

NATIONAL WATER RESEARCH INSTITUTE

Final Report

Independent Advisory Panel

Review of the

Davis-Woodland Water Supply Project

July 18, 2008
Fountain Valley, California

1. PURPOSE OF THE PANEL

In October 2007, the City of Davis City Council: (1) adopted the Environmental Impact Report for the Davis-Woodland Water Supply Project (DWWSP); and (2) ordered an independent review of the recommended project. Subsequently, the City requested the National Water Research Institute (NWRI) of Fountain Valley, California, to appoint an Independent Advisory Panel (Panel) to provide independent peer review of the project. A short biographical sketch of the individual members on the NWRI Panel is presented in Appendix A. Key elements that the Panel was to specifically address include:

1. Overall assessment of the project, such as:
 - a. Evaluation of alternative options.
 - b. Groundwater uses, limitations, and potential conflicts.
 - c. Timing of improvements.
 - d. Area-of-origin and summer water purchases.
2. Effectiveness of public outreach efforts.
3. Future needs and long-term challenges.

The Panel participated in a conference call on March 20, 2008, with staff from the Cities of Davis and Woodland (referred to as “Project Partners”) and their consultants to review the project. The Panel also attended a meeting in Davis, California, on June 3-4, 2008, with those same participants to further discuss the project, review appropriate reports, and participate in a field trip to become more familiar with the proposed project. On June 4, the Panel deliberated in closed session, reviewed various reports (see Appendix B), and was further briefed by staff from the City of Davis. Subsequently, after exchanging various e-mails, the Panel reached the findings and conclusions presented in this report.

2. OVERALL ASSESSMENT OF THE DWWSP

The first question the Panel debated was whether the objectives of the DWWSP were met by the alternative selected. Those objectives included:

1. Provide a reliable water supply to meet existing and future needs.
2. Improve water quality for drinking water purposes.
3. Improve the quality of treated wastewater effluent discharged by the Project Partners through 2040.

The Panel unanimously concluded that the selected DWWSP project, which will develop a surface water supply for use by the City of Davis, the City of Woodland, and the University of California at Davis, in conjunction with the continued use of their groundwater supplies, will fully meet all three of the above objectives. Furthermore, the Panel was impressed by the regional approach exemplified by Yolo County’s Integrated Regional Water Management Plans (IRWMP) and by the foresight shown in 1994 by the Yolo County Flood Control and Water Conservation District in submitting an application to the State Water Resources Control Board (SWRCB) for water rights to withdraw water from the Sacramento River to meet the long-term water supply needs of the County. Without this foresight, the Project Partners would have had a

much more difficult time in developing the DWWSP, which fully meets all three of the above objectives.

In reaching this overall assessment, the areas discussed by the Panel – and the findings reached – are briefly summarized below.

3. WHY NOW? WHY NOT WAIT TO IMPLEMENT THE PROJECT?

The second major question the Panel debated was whether the project could be postponed and implemented at a later date. The Panel concluded that there are several potential consequences of postponing the project, which are summarized below.

3.1 Loss of Water Rights. The Panel concluded that the most serious consequence of postponing the project is the probability of losing the pending appropriative right to withdraw up to 46,100 acre-feet of water per year from the Sacramento River. The application to secure these rights was submitted to the SWRCB by Yolo County Flood Control and Water Conservation District in 1994 in response to a county-wide water supply study. That application has been reassigned to the Project Partners. The SWRCB, however, requires due diligence on the part of the applicant to pursue and implement water rights. Therefore, if the Project Partners are not able to show timely progress, the SWRCB is likely to cancel the application. The net result of this action would be that the Project Partners would have to start the process anew, thereby losing their “place in line.” The money expended thus far in pursuing this application has exceeded \$3 million. If the effort to secure these water rights is postponed to a later date, much of the work would have to be redone. Furthermore, whereas only 11 protests were filed when the original application was filed in 1994, nine of which have been resolved, it is probable that a new application would trigger far more protests and concomitantly reduce the chances of obtaining the rights to appropriate the surface water needed for the project. The Panel found the Technical Memorandum dated October 17, 2007, from Jim Yost et al. to Gary Wegener on this subject persuasive.

3.2 Loss of Summer Water. The Panel concluded that postponement of the project to a later date would likely result in the loss of upstream water currently available for purchase to supplement the amount of water needed during the summer months. As discussed above, the pending water rights application will allow diversion of 46,100 acre-feet of water per year from the Sacramento River. However, this diversion will be subject to limitations specified in permits issued by the SWRCB (e.g., no withdrawals during the summer months or other dry periods). The Project Partners project a total water demand of 55,600 acre-feet per year by 2040. Because this demand exceeds the 46,100 acre-feet per year of surface water that can be diverted from the Sacramento River under the pending application, the Project Partners are negotiating with upstream water rights holders to purchase the water needed to meet the demand. Initially, this supplemental water will be needed primarily during the summer months when withdrawal under the pending application will be prohibited. Failure to proceed to contract for this “summer water” in a timely fashion will probably result in the inability to do so at a later date. A number of agencies throughout the state are continuously looking to purchase water from upstream water rights holders to

supplement shortages in their supplies. The Panel concluded that these shortages will continue and be exacerbated with time due to population growth, climate change, drought, etc. Thus, the number of agencies with water shortages will increase, as will competition for available water from water rights holders. Consequently, the ability to purchase needed water at a future date will be far more difficult and expensive. Furthermore, the water may not even be available.

3.3 Escalating Cost. The Panel carefully considered the costs of the project and debated whether advances in technology would lower the costs if the project were to be postponed. The Panel was unanimous in concluding that any reduction in cost due to changes in technology would have minimal impact on the big picture and that delaying the project would result in much higher total costs. As shown in Figure 1, the cost indices for construction are increasing at very fast rates. By extrapolating these data, it is reasonable to conclude that these costs will continue to increase. Furthermore, engineering costs will increase as well, but at a slower rate.

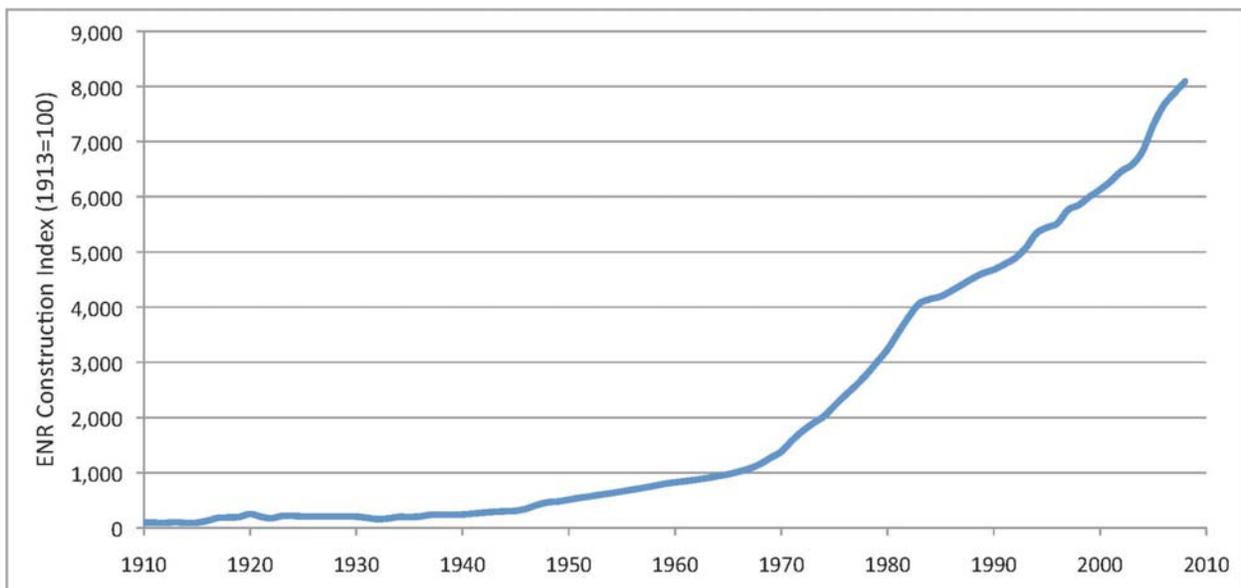


Figure 1. The history of the Engineering News Record Construction Cost Index from 1910 to the present time shows a steady increase.

