BEACON ECONOMICS

Analysis. Answers

The BDCP

Should we dig the tunnels?

Understanding the numbers behind the debate

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Review: How we got here

- **2008 / 2009 Biological Opinions**
  - Water pumping / southern diversion jeopardizing Delta smelt, salmon populations
  - Annual export capability averaged ~6 maf per year from south end of Delta
  - New regulations led to drop in exports to an average of 4.7 maf per year

- **The problems are not fixed**
  - In 2013, CDFW abundance counts of endangered Delta fish showed some of the lowest totals in 46 years for Delta smelt, Longfin smelt, and Threadfin shad
  - 12 new species have been added to the list, including two in 2010 (longfin smelt & California tiger salamander)
  - Without broader program and different approaches exports to be cut further, and may still not fix the issues

BDCP: Bay Delta Conservation Plan

1. Ecosystem Restoration & Preservation
- Reduce pollutants, invasive species, poaching
- Improve hatchery practices
- Up to 150,000 acres of habitat restoration
- Expanded recreation areas

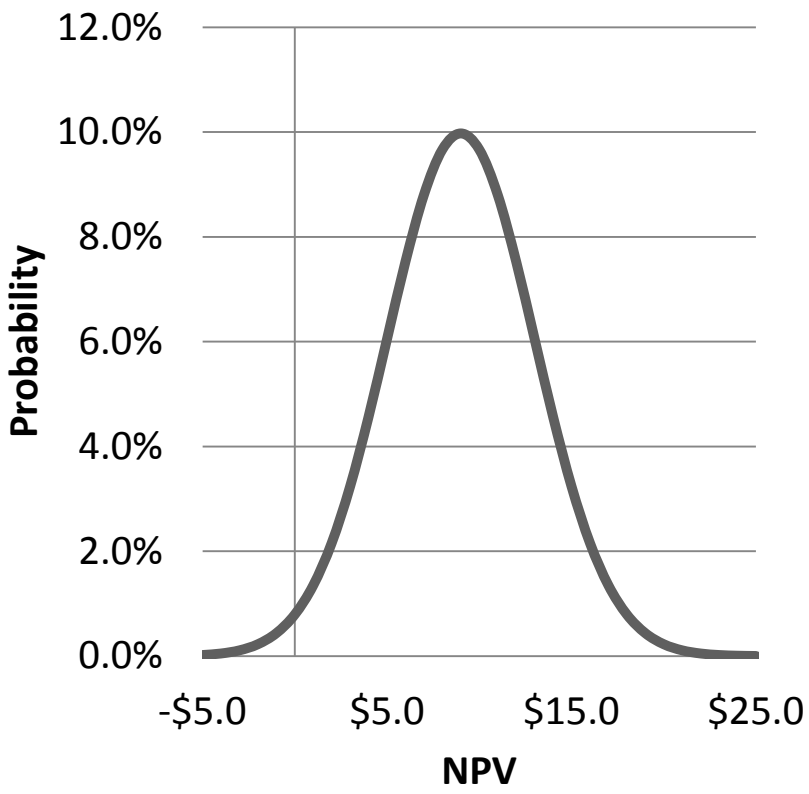
2. A New Water Conveyance System
- New intakes in the north
- Two gravity flow tunnels (~30 miles; 9,000 cubic-feet per second) delivering to South
- Would complement southern extraction route
- Allow for better management of delta species
- Restore some supplies for SWP, CVP
- Protection from earthquake risk by providing alternative route

Economic Cost-Benefit Analyses

- Economic NPV
  - Step 1: Estimate Future Costs
    - Direct (construction, maintenance)
    - Indirect (decline in agricultural output, environmental impacts, construction disruptions)
  - Step 2: Estimate Value of Future Benefits
    - Restoration of water supplies, Increased quality, Value of environmental improvements
    - Option value to deal with uncertainty, reduction in supply risks (earthquakes)
    - Increased usage value of other assets reservoirs
  - Step 3: Collapse time flows to present value
- Avoid common pitfalls
  - It s not about right and wrong, its about the allocation of scarce resources
  - The aggregate NPV is what is important but there will be winners and losers in the process, and those issues need to be dealt with so as to not ruin a good project
  - Environmental mitigation *only* as relates to the construction of the tunnels
  - Do not include issues that are outside the tunnel such as rising sea levels which are an issue for *all* users of the Delta to deal with collectively
  - Focus on the reasonable options: don t let the perfect interfere with the good

