An Evaluation of Measure I on Davis

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Abstract:

At present, Davis relies exclusively on groundwater to sustain city water demand. With the passage of Measure I in 2013, Davis has been given the authority to divert water from the Sacramento River as an alternative water source. In this analysis, we investigated the impacts such a project would have on the City of Davis in terms of water supply, water quality and overall project costs. The goal of our investigation was to determine whether or not the project would be a viable option. After calculating data from various sources, we determined that the water supply in the current system was not sufficient for future growth in Davis, and that the supply brought in through Measure I would be able to suit Davis' needs in the future. Costs too, favored the new plan. While currently it is cheaper to pump groundwater compared to bringing surface water, rising costs due to declining water quality standards in the groundwater will make the current system far more expensive than Measure I in the near future. In assessing water quality, we compared concentrations of 4 major contaminants, including boron, nitrate, sodium and calcium carbonate. Overall, Davis groundwater was found to have far greater concentrations of contaminants than the Sacramento River.

Introduction:

Currently, Davis is exclusively dependant on groundwater sources for water needs. An aging water infrastructure and degradation of water supplies require additional wells to be drilled or a new surface water system to be implemented (WDWCA 2013). Measure I was passed in March 2013 and involves a proposal by the Woodland-Davis Clean Water Agency and the City of Davis Water Committee to divert water from the Sacramento River to the city of Davis. Surface water from the Sacramento River will be used primarily, with groundwater supplying summer peaks and backup use. A schematic of the new infrastructure being created is shown below (figure 1). It should improve drinking water quality and quantity for the increasing Davis demand. The measure will impact the quality and cost of the water being used in Davis, and as inhabitants of this city we felt a need to analyze its implications.

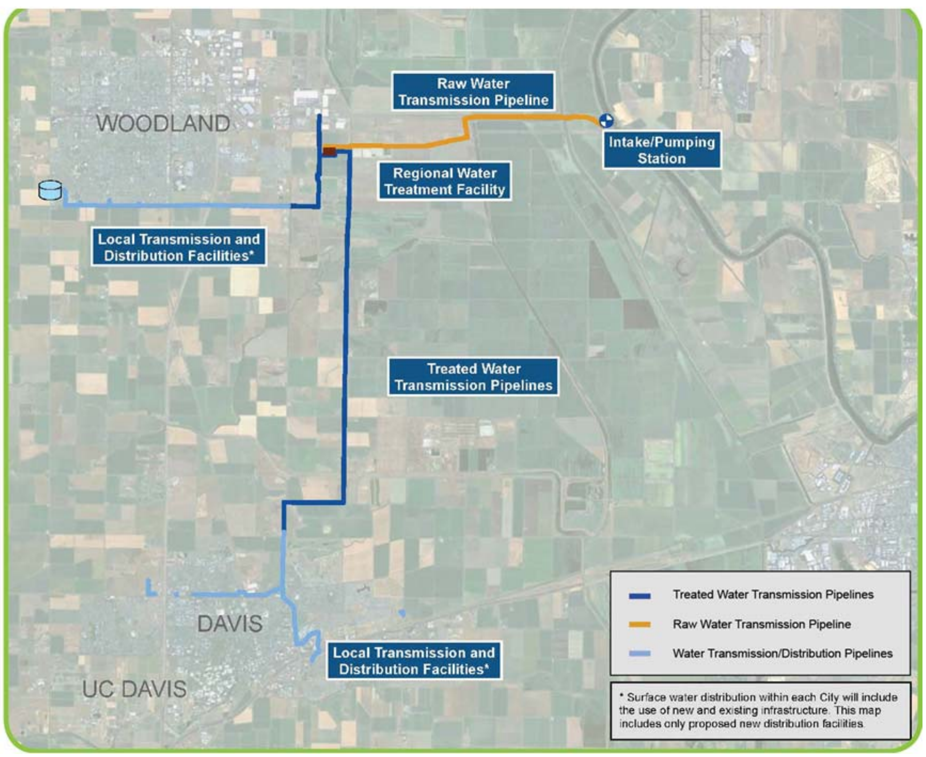

Figure 1. Davis-Woodland Water Supply Project schematic.