As pointed out in the Technical Memorandum dated October 17, 2007, from Jim Yost et al. to Gary Wegener, “Most all construction materials increased by at least 100 percent between 2003 and 2006 ... Since 2003, the rate of inflation has increased by a total of 10 percent.” The Panel agrees with these statistics. Therefore, the only way to avoid these rapidly escalating costs is to continue with the project as planned instead of hoping to save money by postponing the project to a later date. Furthermore, Proposition 84 approved by the voters in 2006 included \$1 billion for implementation of integrated regional water management programs included in the IRWMP that were funded by the earlier Proposition 50. The DWWSP is a key element of the Yolo County IRWMP and is in a good position to

compete for Proposition 84 funding (\$73 million of the \$1 billion is allocated to the Sacramento Valley region). Thus, postponement of the project would take the DWWSP out of competition for these funds and could result in the City of Davis having “to go it alone” at a later date.

3.4 Probable Failure to Meet Wastewater Discharge Requirements. The Panel unanimously concluded that postponement of the project could result in the failure to comply with future wastewater discharge requirements. Such a failure would be serious and could result in fines and litigation. The Panel is well aware that one of the key objectives of the project is to improve the quality of treated wastewater effluent discharged by the Project Partners through 2040. The City of Woodland completed a site-specific investigation of appropriate EC and boron levels to protect beneficial uses and submitted its results to the RWQCB-CVR in 2005. The City of Davis will perform a similar investigation as a requirement of their October 2007 permit and, subsequently, will be issued a National Pollutant Discharge Elimination System (NPDES) permit limiting EC and boron. In a letter dated March 13, 2008, to Mr. Greg Meyer, Deputy Public Works Director of the City of Woodland, the California Regional Water Quality Control Board, Central Valley Region (RWQCB-CVR), under the heading *Protection of Salt Sensitive Beneficial Uses*, stated: “Per U.S. Code of Federal Regulation, Title 40 ... and as required in the Water Quality Control Plan for the Sacramento/San Joaquin River Basins (Basin Plan), water quality objectives must provide reasonable protection of beneficial uses, including consideration of past, present, and probable future beneficial uses.”

The Project Partners are thus required to plan ahead and anticipate what future requirements they will likely be required to meet. The March 13 letter from the RWQCB-CVR further states: “In the absence of an approved site-specific study, Regional Water Board staff would consult published accepted studies (such as the 1985 Ayers and Wescot Study) to establish EC and Boron effluent limitations that are protective of the most sensitive beneficial uses.” The RWQCB-CVR letter then states that the Ayers -Wescot Study recommends an agricultural water quality goal for electrical conductivity (EC)¹ of 700 micromhos per centimeter ($\mu\text{mhos/cm}$) and a boron concentration of 700 micrograms per liter ($\mu\text{g/L}$) as long-term averages. The Basin Plan referenced in the above letter contains the following water quality objectives: (1) a maximum EC of 900 $\mu\text{mhos/cm}$ for drinking water supplies; and (2) an EC of 700 $\mu\text{mhos/cm}$ or less for agricultural uses for the most salt-sensitive crops.

Many agricultural crops are very sensitive to boron, which is quite prevalent in area groundwater and, concomitantly, in wastewater effluent. As stated above, the Ayers-Wescot Study recommends an agricultural water quality goal of 700 $\mu\text{g/L}$ for boron. Current boron concentrations in the wastewater treatment plant effluent from the City of Davis ranges between 1,300-1,800 $\mu\text{g/L}$. The boron concentration in City of Woodland wastewater effluent ranges between 2,100 and 3,000 $\mu\text{g/L}$.

Selenium is another trace element that has received much attention in recent years. Deformed waterfowl and chick deaths in Kesterson Reservoir during the 1980s were

¹ Electrical conductivity and total dissolved solids are both used as a measure of the salinity of water.

attributed to selenium in agricultural drainage waters. Based on a review of tentative and existing waste discharge requirements, project staff anticipate that the RWQCB-CVR will set an effluent limit for selenium of 4.4 µg/L for the City of Davis effluent. Very limited data exist for selenium concentrations in the effluents from the wastewater treatment plants. The available data, however, indicate that neither the City of Davis nor the City of Woodland could meet a selenium requirement of 4.4 µg/L.

As stated above, the Project Partners are required to plan ahead and anticipate what future wastewater discharge requirements they will likely be required to meet. After reviewing the Basin Plan and discharge requirements already established for other jurisdictions in the Sacramento/San Joaquin River Basins, they have determined that it is likely that the RWQCB-CVR will set requirements for the City of Woodland as follows: (1) an EC of 700 mhos/cm; (2) a boron concentration of 700 µg/L; and (3) a selenium concentration of 4.4 µg/L as long-term averages. The Panel concluded that the RWQCB-CVR is indeed likely to include these requirements in the NPDES permit for the City of Woodland and for the City of Davis.

In summary, the Panel concluded that the Project Partners will be unable to meet wastewater discharge requirements likely to be established by the RWQCB-CVR without implementing one of the following options: (1) continuing with the proposed project; (2) installing reverse osmosis treatment processes to treat existing groundwater supplies; or (3) installing reverse osmosis treatment processes to treat the wastewater effluents to remove salinity, boron, and selenium. Furthermore, although option #3 would enable the Project Partners to comply with NPDES permits likely to be established, it would not result in meeting either project objective #1 of providing a reliable water supply to meet existing and future needs or project objective #2 of improving water quality for drinking water purposes specified in the DWWSP. The Project Partners determined that if membranes (e.g., reverse osmosis) were used to remove the salts from existing groundwater supplies, a pipeline would have to be constructed to the Carquinez Strait near Benicia just to dispose of the salts. The Panel concluded that the costs for such a pipeline essentially rule out option # 2 (installing reverse osmosis processes to treat existing groundwater supplies) and option #3 (installing reverse osmosis processes to treat the wastewater effluents to remove salinity, boron, and selenium). Therefore, as stated above, the Panel unanimously concluded that postponement of the project could result in the failure to comply with future wastewater discharge requirements.

3.5 Drinking Water Quality Will Continue to Be Marginal and Threatened. If the project is postponed, the citizens will continue to receive drinking water of marginal quality. Moreover, there is the ongoing potential for shallow, poor-quality groundwater to continue migrating into intermediate and deep aquifer intervals tapped by the drinking water purveyors. As discussed above, the groundwater tapped by drinking water wells is somewhat high in EC. Put another way, it is elevated in total dissolved solids (TDS), including constituents that cause hardness (primarily the divalent ions of calcium and magnesium). Hard water results in increased costs to the consumer. For example, homeowners will have increased costs due to the precipitate formed inside water pipes and other plumbing fixtures, water heaters, etc., thereby decreasing their usable lifespan. Furthermore, many consumers have installed self-regenerating water softeners to treat their

existing supply. Brines from the regenerating process add an appreciable amount of salt to the sewer system, thereby exacerbating the problem of salinity in the effluents from the wastewater treatment plants.

In addition to the problems associated with high TDS in the groundwater, some wells produce groundwater relatively high in iron and manganese. These two constituents result in the staining of bathroom fixtures and washed clothing. The California Department of Public Health has set secondary maximum contaminant levels (MCLs) for iron and manganese at 0.3 and 0.05 mg/L, respectively. City of Davis staff informed the Panel that, in order to reduce consumer complaints, they have to periodically flush areas of the distribution system to flush-out the precipitated iron and manganese. This practice is expensive and results in a waste of groundwater due to its poor quality. However, changing to a surface water supply may not eliminate this practice entirely in that some flushing may be required to maintain water of suitable bacteriological quality.