It isn't that easy

- Hard to accurately quantify some parts of the analysis
  - Many values hard to estimate: value of species preservation? Value of "water" for usage?
  - Appropriate metrics? discount rate?
  - Deal with future uncertainties: lots of things can happen
  - Quantifying political choices: how will we ration water in the event of an earthquake?
  - Potential for new future technologies
- Ultimately we are looking to be in a safe range
  - Try to find the best "average" outcome
  - Scenario analyses to test the range



The Analyses to Date

- Dr. Sunding's Analyses: NPV > 0
  - Multiple Reports, all with same conclusion: positive NPV on the project
    - First report: in the 10's of billions, based largely on environmental values
    - Second report focused on rate payer analysis, drops environmental values
    - Water value based on price elasticity: assumes rising price to cut consumption
    - Assumes further reductions in deliveries in no tunnel scenario
    - Public release (version 3) has slightly higher cost of construction
  - Do not confuse the results with the EIR data

- Michael Report Finds the NPV < 0
  - Relies heavily on BDCP numbers for cost, water value
  - Higher cost of salinity impact on Delta Ag
  - Dismisses environmental use and non-use benefits
  - Does not foresee future reduction in supplies

- Rodney Smith has vague concerns
  - Has no complete NPV analysis
  - Assumes cost overruns, thinks the discount rate is too low
  - Higher risk of tunnel water deliveries compared to other technologies

Summary Results of Studies to Date

	Sunding Analyses			Michael
Costs	Prelim	Low	High	Report
Tunnel Construction		$12,207	$12,207	$12,207
Operations and Maintenance		$673	$673	$673
Increased Salinity of Delta Agl Water		$34	$34	$1,173
Other Costs*		$595	$782	$0
Total Costs	~$18,500	**$13,509**	**$13,696**	**$14,053**
Benefits				
Value of Restoring Water Supply over Current Levels	$3,036	$4,079	$4,079	$3,916
Value of Avoiding Future Reductions	$11,643	$11,643	$11,643	$0
Value Improved Water for Delivery	[illegible]	$1,819	$1,819	$1,819
Reduced Seismic or Flooding Risk	$2,093	$470	$470	$866
Recreational Value	$1,442	$224	$374	$0
Greenhouse Gas Emissions Reductions	$0	$35	$715	$0
Non-Use Value of Habitat Restoration	$34,210	$0	$0	$0
Total Benefits	**$54,226**	**$18,270**	**$19,100**	**$6,601**
Net Benefit	$35,726	$4,761	$5,404	-$7,452

* Includes Restrictions on Outdoor Recreation (due to land conservation) Transportation Disruptions and Delays (due to construction) Reduced Regional Air Quality (due to tunnel system construction and operations) Greenhouse Gas Emissions Mitigation Costs Other Mitigation Costs

The "Value" of Tunnel Water

- Two swing issues
  - What is the *quantity* of the restored water supply
  - What is the *value* of the restored water supply
  - These are not independent: less water restored, the higher the value
- Value Debate: What is an acre foot of Delta Water worth?
  - Opportunity cost model: replacing the lost Delta water with other more expensive sources
    - Other expanded sources already built into Sunding analysis
    - Question: what is the potential to expand other sources
  - Sunding: demand price elasticity analysis, assumes reduced consumption in response to lost supplies
    - Reduced consumption imposes a real economic cost on rate payers, whether agriculture, industrial or residential
    - Value of losses estimated from willingness to pay analysis
    - Critical issue: future demand increases