<u>Objective</u>:

The goal of our project was to analyze the different aspects of the Davis-Woodland Water Supply Project and how they would impact Davis residents. The cost, benefits, quality, and effectiveness of the plan were examined to see if passing Measure I was in the best interest of Davis citizens. This project required retrieving all available data and calculations used by the law makers and project managers. We crosschecked several sources to look for bias between parties and did some calculations of our own to obtain values like future water use and present value of benefits and costs.

Data Sources

Most of the data we used focused on water supply, water costs, and water quality. The majority of our data came from :

1. Woodland Davis Clean Water Agency
2. City of Davis
3. Environmental Protection Agency
4. UC Davis Society of Conservation Biology

Data/Results

When analyzing Measure I, we felt that the three most important factors to look at were water quality, water supply, and cost of the project. If Measure I could not provide a sustainable source of clean water at a cheap price compared to the current method, then it would not serve as a viable source for Davis.

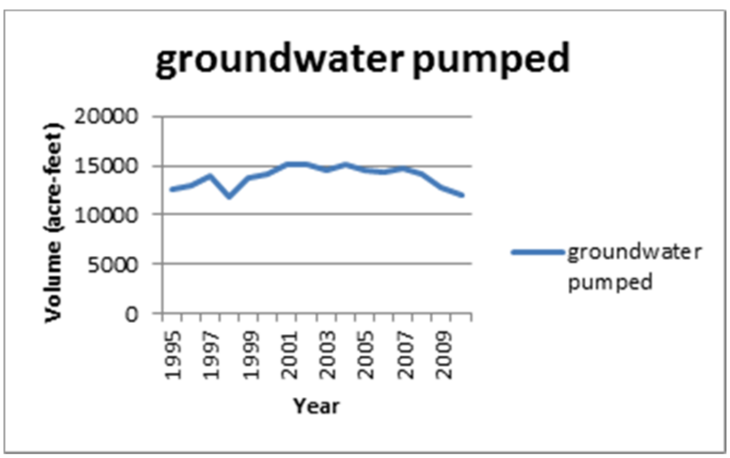

Figure 2

Water supply is the first factor we looked at for our analysis. Currently, the population of Davis is about 65740, with the population expected to rise to around 85000 by 2035.

Right now the water demand per capita for Davis is about 160 gallons per day or about 58,400 gallons per year. For the entire city the water demand is 3,839,216,000 gallons per year, or 11782.12 acre feet per year.

Assuming that Davis does not change its water demand per capita by 2035 the total water demand will be 15233.95 acre feet per year. Davis' current system currently meets the water demand required (Fig 2), but the decrease in water quality due to nitrate and salt build up in the aquifers, will cause future groundwater to be pumped in decreasing amounts to maintain water quality.

Under Measure I Davis will receive about 12 million gallons of water from the Sacramento River with a possible increase to 13.6 million gallons of water. This equals to about 4,380,000,000 gallons per year with an increase to 4,964,000,000 gallons per year. In acre feet this is 13441 acre feet per year with an increase to 15234 acre feet per year. In addition Davis will receive about 4713 acre feet of water from the deep level aquifers that will remain in use. This comes up to 18153 acre feet of water with an increase to 19947 acre feet of water. As seen from the calculations as well as the graph provided by the Woodland-Davis Clean Water Agency technical memorandum (Fig 3) one can see that Measure I is suitable for long term water

