

**Summary Report**

**Review of  
City of Davis  
Water Resources Master Plan**

**February 10, 2009**



**Prepared by  
Edward Schroeder and George Tchobanoglous  
Davis, California**

Review of City of Davis  
**WATER RESOURCES MASTER PLAN**  
Davis, California

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February 10, 2009

Mr. Bill Emlen, City Manager  
City of Davis  
1717 Fifth Street  
Davis, California 95616

RE: Summary Report: **Review of City of Davis Water Resources Master Plan**

Dear Mr. Emlen:

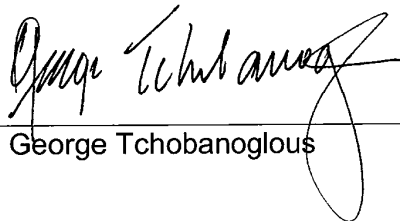
Please find enclosed the Summary Report: **Review of the City of Davis Water Resources Master Plan**. It has been an honor to be of service to the City of Davis and it is hoped that this report will be of aid to the community in securing a sustainable water supply and developing a satisfactory approach to wastewater management and dispersal.

Very truly yours,



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Edward Schroeder



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George Tchobanoglous

Cc. Mr. Bob Weir, Director Department of Public Works

# CONTENTS

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LETTER OF TRANSMITTAL . . . . .	i
EXECUTIVE SUMMARY . . . . .	iv
Guiding Principles . . . . .	iv
A Recommended Path Forward . . . . .	v
1. INTRODUCTION . . . . .	1
Water Resource Management Issues . . . . .	1
Purpose of Report . . . . .	1
Organization of Report . . . . .	2
Acknowledgements . . . . .	2
2. GUIDING PRINCIPLES FOR REVIEW . . . . .	3
Water Security and Reliability . . . . .	3
Responsibility of the City . . . . .	4
Value of Water . . . . .	4
Planning Horizon . . . . .	4
Meeting Applicable Drinking Water and Reuse and/or Dispersal Requirements . . . . .	5
3. WATER SUPPLY ALTERNATIVES . . . . .	7
Development of Partnered Project to Use Sacramento River Water . . . . .	8
Continued Use of Current Well System Supplemented by Solano Project Water . . . . .	8
Continued Use of Current Well System with Addition of New Deep Wells . . . . .	10
Continued Use of Current Well System with Extensive Conservation . . . . .	11
4. WASTEWATER TREATMENT ALTERNATIVES . . . . .	14
Conventional Treatment to Meet Title 22 Requirements . . . . .	14
Conventional Treatment to Meet Title 22 Requirements as Modified by the Value Engineering Recommendations . . . . .	15
Continued Use of Modified Existing System . . . . .	16
Membrane Bioreactor Activated Sludge to Meet Title 22 Requirements for Satellite Water Reclamation and Reuse . . . . .	17

5.	EFFLUENT DISPERSAL ALTERNATIVES . . . . .	20
	Discharge to Conaway Ranch with Water Reuse . . . . .	20
	Discharge to City Land Summer/Winter with Water Reuse . . . . .	21
	Combined Conaway Ranch/Receiving Water Discharge . . . . .	21
	Continued Discharge to Receiving Waters . . . . .	22
	Discharge to Sacramento Regional Wastewater Treatment Plant . . . . .	22
6.	A RECOMMENDED PATH FORWARD . . . . .	24
APPENDIXES		
A.	Reviewer Biographies . . . . .	A-1
B.	Summary of Meetings with City Staff and Consultants . . . . .	B-1

## EXECUTIVE SUMMARY

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The City of Davis relies completely on groundwater aquifers that are deteriorating in quality and of questionable security with respect to producing adequate quantities of water in the future. The City's wastewater treatment plant has proven difficult to operate successfully and periodic violations of discharge requirements have occurred for a number of years. New, considerably more stringent, wastewater discharge requirements have been issued to the City by the State that will require substantial improvements to the current wastewater treatment plant, or a new facility altogether. Since 1989, the City has, with the aid of consultants, been considering a wide range of potential solutions to the water supply, wastewater treatment, and effluent dispersal issues. Nevertheless, questions remained about the thoroughness of the studies with respect to other possible alternatives. To insure that all of the feasible alternatives have been examined, the City commissioned this study.