A changing portfolio of MWD supplies

MWD Water Supplies over Time

1990

Source	Proportion of Total Supply
Colorado River	27%
State Water Project	33%
Local Supply	34%
Conservation and Recycling	**7%**

2015

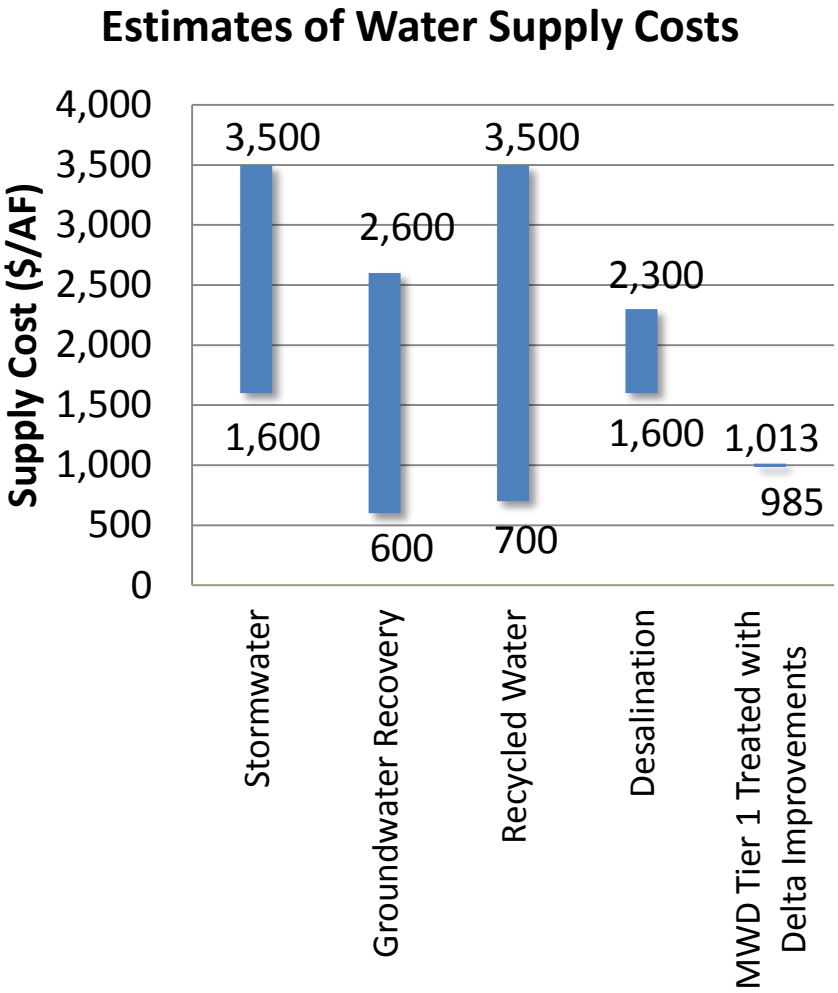
Source	Proportion of Total Supply
Colorado River	20%
State Water Project	22%
Local Supply	32%
Conservation and Recycling	**26%**

2035

Source	Proportion of Total Supply
Colorado River	14%
State Water Project	22%
Local Supply	31%
Conservation and Recycling	**33%**

2015, 2035 based on expected average yearly supply deliveries from IRP. 1990 data is actual

Replacement Cost Analysis



- The bottom line
  - Average cost of restored Delta deliveries: $275 to $425 per AF
  - Includes construction, maintenance and variable cost of conveyance to south
  - Based on 45 to 90 million acre feet in additional deliveries over 50 years
- Questions exist as to the ultimate ability to grow alternative sources to completely offset delta losses
  - Other alternatives have environmental impacts
  - Public pushback
- Other issues?
  - Always a potential for new technologies, but how realistic is this?
- As per Sunding, most losses would have to be absorbed through reduced consumption