The Panel considered all of the above factors, and unanimously concluded that postponement of the project will not meet the objective of improving water quality and its sustainability for drinking water purposes.

3.6 California Environmental Quality Act (CEQA) Documents. If the project is postponed to a future date, the CEQA documents will likely need to be rewritten. Therefore, much if not all of the costs incurred in preparing these documents will be lost. Proposed water supply projects face far more stringent scrutiny now than they have in the past. Therefore, if the Project Partners have to re-issue these CEQA documents in the future, it may be much more difficult to obtain the necessary approvals and the costs will increase accordingly. Also, as pointed out above, the costs already incurred in preparing these documents may be lost.

4. OTHER ALTERNATIVES THAT THE PANEL EVALUATED

The third major question the Panel debated was whether the objectives of the DWWSP could be met by other alternatives than the one selected by the Project Partners. The Panel could only identify the three alternatives shown below that might possibly meet these objectives.

- Deep groundwater without demineralization.
- Groundwater with centralized treatment.
- Groundwater with well-head treatment.

However, as discussed in Section 3.4 above, the alternative of installing reverse osmosis treatment processes to remove excess minerals from existing groundwater supplies was quickly ruled out due to the cost of brine disposal.

4.1 Deep Groundwater without Demineralization. Early in its deliberations, the Panel concluded that the alternative of using deep groundwater without treatment to remove excess minerals had the best possibility of meeting the objectives of the DWWSP. However, after further deliberations, the Panel concluded that even this alternative appears infeasible, primarily because it is unlikely that the Project Partners can: (1) successfully negotiate a less

stringent EC requirement for their wastewater effluents; and (2) eliminate essentially all self-regenerating water softeners. Even if those two obstacles could be overcome, the capital cost savings would be moderate, while risks and other costs are numerous and collectively substantial. Therefore, the Panel concluded that this alternative is probably infeasible and is far less attractive than the DWWSP, which fully meets all three of the project objectives (See Appendix C for a more thorough discussion of this alternative).

4.2 Groundwater with Centralized Treatment. This alternative would require conveying the water from existing or new groundwater wells into a centralized treatment plant. The plant would have to be designed to remove contaminants of concern (e.g., arsenic, selenium, boron, hardness, TDS, etc.). This alternative would allow a consistency of water quality to be delivered to the customers, and also might result in less maintenance than the individualized wellhead treatment alternative. Another advantage of this alternative is that it would provide the ability to change the treatment processes at one central location to meet future regulations. However, as discussed above, the Panel concluded that this alternative would not be feasible, primarily due to the cost of brine disposal. Furthermore, as discussed in Appendix C, there are numerous risks in attempting to use groundwater to meet the long-term objectives of the DWWSP (e.g., potential litigation, land subsidence, deterioration in water quality, and reduction in aquifer yield).

4.3 Groundwater with Well-Head Treatment. This alternative would probably require the installation of water treatment processes at each well (well-head treatment). One advantage of this alternative is that the treatment processes could be tailored to the water quality characteristics of the well. The disadvantages include: (1) the maintenance requirements associated with individual treatment units; and (2) space constraints associated with each well site. More importantly, however, this alternative would also have the same disadvantages as the centralized treatment alternative discussed in Section 4.2. The Panel, therefore, concluded that this alternative would not be feasible.

4.4 Alternative of Choice. The Panel concluded that the alternative selected by the Project Partners will meet all objectives of the DWWSP. The only other alternative that the Panel considered worthy of careful evaluation was the use of deep groundwater without demineralization. However, even that alternative appears to be infeasible, while risks and costs are numerous and collectively substantial, as discussed in Section 4.1 above and in Appendix C.

5. OTHER RECOMMENDATIONS TO CONSIDER

The Panel's overall assessment of the DWWSP was presented in Section 2, and the problems that the Project Partners would probably encounter if the project was postponed were presented in Section 3. Additionally, the Panel discussed several issues that the Project Partners might encounter if the decision is made to proceed with the DWWSP. These issues and recommendations are presented below.

5.1 Water Rights and Water Transfers in the DWWSP

The Panel was presented with four inter-related programs within the DWWSP, three of which involve water transfers and, therefore, water rights issues. The four programs include:

- The Sacramento River surface water supply program.
- The summer agricultural-urban water transfer program.
- The program to produce and sell urban reclaimed water to nearby farms.
- The Woodland metering program (no regional water rights issues).

This section discusses risks and strategies to minimize the risks associated with all but the last of these programs.

5.1.1 Sacramento River Surface Supply Program

Permit Acquisition Risk

This program relies on “area of origin” statutes (Water Code Sec. 11460) to secure high-priority water withdrawal permits from the SWRCB. Yolo County acted with foresight in applying to the SWRCB for such rights to up to either 45,000 acre feet per year (af/yr) (from the presentation materials) or 46,100 af/yr (from the Community Report), and maximum diversion of 80 cubic feet per second (cfs) in 1994. Although not a certainty, due to the lack of extensive opposition and the Project Partners’ continuing effort to reach accommodation with remaining opposition, it is likely that the permit will be issued by the SWRCB if the Project Partners pursue it.

Risk-minimizing strategies: (1) Maintain diligent pursuit of permits and project so as not to compromise the permitting process; and (2) identify a satisfactory threshold of assurance that the permit will be issued before proceeding with financial commitments to build surface-water infrastructure. The Panel recognizes that these strategies are already being pursued.

Standard Permit Term 91 Risk

Standard Permit Term 91 (also called Standard Water Right Term 91) provides a means by which the SWRCB can curtail water deliveries to permit holders to achieve Sacramento-San Joaquin Delta water quality objectives and other in-basin goals. The general validity of Term 91 has been affirmed judicially.² Term 91 provides the SWRCB authority to curtail water withdrawals on a real-time basis.³ Project plans anticipate that no “area of origin” permit water will be available during the summer months as a result of Term 91. The risk associated with Term 91 involves potential future increased degradation of the Delta and expansion of the periods in which no water withdrawals are

² *El Dorado Irrigation District v. State Water Resources Control Board* (2006) 142 Cal. App. 4th 937 (48 Cal.Rptr.3d 468).

³ See “Implementing Standard Terms 91 and 93 for the Sacramento-San Joaquin River Delta Watershed” http://www.waterrights.ca.gov/HTML/license_progam.html#lic4 accessed June 13, 2008.

permitted. The risks manifest themselves as the possibility of stranding surface-water diversion infrastructure assets (intake, treatment, and pipelines), as well as reduced and/or less reliable regional water supply.

Risk-minimizing strategies: (1) Study the historical implementation of Term 91 and project alternative water-loss scenarios (compare historical precedents to Delta degradation scenarios, including climate change impacts and increasing water withdrawals from the Delta); (2) Negotiate cost-sharing with Conaway Ranch of the Sacramento River joint intake facility that accounts for reduced- and no-supply scenarios (this could take the form of dividing some of the capital costs on a fixed percentage basis with the rest of the capital costs divided on a variable [relative use] basis); (3) Expand the capacity of the project's surface-water transmission, storage, and treatment to increase the program's capacity to acquire surface supplies as opportunities arise; and (4) Expand the proposed summer agriculture-urban water transfer program through option agreements to water during other seasons (discussed below).

5.1.2 Summer Agricultural-Urban Water Transfer Program

“Wet Water” Accounting Risk

This risk encompasses whether substitute groundwater utilized by the farms that transfer water to DWWSP will be considered new water to the basin. It is possible that groundwater used by transferors will be considered subsurface flows of the basin and that farms transitioning from surface to groundwater will not be seen as producing new “wet” water (instead of “paper” water, which when withdrawn is in reality a net loss to the basin). This determination would result in DWWSP not being allowed to withdraw summer water as planned.