Thus, the purpose of this report is to answer the following questions:

1. Do alternative solutions exist that have yet to be considered?
2. Can the water supply and wastewater dispersal issues be addressed in a manner that spreads capital investment over a longer period of time and allows lower rate increases?

### GUIDING PRINCIPLES

The review of the available water supply, wastewater treatment, and effluent dispersal alternatives was conducted using the following five guiding principles.

1. **Security and reliability of the water supply source(s) is of paramount importance to the long-term security of a community.** Security and reliability of a water supply is determined by the probability of loss of the quantity required (e.g., dependence on a reservoir that will empty in a long drought) and the physical delivery system. Communities with diversity of supply and infrastructure (e.g., both surface and groundwater) generally have more security and reliability.

2. **Responsibility of the City.** The provision of an adequate supply of high quality water is essential for a functioning and sustainable community and, therefore, a fundamental responsibility of the city. Without adequate water, a community is constrained in the types of choices that can be made for future development; aesthetically, environmentally, and commercially. Limited water supplies do not, and should not, control growth at a desirable level, but result in a community with limited functionality and at risk when drought or other threats to the supply occur.
3. **The value of water will rise significantly in the future.** Water is currently and historically an undervalued resource. In many metropolitan areas the price has doubled in the past five years. In California the cost of suitable surface water is expected to increase by a factor of two to three within the next five years due to changing demographics and effects of global climate change, such as the major drought California appears to be entering currently. Similarly, the value of treated wastewater suitable for reuse applications will increase significantly, a factor the City should consider in selection among treatment alternatives. Of equal importance is the increase in competition for water. Construction of the peripheral canal will impact both competition and priorities for water allocation. Requirements for maintaining and restoring aquatic habitats are expected to increase in the future. Future growth of communities throughout California will place additional pressure on the limited, and possibly decreasing, water supplies of the state.
4. **The planning horizon should be as long as possible.** In the 1950's Davis had a population of less than 10,000 and the City made the decision to rely on groundwater rather than obtain rights to Solano Project water because, for the planning horizon at that time, a good quality, highly reliable source was provided by the intermediate aquifer. The decision resulted in a low cost, reasonable quality water supply for over 50 years.
5. **The city must meet applicable requirements for water quality, water treatment, and water reuse and/or dispersal.** Discharge requirements

have become more stringent and can be expected to tighten in the future.

The City's treatment plant cannot meet the current requirements and there is little confidence by City staff, consultants, and the Regional Board staff that changes in operation will improve the situation.

### **A RECOMMENDED PATH FORWARD**

Based on an analysis of alternatives developed by the City and its consultants and by applying the guiding principles cited above, the recommended path forward is as follows:

1. The City, together with the University and the City of Woodland, should move forward as rapidly as possible to develop a supply of surface water from the Sacramento River and other sources. Even with such supplies, blending of surface and groundwater may be necessary during dry periods. At this point in time, obtaining water from the Sacramento River is critical to securing a sustainable future for the City of Davis.
2. Make interim modifications to existing water supply infrastructure to reduce the selenium concentration, including the drilling of new deep-aquifer wells and converting wells with high selenium for landscape irrigation.
3. Move ahead with an aggressive water conservation program. An extensive water conservation program focused on outdoor uses should be implemented that includes positive inducements for xeriscaping of homes and commercial properties, inspection and repair of residential irrigation systems, improved management of park watering, and changes in public area plantings
4. Make interim modifications to wastewater treatment system to enhance the performance to meet existing discharge requirements for the interim until the final dispersal alternative is selected. As noted above, interim measures will be used to reduce the selenium concentration in the wastewater. Additionally, interim modifications will make it possible to defer the construction of a new wastewater treatment plant and allow costs to be spread over a longer time period.
5. Undertake a comprehensive analysis of the effluent dispersal alternatives

presented in Section 5. The Conway Ranch alternative, which became available recently, as well as the land application alternative, may allow continued use of the current wastewater treatment facility (with upstream selenium control) for some time and, thus, further decrease the financial impact on the City.