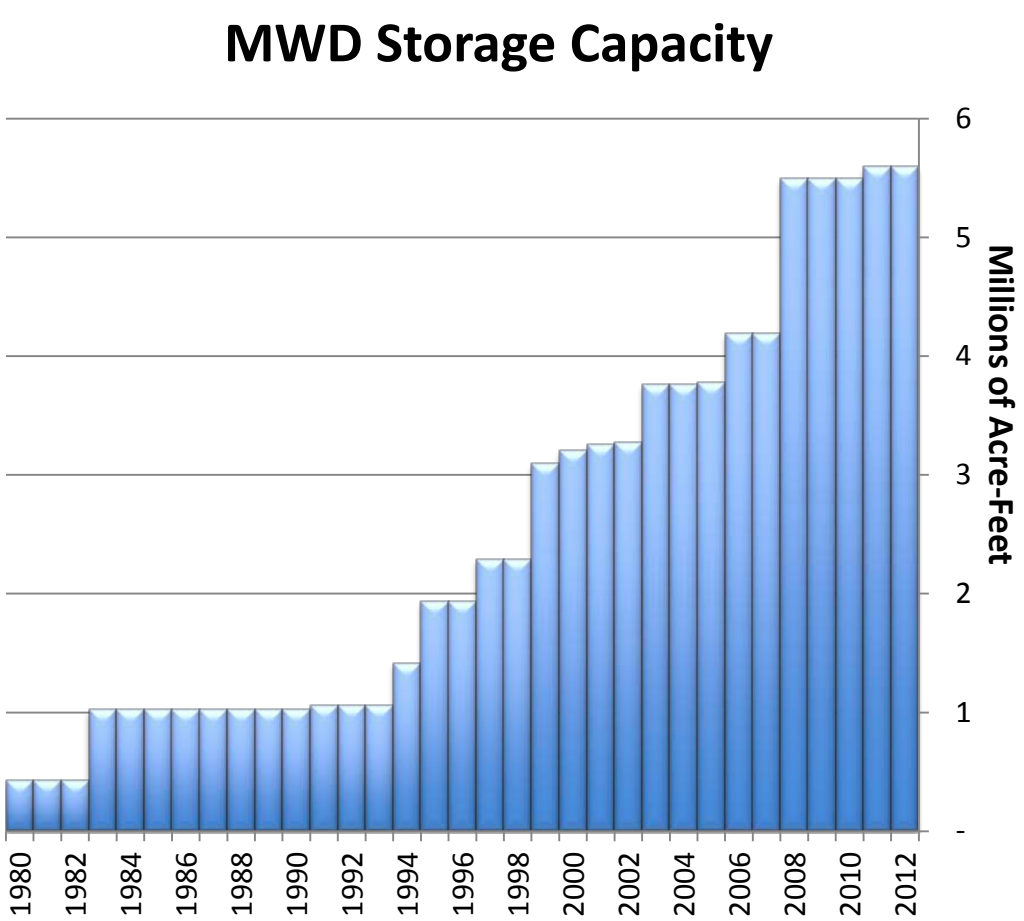
The Quantity of Tunnel Water

- Quantity of Water
  - Sunding: Further restrictions will be enacted, deliveries drop from 4.7 to 3.2 maf per year average without tunnels
  - Michael: No evidence of further restrictions: stays at 4.7
- Who is correct?
  - Evidence of ongoing degeneration of conditions implies tighter regulation and more restrictions on southern exports
  - Even without new absolute limits, increased variability of supply imply overall less exports
    - Potential environmental issues: where are the fish?
    - Potential throughput: 2 access points are better than 1?
  - The big question: are the environmental issues being caused by the location of the pumps or the quantity of water being pumped, or some combination of the two
    - The tunnels mitigate if the location of the pumps is the issue – you can get more water and protect the fish better
    - The tunnels might be unnecessary if it's a total flow issue – but this is an issue that all Delta users have in common, and that isn't how they are acting
    - It does assume that the northern access will have fewer environmental impacts than the south

DFW's Carl Wilcox

"From the Department's perspective, the Department has maintained the position since the 60s that the current diversions in the south Delta are probably the worst thing you could be doing for managing water within the Delta and exporting it. Historically, it has recommended that conveyance be done in a different way to protect species within the Delta from the effects of having a south Delta diversion, so from that perspective, changing the point of diversion, at least in part, is an important component of providing for conservation. That said, there also needs to make sure that it is done in a way that is protective to species within the system."