Risk-minimizing strategies: (1) Secure transfer agreements and options from Yuba County Water Agency or similar agencies and farms with either proven hydrologically-distinct groundwater supplies or otherwise-demonstrated capacity to supply summer water; (2) Structure water transfers on the Devil's Den-Castaic Lake Water Agency model in which farmers' financial compensation was a function of agricultural water availability (the less water applied to the farm, the higher the compensation paid by the urban district); (3) Agree to summer land fallowing on transferring farms, or facilitate/help pay for ecological restoration efforts in exchange for rights to a portion of the saved water; and (4) Secure option contracts for water supply needs consistent with the risk analysis performed related to Term 91 limitations.

5.1.3 The Program to Produce and Sell Urban Reclaimed Water to Nearby Farms

Loss of Willing Buyer Risk

Today's interested buyers may choose not to actually conclude and implement agreements to purchase reclaimed water. The Panel considers this to be a low-probability

risk since other potential users will be identified when the project starts generating usable water.

Risk-minimizing strategy: Reduce the linkage of sale of reclaimed water from other aspects of the DWWSP by minimizing expected freshwater offsets in planning scenarios.

Requirement to Maintain Existing Wetlands Risk

The existing wetlands are a popular habitat for birds and other wildlife. The Panel is unaware of whether or not the wetlands are a habitat for threatened or endangered species, but they may be. Therefore, the Project Partners should carefully consider the impact of planned activities that might impact the wetlands.

Risk-minimizing strategy: (1) Investigate the impacts of reclaimed water transfers on the wetlands and endangered species; and (2) Commence discussions with regulators on the legal status of the wetlands as critical habitat.

5.2 Public Outreach

As documented in the materials provided to the Panel, the Project Partners have expended a significant effort in educating the public about the DWWSP. The EIR process was completed without substantial controversy and was not challenged in court. The DWWSP Community Report issued in December 2007 provides an outstanding summary of the project history and vision for its implementation, and is a useful tool in the public outreach efforts.

Nonetheless, and as expressed by project staff, support for the DWWSP in the local community remains mixed. Decision-makers and the general public alike continue to question the need for the project, and are concerned about the substantial increase in consumer rates to pay for the project, along with the anticipated debt financing that will require repayment over a long period of time. If the Project Partners decide to move forward with the project, more funds will be expended and agreements will be negotiated. However, it is not certain that when the elected decision-makers are asked to finally approve and commit to long-term financing of the project, the votes will be there. Therefore, the Project Partners must also commit to continuing their public education campaign from this point forward to ensure the necessary support from the community. Education must remain a key element of the implementation efforts. The Panel concluded that the DWWSP will provide numerous benefits to the public, including: (1) a high-quality drinking water supply; (2) improving the reliability of their water supply; (3) lower costs to consumers who currently treat their water supply; (4) water reuse opportunities thereby preserving limited surface and groundwater; and (5) improving the quality of wastewater discharges thereby reducing the potential for fines and litigation. These benefits should be clearly stated and presented to the public as part of the education process.

The following are several public outreach suggestions and ideas the Project Partners might want to consider as the DWWSP moves forward:

5.2.1 Address the Rates Issue Head-On: Project staff need to help the public and decision-makers understand the “true cost” of water. Davis and Woodland have been the beneficiaries of some of the lowest water rates in California, primarily due to a modest scale of investment in the water supply infrastructure over time. The Panel appreciates that the rate increases for the project will generate controversy; nevertheless, even after the increases, the Panel believes that the new rates will be reasonable compared to rates throughout the State. Therefore, the rate issue should be viewed as an educational challenge. *Water rates will go up anyway.* The Panel recommends that the costs of various water supply options be presented using a cost per acre foot metric; this is a common metric used in water supply projects and is readily understood by decision-makers and the general public.

5.2.2 Convey the Project’s Importance as One Part of an Overall Sustainable Water Supply Portfolio: The Project Partners must convey the message that the surface water supply project is an important, but not the only, piece of the community’s overall water supply picture. If one thinks of the water supply portfolio as a stool (see Figure 2), the community currently has a two-legged stool: groundwater and conservation. Both are important, but the community cannot be sustained using this unbalanced approach. The surface water project and water reuse provide the other two legs of the stool to balance out the portfolio. Conservation should continue to be an important part of the education campaign; therefore, water conservation successes in the community should continue to be reported and emphasized.



Figure 2: Sustainable water supply portfolio.

Furthermore, the Project Partners should look for ways to increase conservation. Governor Arnold Schwarzenegger recently proclaimed that California is in a drought, the first such proclamation in 17 years. The *San Jose Mercury News* in an editorial of June 6, 2008, stated that the Governor's proclamation "...could help drive home the urgency of conservation. If calls for voluntary cuts don't work – and they tend not to – then water agencies need to offer more incentives or levy penalties to change behavior." The editorial continued: "It's the second straight year of below-normal precipitation, and this spring was the driest on record for the Sierra Nevada." Assembly Bill 2175, which recently passed the Assembly, would require a 20 percent decrease in urban water use by 2021. The Panel is aware of court decisions to further cut pumping from the Sacramento Delta to protect fish. All of these facts point out the importance of maximizing conservation. By doing so, the Project Partners will be helping to ensure that they have an ample water supply during years of drought. And, as pointed out above, water reuse, which is further discussed below, is an important part of the overall water supply picture.

5.2.3 Use Media Appropriate to the Message: Single-page question and answer (Q&A) fact sheets are very useful tools in conveying targeted messages and simplifying highly technical information for a non-technical reader. The October 17, 2007 Technical Memorandum titled "*Why Surface Water & Why Now*" (provided in the Panel's binder) contains highly relevant material to the public's understanding of the project and provides good answers to the "why this, why now" question. The *2007 Community Report* also contains good information. Much of this material could be translated to one-page fact sheets covering individual topics; use more graphics than text to convey meaning. The fact sheets should be posted on the project's website and placed in water bills. The Project Partners should be perceived as the reliable and credible source of information about the project. This kind of material can help in that perception. It is important to be as transparent as possible.

5.2.4 Public Outreach Does Not End with the CEQA Process: Many communities appropriately use the CEQA process as the framework for public outreach because it has predictable milestones and has a beginning-middle-end. However, just because the DWWSP EIR was certified without much controversy does not mean that the public is "okay" with the project and their interest has diminished. If anything, the public needs to be kept more informed *after* the CEQA process because now the project is moving into design, financing, and construction. This is when the project finally becomes "real" to people, and designing outreach and education materials for this phase of implementation is critical.

5.3 Project Costs

The Panel would like to compliment the Project Partners for thoroughly investigating the costs of the various alternatives to improve the reliability and enhance the quality of their drinking water supply. Following are some additional considerations regarding project costs.

5.3.1 Mitigating Costs: Regarding the documentation of costs and mitigation of costs for the various water supply alternatives, the Panel made the following findings:

- The costs of the water supply alternatives were thoroughly examined.
- The cost of doing nothing is important to document, including the impact on water rights, summer water purchasing, meeting discharge requirements, risk of relying upon aging infrastructure, and others.

If the decision is made to proceed, the Panel recommends that the Project Partners examine all viable means to cost-effectively design and implement the DWWSP using strategies including incorporating public-private partnerships that do not sacrifice reliability, stability, and public health.

In particular, the Panel supports and encourages the Project Partners to pursue grants, loans, and bonds to help offset the costs of funding the DWWSP and to keep increases to water rates at a minimum.

5.3.2 *Alternative Water Supply Options:* The Panel agreed that they could not identify any other lower cost water supply alternatives that could achieve objectives similar to those proposed by the DWWSP (see Appendix D for summaries of cost by alternatives). The Panel discussed the idea of a deep groundwater without demineralization alternative, which shows a lower cost per acre-foot, but concluded that it was probably not a viable option (See Section 4.1 and Appendix C).

