Contra Costa County. After the construction period, the WaterFix may have little impact on these infrastructure related sectors such as transportation and energy. However, these sectors could be indirectly impacted, potentially severely, if the WaterFix affects levee investments and flood control in the area.

III. WaterFix Operations Are Not Feasible.

Feasibility studies are a normal and well-established part of planning water resources projects. Agencies, including the Petitioners, have well established guidelines for investigating and establishing project feasibility. Other large water storage and conveyance proposals by

Petitioners, including Sites and Temperance Flat reservoirs and a proposed raise to Shasta dam, are informed by feasibility studies that include significant economic and financial analysis. WaterFix stands alone among the largest water infrastructure proposals in California for not including economic or financial feasibility analysis, despite having the highest cost by far.

In addition to being a normal part of evidence presented to support a water resource infrastructure project, the Board specifically requested evidence of feasibility to Petitioners in a March 4, 2016 ruling that stated "The petitioners should also show that there are feasible operations available to meet any performance standards."

A. Economic feasibility is essential to the concept of feasibility. Petitioners have provided no evidence to support economic feasibility.

CEQA states "Feasible shall mean capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors." The CEQA definition of feasibility is the common meaning of the term applied in many legal and planning settings throughout California. The definition explicitly lists economic factors among four areas of consideration.

Every relevant application of the concept of feasibility in water resources infrastructure planning has economic and financial issues in a central role. Earlier this year, the California Water Commission identified the following factors that inform project feasibility:[9]

- Project Description and Operations
- Feasibility Studies and Engineering
- Environmental Documentation, Mitigation Requirements, and Permit Status
- Cost Estimate
- Benefit/Cost Analysis
- Cost Allocation and Requested Amount
- Finance and Construction Planning

- Monitoring and Management Planning

Petitioners have provided no evidence regarding four of these eight components of feasibility identified by the California Water Commission.

In 2014, the Department of Water Resources published "Guidance for Development of a State-Led Feasibility Study."[10] On page 1, the DWR guidance document identifies the three most important factors to feasibility as follows:

- "Financing: feasibility studies must be accompanied with a reasonable and implementable financing plan
- Agency Alignment: many water resource projects require permitting. Proper environmental documentations and alignment of the agencies during the planning process is needed to ensure support by permitting agencies
- Value assessment: it is critically important to our decision makers and the public to understand the value of a proposed projects, how it helps the wellbeing of the society, its health and safety, its environment and its economy"

Petitioners have presented no financing plan and no assessment of the economic value of the WaterFix and thus are ignoring their own standards for determining project feasibility.

The Department of Water Resources' *Economic Analysis Guidebook*,[11] published in 2008, also provides clear definitions and guidelines for benefit-cost analysis and financial feasibility analysis, and how they are integral components of determining project feasibility. Page 5 of the *Guidebook* states:

> "The objective of economic analysis is to determine if a project represents the best use of resources over the analysis period (that is, the project is economically justified):
>
> > The test of economic feasibility is passed if the total benefits that result from the project exceed those which would accrue without

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[9] https://cwc.ca.gov/Documents/2016/02_February/February2016_Agenda_Item_10_Attach_1_ModelingPresentation_final.pdf

[10] http://www.water.ca.gov/floodmgmt/funding/docs/Final-Draft-Feasibility-Study-Guidance-wAppendices-2014.pdf

[11] [11] http://www.water.ca.gov/pubs/planning/economic_analysis_guidebook/econguidebook.pdf

> the project by an amount in excess of the project costs. It is important that the comparison be *with* and *without* rather than *before* and *after* because many of the after effects may even occur without the project and can thus not properly be used in project justification. Economic justification is contingent on engineering feasibility because a project incapable of producing the desired output is not going to produce the benefits needed for its justification.

The economic analysis should answer questions such as, Should the project be built at all? Should it be built now?, Should it be built to a different configuration or size? Will the project have a net positive social value for Californians irrespective of to whom the costs and benefits accrue? Three common methods of economic analysis are cost effectiveness, benefit-cost, and socioeconomic impact analyses.

The objective of financial analysis is to determine financial feasibility (that is, whether someone is willing to pay for a project and has the capability to raise the necessary funds). The test of financial feasibility is passed if (a) beneficiaries are able to pay reimbursable costs for project outputs over the project's repayment period, (b) sufficient capital is authorized and available to finance construction to completion, and (c) estimated revenues are sufficient to cover allocated costs over the repayment period. Thus, a financial analysis answers questions, such as, Who benefits from a project? Who will repay the project costs? Are they able to meet repayment obligations? Will the beneficiaries be financially better off compared to what they will be obligated to pay? Within DWR, the State Water Project Analysis Office performs financial feasibility analyses for proposed SWP facilities."