The Role of Reservoirs



Rodney Smith critique flows from other sources more consistent, hence better and should be used

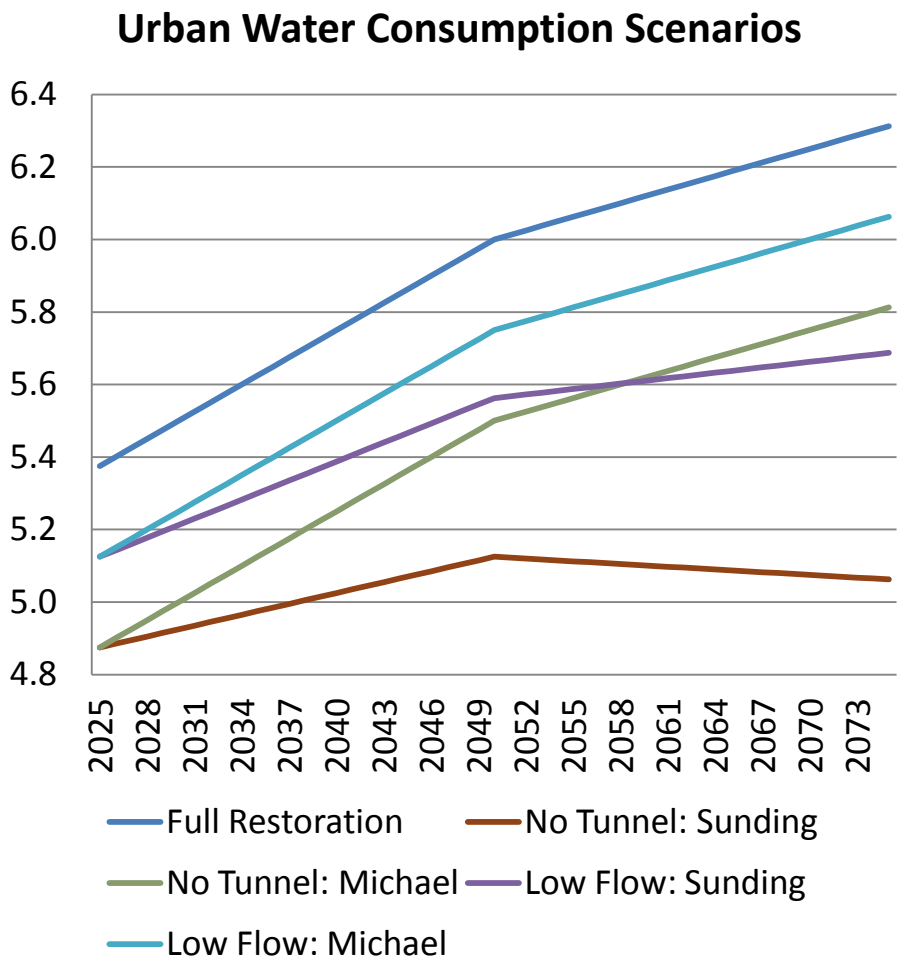
- Storage capacity has increased 13 times since 1980
- Right now, 2.7 million acre-feet of water is being stored
- MWD continues to make investments in storage projects, such as roughly $2 billion for the construction of Diamond Valley Lake