5.4 Surface Water Treatment

5.4.1 *Conventional Surface Water Treatment*

5.4.1.1 As the Project Partners move away from groundwater supplies and begin planning and designing their surface water treatment plant, there may be reliability issues that should be considered, some of which might be too detailed for consideration at this time. For example, at present, the Project Partners rely on a network of wells to provide water to their customers. As the wells are closed and they move toward a surface supply, there will only be one primary conduit from the water treatment plant to the City of Davis and one to the City of Woodland. The Project Partners may want to explore the option of placing multiple lines from the water treatment plant and intake to their distribution network to ensure that supply can be maintained during short pipeline outages (repair or maintenance). This redundancy would improve the operational reliability and flexibility of the water supply systems of both cities.

5.4.1.2 While conventional treatment is proposed for the DWWSP, alternative treatment technologies should be evaluated for potential cost savings. If the project moves forward, the Project Partners should consider forming and convening a technical advisory panel to review and evaluate treatment process options. Simply dismissing treatment alternatives due to the turbidity of surface water sources or due to the fact that neighboring utilities use conventional treatment processes is insufficient given the advancements and operational configurations of treatment technologies, such as membranes. Submerged membranes (Carmichael) and ballasted sedimentation (Placer County Water Agency) may be treatment processes worth evaluating.

5.4.2 Other Concerns

- 5.4.2.1 The commingling or blending of treated surface water and groundwater presents water quality challenges. The Project Partners need to carefully plan how the waters are to be blended, as well as the location of the blending point(s). That is, the blending process must be carefully planned, designed, operated, and managed to ensure that stable water quality is maintained in the distribution system and delivered to the customers.
- 5.4.2.2 Operation of a surface water treatment plant will be very different from the operation of a groundwater-only water system. The Project Partners have anticipated and appear to be prepared for the hiring and/or retraining needed treatment plant operators.
- 5.4.2.3 Simply meeting primary and secondary drinking water standards should not be sufficient operating or production objectives for the final product. Given that the source water quality for the DWWSP will be much improved over the current supply, water quality objectives that are lower than the primary and secondary drinking water standards should be the norm.
- 5.4.2.4 Operators of the Project Partner's distribution systems need to be cognizant of water chemistry challenges, flow patterns, changes in water quality due to biofilm formation, corrosion of pipes, etc.
- 5.4.2.5 If localized blending of groundwater and treated surface water within the distribution system does not meet water quality objectives, it may be necessary to consider pumping groundwater to the treatment plant for blending prior to distribution.

5.5 Water Reuse

As pointed out above, the Panel recommends that the Project Partners increase the use of reclaimed water to achieve a balanced water portfolio. The Panel recognizes, however, that the quality of effluent currently produced by the Project Partners prevents them from maximizing reuse within their service areas and adjacent lands. If the Project Partners proceed with the DWWSP, the effluent produced will be of better quality (e.g., low concentrations of TDS, selenium, and boron), which will be an encouragement to agricultural and other users to consider reuse in lieu of using ground or surface water.

There are numerous resources that can be used to identify potential recycled water uses and applications such as the Department of Water Resources website at www.owue.water.ca.gov/recycle, the University of California's library and information resources, and the California section of WaterReuse Association (www.watereuse.org/ca/index.html).

Reclaimed water has been used in California as a non-potable water supply for more than a century, primarily for agricultural and landscape irrigation. Early recycling projects were initiated primarily to help control water pollution. However, as wastewater treatment has improved and as water supplies have become scarcer, the beneficial uses of reclaimed water have

increased appreciably. Furthermore, California law (Water Code Sections 461-465) requires the maximum use of treated wastewater. In 1991, California Water Code 13577 set recycling goals of 700,000 acre-feet annually by year 2000 and 1 million acre-feet annually by 2010. Currently, recycled water is used for the following beneficial uses: (1) agricultural irrigation; (2) landscape irrigation; (3) industrial use; (4) groundwater recharge; (5) seawater barriers; (6) recreational impoundments; and (7) wildlife habitat. The degree of treatment required for these different uses will vary. Where such use may result in a potential threat to health, the treatment required and restrictions on use are governed by regulations promulgated by the California Department of Public Health. However, the water quality required for agricultural use is plant- or crop-specific. Furthermore, there may not be regulations governing such use, but there may be guidelines of good practice to ensure that the use will not result in damage to the crop being grown.

5.5.1 The Panel is aware that the largest market for recycled water in the project area will be agriculture. The Panel also realizes that rice is one of the predominant crops grown in the area, but knows of no research regarding the quality of water required for its successful irrigation with recycled water. The Project Partners may need to either identify such research and/or farm advisers to determine the quality of water required, and then conduct tenant education to encourage use of the resource. Such use, of course, will depend on the completion of the DWWSP and the ability to produce a reclaimed water of suitable quality.

6. Conclusions

Based on review of the technical information provided by the Project Partners and on the knowledge and experience of the individual Panel members, the Panel unanimously concluded that the alternative of using Sacramento River water and groundwater in the proposed DWWSP will fully meet all three of the following project objectives:

1. Provide a reliable water supply to meet existing and future needs.
2. Improve water quality for drinking water purposes.
3. Improve the quality of treated wastewater effluent discharged by the Project Partners through 2040.

In addition, the Panel also came to the following conclusions:

- The most serious consequence of postponing the project is the probability of losing the pending appropriative right to withdraw up to 46,100 acre-feet of water per year from the Sacramento River. Furthermore, postponing the project most likely will result in other serious negative consequences, such as the loss of summer water purchases, funding opportunities, partnerships, increased costs due to inflation, increased costs to rewrite the CEQA documents, and the failure to comply with future wastewater discharge requirements, which could result in penalties and litigation.
- The Panel was unable to identify any other alternative that could potentially meet the project objectives other than the alternatives evaluated by the Project Partners (using deep

groundwater without demineralization, groundwater with centralized treatment, and groundwater with well-head treatment).

- The alternatives of using groundwater with either centralized or well-head treatment are not feasible due to the high costs of brine disposal.
- The use of deep groundwater without demineralization is probably infeasible and fraught with obstacles. Furthermore, even if these obstacles could be overcome, the capital cost savings would be moderate, while risks and other costs are numerous and collectively substantial. Therefore, the Panel concluded that this alternative is far less attractive than the alternative selected by the Project Partners of using Sacramento River water and groundwater to comply with the objectives of the DWWSP.
- The Project Partners thoroughly investigated the costs of the various alternatives that had the potential of meeting the project objectives. Project staff need to help the public and decision-makers understand the “true cost” of water. Davis and Woodland have been the beneficiaries of some of the lowest water rates in California, primarily due to a modest scale of investment in the water supply infrastructure over time. The Panel appreciates that the rate increases for the project will generate controversy; nevertheless, even after the increases, the Panel believes that the new rates will be reasonable compared to rates throughout the State.
- The Panel identified a number of strategies to minimize the risks associated with water rights issues associated with the proposed DWWSP project. These strategies are outlined in the report.
- The Project Partners are strongly encouraged to develop an effective public outreach program to ensure the necessary support from the community. A key element of this public outreach effort will be to directly address the projected increase in water rates with the general public and to clearly identify the benefits that the DWWSP will provide to the public. Suggestions on how best to accomplish this are contained in the report.
- The Panel identified additional concerns that the Project Partners will need to address as they move forward, including issues associated with: (1) conventional surface water treatment (such as alternative surface water treatment options); (2) challenges associated with blending treated surface water and groundwater; and (3) maximizing water conservation and reuse.
- Finally, the Panel was impressed by the regional approach exemplified by Yolo County’s Integrated Regional Water Management Plans and by the foresight shown in 1994 by the Yolo County Flood Control and Water Conservation District in submitting an application to the State Water Resources Control Board for water rights to withdraw water from the Sacramento River to meet the long-term water supply needs of the County. Without this foresight, the Project Partners would have had a much more difficult time in developing the DWWSP, which fully meets all three of the project objectives.