There are more examples, but the point should be clear. Evidence of feasibility requires evidence of economic and financial feasibility including benefit-cost analysis, and a cost allocation with financial plan. Economic and financial analysis is critically linked to operational, engineering, and environmental feasibility. Petitioners have provided no evidence of economic or financial feasibility in the long established professional standards, including their own agency guidelines, and the request of the Board.

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B. The Benefit-Cost Ratio and Cost Per Acre Foot For WaterFix Shows It Is Infeasible For Operations Described In The Petition

In "Benefit-Cost Analysis of the California WaterFix,"[12] I estimated benefits and costs for the operations described in the Biological Assessment, an average annual water yield of 225,000 acre feet. The base scenario estimates the value of water to urban agencies by the cost of alternative supplies as most recently estimated by the Department of Water Resources, and estimates the value of water to agricultural users by comparing market data on the rental value of irrigated and unirrigated farmland in 2014, a year where farm profits were near record high, water was relatively scarce, and irrigated land rents were at record levels. These values are then increased by 20% to account for the possibility that the value of water at the margin could increase faster than general inflation, and the value of urban water from the tunnels was not adjusted for pumping and treatment costs. Thus, even the base scenario could be seen as favorable to the tunnels. The "optimistic" scenario derives the value of water from earlier work to support the BDCP that exaggerated the future scarcity value of water by using out-of-date, high growth forecasts and assuming there would be no additional development of alternative water supplies, no increase in conservation, and no development of new technology for alternative water supplies. While the demand assumptions in the optimistic scenario are unrealistic and biased to favor the tunnels, it results in an average value of all incremental water from WaterFix that is very similar to the urban value of water in the base scenario. Thus, the optimistic scenario could be seen through another lens where the WaterFix is an urban-only project where urban agencies pay all costs and receive all the incremental water supply.

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[12] http://www.pacific.edu/Documents/school-business/BFC/WaterFix%20benefit%20cost.pdf

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Present Value of Benefits and Costs of the California WaterFix.

2014 dollars, 3.5% real discount rate, 15 years of construction, and 100 years of operation.

	Base scenario	Optimistic Scenario
Benefits		
Export Water Supply	$1,319,521,208	$2,822,409,124
Export Water Quality	$1,677,361,307	$1,677,361,307
Earthquake Risk Reduction	$0	$435,796,554
Total Benefits	*$2,996,882,515*	*$4,935,566,984*
Costs		
Construction and Mitigation	$11,676,474,531	$11,676,474,531
Operation and Maintenance	$591,658,075	$591,658,075
Ecosystem	$0	$0
In-Delta Municipal	$111,279,332	$37,093,107
In-Delta Agriculture	$682,807,143	$293,953,421
In-Delta Transportation	$132,205,755	$132,205,755
Total Costs	*$13,194,424,836*	*$12,731,384,889*
Net Benefit	($10,197,542,281)	($7,795,817,905)
Benefit/Cost ratio	**0.23**	**0.39**

The benefits to the tunnels include export water supply, export water quality, and risk reduction from a catastrophic flood from an earthquake or other source that could interrupt water exports. Costs include construction, mitigation and operation costs that would be paid by exporters and impacts to third-parties such as environmental cost, in-Delta municipal, agriculture and transportation impacts. As shown in the table and discussed the report, various

estimates of values and costs around most of these categories have little impact on the benefit-cost ratio because of the project's enormous construction cost. Two variables where there is some uncertainty are the key to the benefits and costs: 1) export water supply, and 2) construction costs. The WaterFix has been described as only at 10% design, and the history of large tunneling projects suggests that there is a significant risk of substantially increased costs from the current estimate. In addition, the analysis does not consider the risk of construction delays, environmental harm, or other 3rd-party costs such as impacts on Delta recreation, upstream water users, or flood control.

As shown in the table, the results of the benefit-cost analysis show the net benefit is negative $10 billion and benefit-cost ratio is 0.23 for the base scenario, and nearly negative $8 billion and a benefit cost ratio of 0.23. Using optimistic values, the net benefit is negative $7.8 billion and benefit-cost ratio is 0.39. The project is clearly not economically feasible at the operations described in the biological assessment. The results can be used to consider how much additional export water yield would be needed for economic feasibility, if export water yield could be increased without causing significant environmental harm or damage to 3rd-parties. Economic feasibility would require export water yields of about 2 million acre feet in the base scenario, and nearly 1 million acre feet annually in the optimistic scenario. The highest water yield estimated in the Petition is the Boundary 1 (B1) scenario. According to Thomas Burke, DSM2 modeling of B1 estimates an annual average water yield of 812,000 acre feet which falls short of economic feasibility even under the most optimistic assumptions.