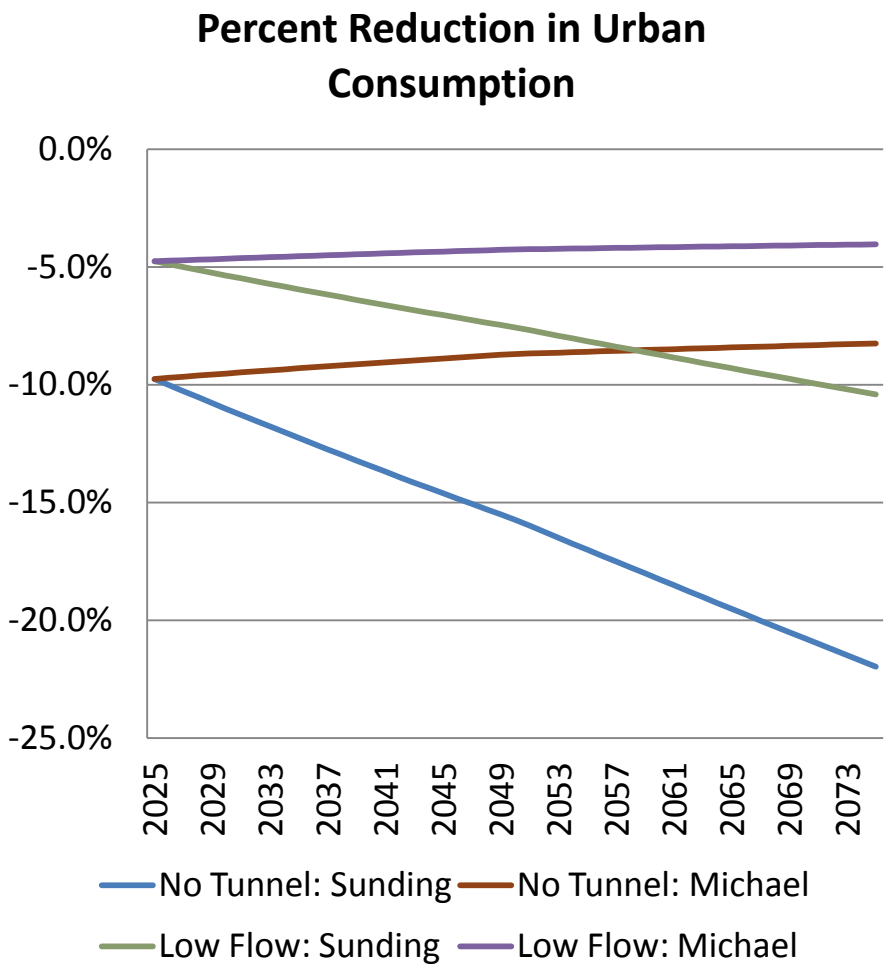
Elasticity Analysis

- The "value" of water can be estimated using price elasticity
  - Price sensitivity gives us an estimate of hypothetical price increase to reduce consumption by lost amount
  - Prices do not need to be actually raised, rules restricting consumption (rationing) leaves same result
  - The greater the reduction, the greater the losses
  - Social loss estimated by subtracting average variable costs
- Demand will grow over time
  - More population, higher income, smaller households
  - Implication is demand will become more price inelastic holding all else equal