APPENDIX A: PANEL BIOGRAPHIES

HARVEY F. COLLINS, PH.D., P.E. (Chair)

Environmental Engineer Consultant (Sacramento, California)

Harvey Collins has over 30 years of experience in California state government, working in all fields of sanitary/environmental engineering and environmental health. He served as Deputy Director of Public Health at the California Department of Health Services, and was Chief of the Division of Drinking Water and Environmental Management when he retired in 1995. Since then, he has consulted on various water and wastewater engineering projects and has served on several blue ribbon panels. He also has received numerous awards, including a Rudolf Hering Medal of the American Society of Civil Engineers, Walter F. Synder Award from the National Environmental Health Association and NSF International, and Special Recognition Award from the California Department of Health Services. Collins received a B.S. in Civil Engineering from Oregon State University, an M.S. in Sanitary Engineering from the University of Missouri, Columbia, and a Ph.D. in Sanitary Engineering from the University of California, Berkeley. He is a licensed Civil Engineer in the State of California.

ROBERT C. CHENG, PH.D., P.E.

Deputy General Manager, Operations (Long Beach, California)

Robert Cheng is the Deputy General Manager of Operations for the Long Beach Water Department. There, he oversees the operations of the potable water system (including 30 wells, 62.5 MGD Groundwater Treatment Plant, and associated distribution system), reclaimed water system, sanitary sewer collection system, and all Department research activities, including a \$20 million, 10-year seawater desalination research program. Before becoming Deputy General Manager of Operations in 2005, Cheng served the Department as Director of Operations. He had also performed numerous bench-, pilot-, and full-scale water treatment studies as a process engineer with the Metropolitan Water District of Southern California prior to joining the Department and, in addition, worked as a Senior Process Engineer for Black & Veatch Consulting Engineers in Kansas City, Missouri. Cheng has also taught Water and Wastewater Treatment classes within the Civil Engineering Department at the California State Polytechnic University, Pomona. Cheng received a B.E. and M.S. in Chemical Engineering from Vanderbilt University, and Ph.D. in Civil Engineering from UCLA. Cheng is active in the water industry, where he serves on several AWWA Councils and also on the AwwaRF Research Advisory Council.

GRAHAM E. FOGG, PH.D.

*Professor of Hydrogeology and Hydrogeologist
University of California, Davis (Davis, California)*

Graham Fogg has had over 30 years experience characterizing and analyzing groundwater under a variety of conditions in the southwest and western United States. He is currently a professor of

Hydrogeology in the Department of Land, Air and Water Resources (LAWR) at the University of California, Davis where he teaches undergraduate and graduate courses such as Hydrogeology and Contaminant Transport and Numerical Modeling of Groundwater Systems. His research has also made important contributions to UC Davis' Center for Watershed Sciences. His area of expertise includes groundwater contaminant transport, groundwater basin characterization and management, and the role of molecular diffusion in contaminant transport and remediation. Fogg received a B.S. in Hydrology from the University of New Hampshire, an M.S. in Hydrology at the University of Arizona, and Ph.D. in Geology at the University of Texas at Austin.

BRENT M. HADDAD, PH.D.

*Director, Center for Integrated Water Research
Professor of Environmental Studies Department
University of California, Santa Cruz (Santa Cruz, California)*

Brent Haddad has taught courses in Environmental Studies at the University of California, Santa Cruz (UCSC) for the past 10 years, including UCSC's most highly enrolled course, *Introduction to Environmental Policy and Economics*. In 2007, he founded and became Director of the UCSC Center for Integrated Water Research. The Center undertakes research to work towards refocusing and resolving major debates on water quality and supply in the U.S. and abroad. Major projects of the Center include developing a tool to guide state and local desalination planning and an economic analysis of the development of a major desalination plant in Monterey Bay known as the Coastal Water Project. Haddad received his B.A. in International Relations from Stanford University, an M.A. in International Relations from Georgetown University, and an MBA in Business and Public Policy as well as a Ph.D. in Energy and Resources from the University of California, Berkeley.

RICHARD H. SAKAJI, PH.D., P.E.

*Manager of Planning and Analysis for Water Quality
East Bay Municipal Utility District*

Dr. Richard Sakaji is the Manager of Planning and Analysis for Water Quality with the East Bay Municipal Utility District (EBMUD). Prior working for EBMUD he was with the California Department of Public Health (for close to 15 years) as the water treatment specialist for the Drinking Water Program (providing regulatory oversight in the arena of new and emerging treatment technologies for California's public drinking water systems and enforcement of the Federal and State Safe Drinking Water Acts). Dr. Sakaji's unique background in research and regulatory affairs has allowed him to bring a public-health perspective to advisory committees and workshops on public health, water quality, and water-treatment issues surrounding drinking water and wastewater reclamation. Currently, he has served on several project advisory committees for the American Water Works Association Research Foundation and the Water Environment Research Foundation and is a member of the U.S. Environmental Protection Agency's Science Advisory Board Drinking Water Committee. He was also among the co-authors of NWRI's Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse. Dr.

Sakaji received an A.B. in Marine Biological Studies and both an M.S. and Ph.D. in Environmental Engineering from the University of California, Berkeley.

R. RHODES TRUSSELL, PH.D., P.E., DEE

President

Trussell Technologies, Inc. (Pasadena, California)

R. Rhodes Trussell, Ph.D., P.E., DEE, is recognized worldwide as an authority in methods and criteria for water quality and in the development of advanced processes for treating water or wastewater to achieve the highest standards. A Civil and Corrosion Engineer with 35 years of experience, he has worked on the process design for dozens of treatment plants ranging in size from 1 to 900 million gallons per day in capacity. At present, he is President of Trussell Technologies, Inc., an environmental engineering firm that focuses on the quality and treatment of water and wastewater. He is also active on numerous boards and committees, such as serving as Chair of the Water Science and Technology Board for the National Academies. Just recently, he retired from the U.S. Environmental Protection Agency's Science Advisory Board after 17 years of service. Trussell received a B.S. in Civil Engineering and both an M.S. and Ph.D. in Sanitary Engineering from the University of California, Berkeley.

GUS YATES, PG, CHg

Independent Consulting Hydrologist (Berkeley, California)

Gus Yates is an independent consulting hydrologist with 24 years experience in technical analysis, water resources planning, and project management for investigations involving surface water, groundwater, water quality and habitat restoration. His particular expertise is in modeling. However, water-related projects are inherently interdisciplinary and Mr. Yates has developed competence in hydrology, hydraulics, water quality, riparian and aquatic ecology, fluvial geomorphology, water system operations, stakeholder facilitation, and regulatory compliance. His professional experience includes 8 years each at the U. S. Geological Survey and Jones & Stokes, a leading natural resource management consulting firm in Sacramento. The past 8 years he has been an independent consultant, working mainly for cities, counties and water districts in northern and central California. He lived in Davis from 1982 to 2002, where he led or participated in technical studies and stakeholder processes related to Putah Creek (flow regime, Solano Project operations, and channel substrate), Willow Slough (watershed management plan), Cache Creek (stream-aquifer study, gravel mining impacts), Yolo Bypass (management plan and fish habitat enhancement), and the entire county (Integrated Water Resources Management Plan).

VALERIE J. YOUNG, AICP

Senior Environmental Planner

Winzler & Kelly (San Francisco, California)

Valerie Young is a senior environmental planner and water reuse specialist with over 28 years of professional planning experience. Since 1993, she has focused her environmental planning work (CEQA/NEPA) on recycled water and water-related projects in California. She has been a contributor to the success of California recycled water programs in Redwood City, San Jose, and the San Ramon and Upper San Gabriel Valleys. Her primary role has been to shepherd these projects through the environmental review process, preparing environmental documents and addressing community and agency concerns, and supporting engineering teams to bring water projects to fruition. She has served on two National Water Research Institute advisory panels (San Francisco Recycled Water Alternatives and Los Osos Wastewater Management Plan) and is currently serving on a WateReuse Foundation Project Advisory Committee researching the relationship between recycled water supply and growth inducement. She is an active member of the WateReuse Association and Association of Environmental Professionals, and a member of the American Institute of Certified Planners since 1986. Young received a B.A. in History from the University of California, Santa Barbara, and an M.A. in Geography from Arizona State University.