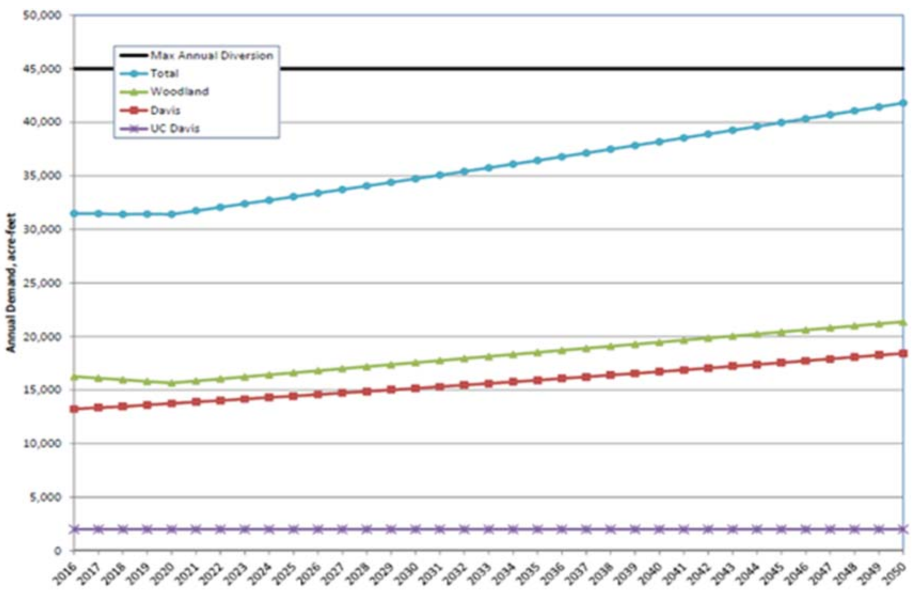

Figure 3

supply. As seen in the table, even when considering Woodland's share of the water supply, the total demand does not exceed the total supply.

Cost is another factor to consider when comparing Measure I to the current. According to the Woodland Davis Clean Water Agency (WDCWA 2010), a study done by the City of Davis and UC Davis shows that it will cost $94,300,000 in 2009 dollars to repair and replace existing and new groundwater facilities. In 2013 dollars, with an inflation rate of 8.9%, this comes out to $102,655,429.13. However according to the study the cost to repair and replace existing groundwater wells could rise up to 600 million due to rising water quality standards and decreasing water quality in the wells. This cost is a one-time cost. Although data on the operation and maintenance for the Davis groundwater wells is not available, according to EPA, in 2001 the range of costs for pumping groundwater for these wells is between $173,000 per year to $197,000 per year. This comes out to $228,268.12 to $259,935.38 in 2013 dollars with inflation at 31.9%.

The total cost of Measure I is 325 million as of June 2009, but the cost is expected to go down. Davis's share is about 151 million dollars. In 2013 dollars the total cost is $353,796,547.91 and Davis's share is $164,379,319.19. A breakdown of the cost can be seen in Fig. 4.

Construction Costs[(a)]

Project Component	Cost
Joint Intake (Agency Portion)[(b)]	14.52
Raw Water Pipeline	23.76
Regional Water Treatment Facility (RWTF)	96.7
Woodland Treated Water Pipeline	5.70
Davis Treated Water Pipelines	23.35
Permit Fees & Construction Counsel	2.89
TOTAL	166.91

(a) Includes DBO contract design and construction costs, design-bid-build Joint Intake construction costs, and Agency design review, construction quality assurance and contract compliance, engineering services during construction,

Capital Costs, 2009-2016

Cost Category	Total
Agency Administration	3.56
Program Management	3.47
Water Supply	1.71
Environmental & Permitting	1.59
Land/ROW Acquisition	4.30
Pre-Design	6.18
Construction	166.91
Capital Contingency	7.79
Woodland and Davis Local Facilities	31.74
Costs Expended 2009-2011	7.49
TOTAL CAPITAL COSTS	234.75

Figure 4

The annual operation and maintenance cost is expected to be around 4 million a year. Not much data is available as this project is still currently being planned.

In determining whether or not the Davis Woodland Water Supply Project would be a viable option, we also compared water quality from both Davis groundwater and the Sacramento River. While Davis groundwater normally complies with water quality standards, certain wells have been known to contain contaminants which have exceeded maximum contaminant levels (MCL). The supply wells most susceptible to high concentrations of contaminants are those which are used to pump water from the intermediate depth aquifer. In general, wells which pump water from the deep aquifer maintain a relatively higher water quality than those which pump from the intermediate aquifer (Fig. 6). With stricter water quality standards expected, it is predicted current groundwater supplies will no longer be able to meet water quality standards in the future.

Among some of the contaminants of concern are boron, nitrate, sodium and calcium carbonate. Boron is of significant concern to Davis, which recently discovered three wells with concentrations exceeding the notification level of 1000 parts per billion (ppb). With an average boron concentration of 837 ppb, the three wells exhibited concentrations of 1200 ppb, 1100 ppb and 1000 ppb. While not a regulated contaminant, it can pose potential risks to plants, animals and pregnant women. Origins of boron in the Davis groundwater supply come from borate or borosilicate rocks and soils which have been leached (City of Davis 2011).