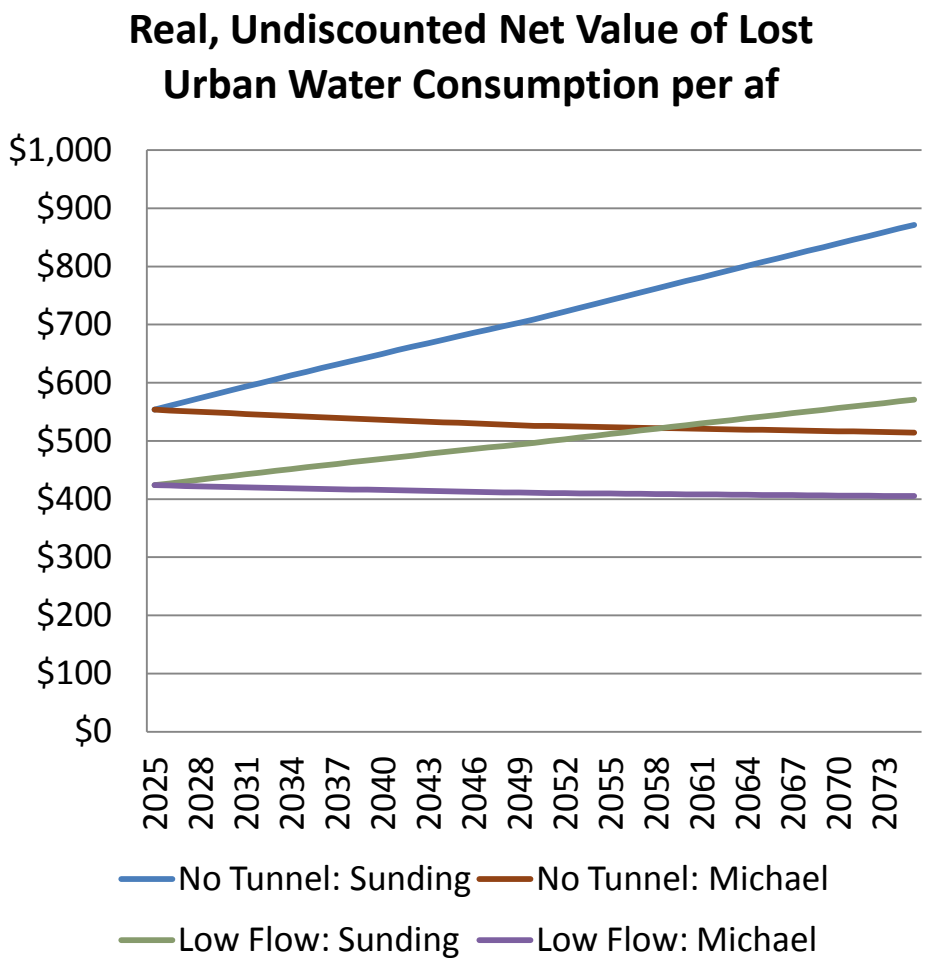
- Simple Example
  - Urban Elasticity = -.3
  - Urban Current Price = $1300
  - Average water reduction with no tunnels: 7% to 15%
  - Average water reduction with tunnels but with low flow 4% to 7%
  - "Price increases" needed to reduce demand: 16% to 60%
  - Average variable cost of Delta tunnel water for urban users $1100
  - Half of water goes to agricultural uses, valued at $150 per acre-foot
- Note: Parameters used here are "low" I am deliberately erring on the side of caution

How it works: Simplified





The Shortage Results



PV of Water Restoration

	Full	Half
Sunding	$21,378	$8,019
Michael	$10,195	$4,211

- Cost of tunnels: ~$12.5
- Overestimating the benefits?
  - Northern access points have environmental issues, sliced more than half
  - Cheap ways to conserve without consumption effects
  - Big shift away from historic rights model
- Underestimating the benefits
  - True variable cost to tap. $1000?
  - Benefits to agriculture could be higher
  - Potential environmental values of 2 access points
  - Even more dramatic reductions in supply
  - Earthquake risk reduction
  - Increase in demand, greater?

Other Benefits

- Other Benefits on water quality, carbon emissions, etc
  - Sunding: $1.3 to $2.1 billion
  - Michael: $.4 to $1.2 billion
- Truth on environmental issues is in between
  - Michael's critique correct: much of the value of environmental restoration in initial Sunding analysis comes from non-tunnel efforts, and should not be included in the cost-benefit analysis
  - Don't dismiss *all* the environmental value, as per updated studies. Having alternative North-South routes of transfer allow for fish stocks to be better managed
  - Actual value: unknown, but remember that 5% of non-use value is still $1.5 billion
- Earthquake Scenario
  - 2% probability per year, half of water deliveries lost for 3 years due to seismic event with no tunnel
  - Value $1.6 billion to $2.2 billion
  - Levee repair is not enough to offset this
- Sum total other effects
  - Sunding: $4.4 to $6.0 billion
  - Michael: $3.5 to $5.1 billion