APPENDIX B: DOCUMENTS REVIEWED

Binder provided to the Panel for the June 3-4, 2008, meeting on the Davis-Woodland Water Supply Project, which contained the following items:

1. Meeting Agenda
2. Panel Contact List
3. Panel Biographies
4. Tour Route Map
5. Power Point Presentation
6. Davis-Woodland Regional Water Supply Project Figures
 - a. Figure 1 – Major Existing or Planned Sacramento River Intakes in Vicinity of DWWSP
 - b. Figure 2 - Regional Re-Use Potential
 - c. Figure 3 – Davis Local Facilities
7. Background Groundwater Information
 - a. Summary of Groundwater Work
 - b. Water Quality Concentrations for Constituents of Concern
 - c. Figure 4.1 – Wells with Information in the Yolo County WRID by Entity
 - d. Figure 4.2 – Groundwater Sub-basin and Wells by Entity with Water Level or Water Quality Measurement
8. Davis-Woodland Water Supply Community Report
9. DWWSP Information and Analysis Related to the City of Woodland’s Question “Why Surface Water & Why Now” Technical Memorandum
10. Power Point Presentation to Woodland City Council on October 23, 2007 “Workshop on Water Issues”
11. California Regional Water Quality Control Board Letter dated March 13, 2008
12. Groundwater Only Alternative
 - a. Reverse Osmosis – Brine Pipeline Route
 - b. California Energy Commission Water Energy Use in California
13. Community Outreach
 - a. Davis-Woodland Water Supply Project and Wastewater Treatment Improvement Project
 - b. Incorporating Sustainability at Davis’ WWTP
 - c. City of Davis Wastewater Treatment
 - d. Davis-Woodland Water Supply Project Draft Environmental Impact Report Available for Public Review
 - e. Davis-Woodland Water Supply Project Surface Water Supply Project Begins Environmental Process
 - f. City of Davis/UC Davis Water Feasibility Study
14. Davis-Woodland Water Supply Project Water Treatment Plant Design Concept Technical Memorandum
 - a. Davis-Woodland Regional Water Supply Project Water Treatment Plant Figure
 - b. Davis-Woodland Water Supply Project Water Treatment Plant Design Concept Technical Memorandum
15. Davis-Woodland Water Supply Project Environmental Impact Report

- a. DWWSP Final EIR Cover Page
- b. DWWSP Draft EIR Cover Page
16. Permits
 - a. Master Permit Schedule
 - b. Anticipated Regulatory Requirements and Permits for Project Implementation
17. Joint Powers Agreement
18. Integrated Regional Water Management Plan Executive Summary
19. California-Nevada Section, American Water Works Association 2007 Water Rate Survey
20. Davis WWTP/Re-Use Presentation

City of Davis & University of California Davis Joint Water Supply Feasibility Study. Prepared by West Yost and Associates. September 2002. 011-00-23.99

City of Davis & University of California Davis Hydrogeologic Investigation Deep Aquifer Study. Prepared by West Yost and Associates in conjunction with Montgomery Watson. March 24, 1999.

City of Davis in Conjunction with UC Davis and City of Woodland Executive Summary: Phase II Deep Aquifer Study. Prepared by Brown and Caldwell in conjunction with West Yost and Associates. July 2005

City of Davis in Conjunction with UC Davis and City of Woodland Phase II Deep Aquifer Study. Prepared by Brown and Caldwell in conjunction with West Yost and Associates. July 2005

Davis-Woodland Water Supply Project Draft Environmental Impact Report. Prepared by City of Davis, Public Works Department in association with UC Davis and City of Woodland, Vol. 1. April 2007. State Clearinghouse No. 2006042175.

Technical Memorandum dated May 9, 2003, from Mr. Jacques DeBra, City of Davis, to Mark Soldati, Soldati Engineering Services, on *Groundwater System Implementation Plan Final Report.*

Hydrogeologic Conceptualization of the Deep Aquifer. Prepared by Luhdorff and Scalmanini Consulting Engineers. May 2003. File No. 02-1-091.

The Yolo County GPS Subsidence Network Recommendations and Continued Monitoring. Prepared by Don D'Onofrio, Geodetic Consultant, and Jim Frame, Frame Surveying & Mapping. February 2003.

The Yolo County GPS Subsidence Project 2002 Project Report. Prepared by Jim Frame, Frame Surveying & Mapping, and Don D'Onofrio, Geodetic Consultant. September 10, 2002.

The Yolo County GPS Subsidence Project 2005 Project Report. Prepared by Jim Frame, Frame Surveying & Mapping, and Don D'Onofrio, Geodetic Consultant. October 1, 2005.

The Yolo County GPS Subsidence Network: Recommendations for Future Monitoring. Prepared by Don D'Onofrio, Geodetic Consultant, and Jim Frame, Frame Surveying & Mapping. September 1999.

APPENDIX C: DEEP GROUNDWATER WITHOUT DEMINERALIZATION ALTERNATIVE

As discussed in Section 4.1, early in its deliberations, the Panel concluded that the alternative of using deep groundwater without treatment to remove excess minerals had the best possibility of meeting the objectives of the DWWSP. The assumptions used by the Panel in considering this option and the conclusions reached are presented below. The costs presented are rough approximations, which were deemed “close enough” for general comparisons between the various alternatives examined by the Panel.

1. Project Description

- All 15 intermediate wells are replaced by deep wells over 10-15 years (to meet expected compliance timeline for wastewater discharge).
- New deep wells are selectively screened to avoid high boron zones. Assume 25-percent loss of potential yield, so assume 19 new wells needed. This equates to a new well every 15-23 months.
- Wellhead treatment is installed at about half of the wells for Fe-Mn.
- Desirable option: Some new well sites are outside City limits to spread out pumping stress (to minimize well interference and impacts on University of California, Davis, wells).
- Self-regenerating water softeners are completely eliminated (existing users have the option to switch to “exchange tank” type softeners, which are regenerated centrally, or simply forego softening).
- Municipal salt pickup in wastewater in the absence of self-regenerating water softeners is 200 mg/L.
- Expected water quality of key constituents is as follows:

Constituent	Water Supply ^a	Wastewater	Expected Discharge Requirement
EC (µmho/cm)	540	848 ^b	700
B (mg/l)	0.8-0.9	0.7 ^c	0.7
As (µg/l)	3-5	3-5 ^e	<10 ^d
Se (µg/l)	2-4	2-4 ^e	4.4
Fe (µg/l)	100		None
Mn (µg/l)	36		None
Hardness	100-130		None

^a Median values from existing deep wells.

^b 200 mg/L salt pickup /0.65 = 308 µmho/cm.

^c Assuming selective screening of new wells avoids highest boron zones.

^d The waste discharge requirements might not include an arsenic limit, but if it does, there is a good chance it would be lower than the drinking water MCL of 10 µg/L (per Keith Smith).

^e Assuming no pick-up of this constituent during municipal use and no evaporative concentration during wastewater treatment.