Another approach to considering economic feasibility from the perspective of export water agencies is to compare the cost per acre foot to alternative water supplies. Noted water economist and consultant Dr. Rodney Smith provided me with a brief report that calculates the cost per acre foot for the delta tunnels at various levels of project yield. The table below shows his results and clearly illustrates the important relationship between the projects operations and its financial requirements. Dr. Smith advises that a risk premium of between 1% and 2% is appropriate for the state water project which would be cost in excess of $6,000 per acre foot for most of the scenarios described in the Petition. Dr. Smith notes that these costs are for a non-

firm supply of untreated water in Tracy and thus pumping, treatment and reliability would need to be considered.

Annualized Cost of Twin Tunnels Water (2014$) by Incremental Yield of Tunnels[13]

Annual Yield		**Risk Premium**	
(acre feet)	0%	1%	2%
100,000	$9,590	$12,817	$16,926
200,000	$4,795	$6,408	$8,463
300,000	$3,197	$4,272	$5,642
400,000	$2,397	$3,204	$4,231
500,000	$1,918	$2,563	$3,385
600,000	$1,598	$2,136	$2,821
700,000	$1,370	$1,831	$2,418
800,000	$1,199	$1,602	$2,116
900,000	$1,066	$1,424	$1,881
1,000,000	$959	$1,282	$1,693
1,100,000	$872	$1,165	$1,539
1,200,000	$799	$1,068	$1,410
1,300,000	$738	$986	$1,302
1,400,000	$685	$915	$1,209
1,500,000	$639	$854	$1,128
1,600,000	$599	$801	$1,058
1,700,000	$564	$754	$996
1,800,000	$533	$712	$940

[13] August 2016 Memorandum from Rodney Smith regarding the Impact of the Annual Yield of the Twin Tunnels Project on the Cost of Project Water

1,900,000	$505	$675	$891
2,000,000	$479	$641	$846

Given proportional cost allocation, financial feasibility is going to be determined by comparing the cost of the project to the participants with the lowest ability and willingness to pay. Thus, the feasibility should be determined by comparing the values to the willingness and ability to pay of agricultural users. Dr. Smith's table shows cost per acre foot exceed $600 per acre foot at 2.0 maf of average annual yield, above a reasonable estimate of average willingness to pay of agricultural contractors across all water years. From this viewpoint, it appears that my previous estimate that WaterFix feasibility requires 2 million acre feet of annual yield is too optimistic.

Feasibility of the project increases if a finance plan were developed such that all of the incremental water went to urban contractors such as the Metropolitan Water District. At about 700,000 acre feet of annual yield, the tunnels have similar average cost as the desalination plant recently opened in Carlsbad. However, a desalination plant in Southern California is a superior water supply source to the tunnels because it is reliable in droughts and provides purified water close to the point of consumption rather than untreated water in Tracy. WaterFix yield needs to be in excess of 1 million acre feet per year before it is competitive with most relevant urban alternatives such as water recycling plants. This yield is far outside the range considered in the Petition.

Some urban water agencies, such as Santa Clara Valley Water District (SCVWD), have done similar calculations to Dr. Smith using an assumed incremental water yield of about 1.4 million acre feet annually, and assume that agricultural agencies are able to pay a majority of the WaterFix construction costs.[14] Under these assumptions, SCVWD found the cost per acre foot was comparable to increased water recycling. However, it is critically important to note

[14] See item 5 of recent SCVWD agenda package for staff analysis of the WaterFix business case. https://scvwd.legistar.com/View.ashx?M=A&ID=494732&GUID=6D0F99B6-3364-4700-B02C-4208C5D933D7

that this analysis assume water yield that far exceeds the scenarios evaluated in this petition, and is not supported by any evidence of the more important project feasibility question of whether the project is feasible to agricultural agencies. Thus, the analysis by Santa Clara Valley Water District staff falls far short of what is required for a finding of project economic feasibility. Moreover, the SCVWD shows that export water agencies are expecting project operations that are much different than those presented in this petition as it does not even consider a scenario in which WaterFix yields are within the range of scenarios in this petition.

Both approaches to examining economic feasibility, benefit-cost analysis or comparing cost per acre foot to alternative water supply costs find that the WaterFix is not feasible for any of the operational scenarios considered in the petition. As WaterFix is proposed with full participation by agricultural contractors, economic feasibility would require project water yields in excess of an average of 2 million acre feet per year. If a cost allocation plan was developed in which urban users received all the incremental water and paid all the costs, the tunnels could be feasible at project yields over 1 million acre feet of yield. This far exceeds the water yield of scenario B1, the boundary scenario in the petition with the highest water supply. Thus, even an urban only finance plan would not make the project feasible for the most optimistic operational scenario under consideration.

In conclusion, the WaterFix petition fails to include any evidence to support economic or financial feasibility even though such information is critically linked to engineering and environmental feasibility and a normal part of project evaluation. While petitioners provided no evidence on these subjects, there is ample evidence from other benefit-cost analysis of the project, as well as calculations of cost per acre foot, to show very clearly that the WaterFix project is not feasible as described in the Petition.