Nitrates, which enter waterways through agricultural runoff and wastewater treatment plants, are contaminants of concern for both Davis and Sacramento water supplies. With increased nitrate levels, algal blooms can occur, reducing water clarity, promoting bacterial growth and decreasing available oxygen for various species. According to Davis and Sacramento River Water Quality Reports, Davis groundwater has an average nitrate concentration of 10.4 ppm while the Sacramento River has one of 0.35 ppm (City of Davis 2011;

Howe 2012). Clearly there is a significant difference in water quality. It is expected current nitrate levels in Davis groundwater will only get worse in the future (Fig 5).

Another potential concern regarding water quality is the amount of sodium in the water. Davis is reported to have an average concentration of 84 ppm while the Sacramento River is reported to have a concentration of 9.35 ppm (City of Davis 2011; Howe 2012). Although sodium is a natural part of groundwater systems, high salt levels can have substantial costs, affecting native plants and biodiversity, reducing the efficiency in crop production and causing corrosion of water pipelines and infrastructure. Normally, salts in water supplies are caused by natural processes such as weathering or erosion, but high salt levels can also be caused by wastewater discharge. In Davis for instance, water is rather hard, meaning many people use softeners in order to soften their water. The effects of softeners are that they produce additional salt which will enter back into the water supply (City of Davis 2007).

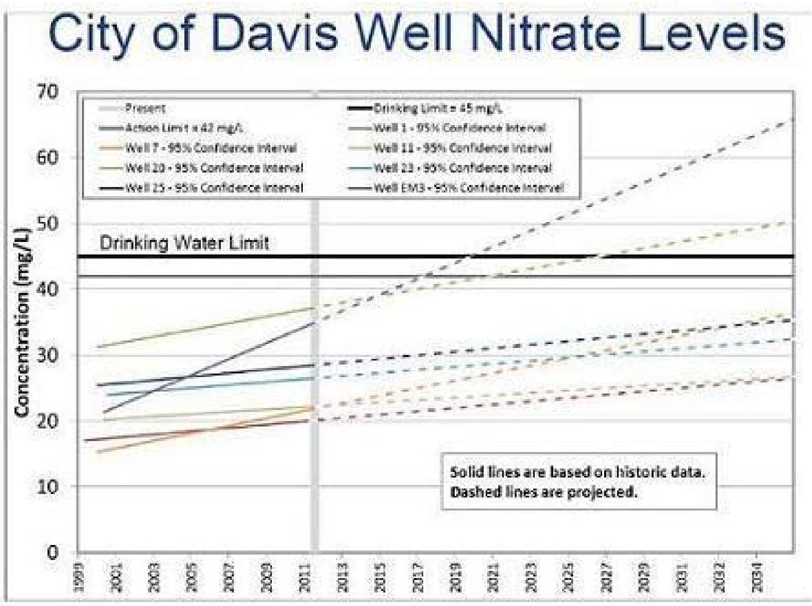

Figure 5

Compared to the Sacramento River's concentration of calcium carbonate, 64 ppm, Davis' groundwater has an average concentration of 299 ppm (City of Davis 2011; Howe 2012). Calcium carbonate is what leads to water hardness. Besides producing additional salt as a result of water users use of softeners, calcium carbonate can also lead to plumbing and water appliance corrosion, thus reducing their lifespan (Hartman and Steele 2013). A summary of water quality from the City of Davis 2010 Urban Water Management Plan is shown below (Fig 6).

Figure 6

Table 4-3. Water Quality Comparison		
	Hardness (CaC03)	Total Dissolved Solids
Water quality objective	110 mg/L	300 mg/L
Surface water quality (Sacramento River)	85 mg/L	100 mg/L
Groundwater Quality		
Intermediate depth wells	300 – 590 mg/L	480 - 1,000 mg/L
Deep aquifer wells	71 - 180 mg/L	270 – 340 mg/L

Conclusion

In comparison to using the Davis groundwater, the extraction of water from the Sacramento River appears to be more beneficial. Measure I not only provides a lower cost, but it also provides cleaner water at a larger quantity for the city of Davis. Furthermore, the water found in the Sacramento River appears to be more sustainable than the water found in Davis, as further extraction of Davis groundwater will have greater concentrations of contaminants, such as Boron and Nitrate. As this paper encourages the continuation of Measure I, hopefully through the completion of Measure I it will set an example to a regional level for proper water control and extrapolation. By studying the future cost of potential solutions and comparing these future costs to alternatives, water policy will become easier to manage elsewhere.

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