- A new water supply plan and EIR are needed.
- Half of the new deep wells are drilled on existing intermediate-depth well sites.
- Approximate cost:

	Cost
Well design and construction (19 wells at \$2.5 million)	\$47.5 million
Wellhead Fe-Mn treatment (10 wells at \$1.5 million)	\$15 million
Land costs (10 sites at \$500,000)	\$ 5 million
Pipelines for wells outside city limits (5 mi at \$2 million??)	\$10 million
EIR, permitting, litigation	\$ 2 million
Total	\$79.5 million

2. Advantages, Disadvantages, and Risks

- **Cost.** Based on the above assumptions, the only advantage to this alternative is lower capital cost, which is approximately 60 percent as large as the cost of the DWWSP.
- **Stranded Assets.** If the purpose of the alternative is to delay rather than avoid the surface water project, then the large number of new deep wells that would have to be constructed in the next decade under this alternative would become largely superfluous when the surface water project subsequently comes online.
- **Waste Discharge Permit.** Based on the City of Woodland’s experience with the RWQCB-CVR, it is unlikely that the City of Davis will succeed in arguing for a salinity discharge limit of 900 $\mu\text{mho/cm}$ rather than 700 $\mu\text{mho/cm}$. This may be a fatal flaw.
- **Water Softener Elimination.** It is highly unlikely that the City will be able to convince all customers to forego water softening or switch to exchange tank-type softening equipment. Participation in the conversion effort would have to approach 100 percent for this alternative to succeed. The hardness of the deep zone groundwater (100-125 mg/L as CaCO_3) is sufficiently high that customers might not immediately conclude that softening is unnecessary. The Panel knows of no precedent for such a comprehensive and rapid decommissioning of private water softeners. As we understand the current law, the City can ban the installation of new softeners, but does not have the power to directly require that existing softeners be removed.
- **Deep Aquifer Yield.** There is a risk of overdraft in the deep zone. The increase in production from that zone from about 2,800 to 7,700 af/yr during the past 15 years has not resulted in chronic declining water levels. However, the increase to 27,600 af/yr would probably cause water levels to decline. The decline might stabilize when the “pumping trough” has reached a size large enough to induce leakage from the intermediate aquifer zone equal in magnitude to the well production. Several studies of the deep aquifer completed to date have not been able to estimate its sustainable yield based on available data. Additional studies, including comprehensive groundwater modeling, would likely reduce the uncertainty regarding sustainable yield, but there is also substantial risk that the sustainable yield will not be adequately quantified until the deep aquifer production increases and adverse impacts commence. The potential adverse impacts are degradation in groundwater quality, subsidence, and increased energy costs.
- **Subsidence.** There is a moderate risk of subsidence in the deep zone. Water-level declines (seasonal, long-term and drought-year) would all be larger than the

corresponding declines in the intermediate zone. Therefore, the head stresses that induce compaction of clay layers would be greater than the stresses that have historically caused subsidence in the intermediate zone. However, clays in the deep zone are probably less compressible than clays in the intermediate zone because of their greater age and depth of burial.

- ***Deep Aquifer Quality.*** Even if pumping from the deep aquifer does not exceed its sustainable yield, it is likely that the quality of water produced by deep wells will gradually deteriorate over a period of decades (possibly more than a century). Three processes could contribute to the deterioration: (1) pumping will induce downward leakage of intermediate-zone groundwater into the deep zone; (2) decreased head in deep aquifers will cause water to seep out of adjacent aquitards into the aquifers; and (3) decreased head in deep aquifers will cause upward flow of still deeper, brackish, or saline water. The water quality in clay aquitards is typically worse than in aquifers. This effect was noticeable in the intermediate zone wells when water-levels declined during the 1987-1992 drought. Therefore, the deep aquifer alternative is not considered indefinitely sustainable from a water quality standpoint.
- ***Interference with UC Davis Wells.*** Well testing and water level monitoring have shown that pumping of City of Davis deep aquifer wells would cause additional drawdowns in water levels of UC Davis wells. While the ultimate seriousness of future interference between City and University wells is unclear, there is the risk that the two parties would end up competing for the same, limited source of water. Because the University developed the deep aquifer resources before the City did, the University's rights to the deep aquifer would likely be considered superior.
- ***Carbon Footprint.*** The energy cost per acre-foot for the deep aquifer alternative would be substantially greater than for the DWWSP. The DWWSP FEIR estimated that greenhouse gas emissions for the No Project alternative would be 30-percent greater than for the DWWSP at production levels in 2040.
- ***Restricted or Foregone Future Water Supply Alternatives.*** Pursuing the deep aquifer alternatives could restrict or eliminate the feasibility of implementing the DWWSP at a future date. Briefly, the risk and cost considerations are:
 - The SWRCB would very likely cancel the existing 1994 application for lack of due diligence.
 - The City of Woodland would probably seek an independent solution to its water supply problems and might not be available as a partner in the future.
 - Climate change will likely change the yield of Lake Shasta and could decrease the availability of unappropriated water.
 - Competition for purchases of summer water from willing sellers will almost certainly be much greater. It is unlikely that most of the current identified potential sellers would have as much water available to sell in 25-30 years.
 - The cost to date of the water rights application, protest negotiations, and CEQA documentation is approximately \$3 million; most of this money would be lost because these documents would have to be updated in the future, thereby incurring additional costs.
 - RD 2035 (Conaway Ranch) almost certainly needs to replace its intake in the near future anyway and, without the DWWSP, the Ranch would probably not construct the full 400 cfs capacity, thus increasing the cost of any future project.

- Construction costs have been increasing far faster than inflation, so the rate impact in the future would be higher.

3. Conclusion

The deep groundwater without demineralization alternative appears to be infeasible, primarily because the likelihood is slim of: (1) successfully negotiating a less stringent EC discharge requirement at the wastewater plant; and (2) eliminating essentially all self-regenerating water softeners. Even if those two obstacles could be overcome, the capital cost savings would be moderate, while risks and other costs are numerous and collectively substantial. Therefore, the Panel concludes that this alternative is probably infeasible and is, in any event, less attractive than the DWWSP.

APPENDIX D: SUMMARIES OF COST BY ALTERNATIVES
 (Provided by the project partners at the request of the Panel)

Table 1: Davis-Woodland Water Supply Project Greenhouse Calculations

Project Alternative	Energy Cost per Year, thousands of dollars	CO₂ Equivalents, metric tons/year
No Project	1,586	4,522
Surface Water	916	2,611
Treated Groundwater	3,027	8,629

Table 1: Cost per Acre-Foot of Water Supplied from Surface Water and Groundwater

Alternative	Total Expenditures	Ave. Annual Expenditures	Ave. Annual Acre-Feet	Cost/ac-ft in FY 31/32 dollars	Cost/ac-ft in FY08/09 dollars
<i>Surface Water - No Grant</i>	\$1,180,533,982	\$39,351,133	22,900	\$1,718	\$560
<i>RO/Brine Disposal Option</i>	\$1,720,951,341	\$57,365,045	22,900	\$2,505	\$820
<i>Existing Groundwater System</i>	\$1,066,824,840	\$35,560,828	22,900	\$1,553	\$510

Steps for determining cost per acre-foot for each alternative:

- 1) Column B: From the rate model completed by Tom Pavletic, the summation of the total expenditures due to pay-as-you-go capital expenditures, O&M and debt over the 30 year life of the loans (in escalated dollars).
- 2) Column C: The average annual expenditures determined by dividing the total expenditures (column B) by the 30 years evaluated.
- 3) Column D: The average annual 2040 water demand.
- 4) Column E: The cost per acre-foot in FY 31/32 (mid-point of 30 year evaluation period) dollars is determined by dividing the average annual expenditures (column C) by the average annual acre-feet (column D).
- 5) Column F: The cost per acre-foot in today's dollars (FY 08/09) was determined by taking the cost per acre-foot in FY 31/32 (mid-point of 30 year evaluation period) dollars (column E) and dividing by the cumulative escalation (at 5% per year).

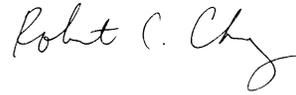
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Respectfully submitted by the Independent Advisory Panel,



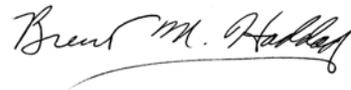
Harvey F. Collins, Ph.D., P.E.
Panel Chair



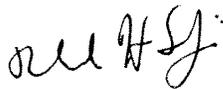
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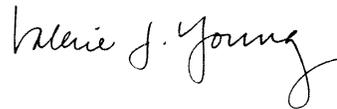
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