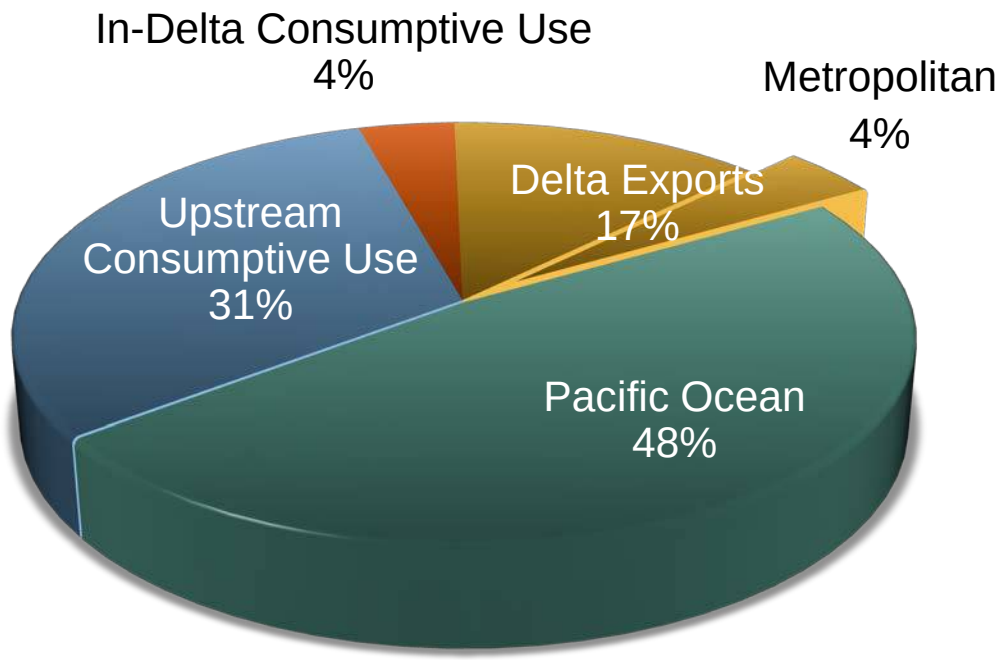
Low 2nd Effects	Full	Half
Sunding	$25,778	$12,419
Michael	$13,695	$7,711

High	Full	Half
Sunding	$27,378	$14,019
Michael	$15,295	$9,311

Economic Cost-Benefit Analyses

- The tunnel will restore some supplies and increase reliability
  - Restoration occurs even as the ecology of the Delta improves
  - It's a big project – but not that big, and paying for it is built in
  - It's not THE solution to water in California, but a part of it.
- Stop hitting the panic button!
  - 33 million acre-feet of annual runoff through the Delta
    - 16 million acre-feet of that water flows into the ocean
    - 10 million acre-feet of that water is used upstream of the Delta
  - Even before the federal biological opinions, less than 6 million acre-feet of water was exported per year on average
    - On average less than 20% of runoff through the Delta was used for exporting
    - Little will change even if Delta exports are restored to as much as 5.9 maf / year

Average Distribution Delta Watershed Supply



Source: Delta Vision Report, Average 90-05
Based on annual average 32.9 maf

Summing Up

- We think it is clear that the Tunnel's NPV is > 0
  - Alternative supplies are simply far more expensive
  - Adding in the option value of two access points adds to the bottom line
  - Concerns about issues with the entire Delta system need to be met by all delta users, not just the southern access exporters
  - Seems unreasonable to assume no future supply cuts
- Must compare results across range of solutions
  - The 9000 cfs tunnel system gives best bang for buck according to current modeling, except for canal
  - Are there alternative "Delta" plans that have similar net benefits?
  - What is the NPV of these other options? Are these options politically viable?
- There is more to figure out
  - Are the assumptions correct? More tweaking of parameters?
    - Cost of moving the water south to users $1000?
    - Has population growth been fully integrated?
  - Big questions outside my analysis
    - Are the northern access points more eco-friendly than the south?
  - Many scenarios are outside the realm of estimation

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