6. Once construction begins on the new water supply from the Sacramento River, reconsider the need for a new wastewater treatment plant.

The City of Davis is currently addressing a number of water resource management issues related to water supply, wastewater treatment, and effluent dispersal. Over the past 20 years, the city has engaged a number of consultants and numerous reports have been prepared on various aspects of each of these areas of concern. Most recently (2008), the City retained the National Water Research Institute (NWRI) to form an expert panel to review the water supply recommendations put forth by the consultants. The principal water resource management issues, as well as the purpose and organization of this report, are presented in this section.

**WATER RESOURCE MANAGEMENT ISSUES**

The principal water supply, wastewater treatment, and effluent dispersal issues confronting the City are:

- The quality of the City's water supply is decreasing due to increasing concentrations of nitrate, selenium, heavy metals, and total salinity.
- The security and reliability of the existing water supply is decreasing as demand for water increases.
- Recently imposed wastewater discharge requirements cannot be met reliably with the current wastewater treatment and dispersal system.
- Solutions to the above issues recommended by consultants will require significant capital investment and large increases in fees.

**PURPOSE OF REPORT**

In developing recommended solutions for the management of both water and wastewater, the consultants retained by the City have considered a wide range of potential alternatives. Nevertheless, questions remain about the thoroughness of the studies with respect to other possible alternatives. To insure that all of the feasible alternatives have been examined, the City retained Professors E. D. Schroeder and George Tchobanoglous, to review what has been done and to put forth other alternatives, if they exist. Both reviewers are long-term residents of the

City of Davis; their biographies may be found in Appendix A. The purpose of this report is to answer the following questions:

1. Do alternative solutions exist that have yet to be considered?
2. Can the water supply and wastewater dispersal issues be addressed in a manner that spreads capital investment over a longer period of time and allows lower rate increases?

Responses to the above questions have been developed by considering water supply, wastewater treatment, and effluent dispersal alternatives; the interconnections resulting from selection of the alternatives; and the probable future conditions for water rights; and wastewater dispersal regulation in California.

### **ORGANIZATION OF REPORT**

The report has been organized into the following sections:

1. Introduction
2. Guiding Principles for Review
3. Water Supply Alternatives
4. Wastewater Treatment Alternatives
5. Effluent Dispersal Alternatives
6. A Recommended Path Forward

The guiding principles used in assessing the various water resource management alternatives are set forth in Section 2. The various alternatives for water supply, wastewater treatment, and effluent dispersal are presented in Sections 3, 4, and 5, respectively. Integration of the individual elements into a recommended water resources management plan is presented in Section 6.

### **ACKNOWLEDGEMENTS**

The assistance of the following individuals is acknowledged gratefully. Keith Smith, Diane Phillips, and Jacques DeBra of the Department of Public Works of the City of Davis. Members from City's consultants including Brown and Caldwell; Carollo Engineers; Larry Walker and Associates; West Yost Engineers; Robinson, Stafford & Rude, Inc.; and Paul Simmons and Tess Dunham of Somach, Simmons, and Dunn. Dr. Harold Leverenz, UC Davis, reviewed the report.

## **GUIDING PRINCIPLES FOR REVIEW**

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In preparing this review, it was important to develop guiding principles against which all of the possible water supply, wastewater treatment, and wastewater dispersal alternatives could be judged. The review was conducted using the following five guiding principles.

1. Security and reliability of the water supply source(s) is of paramount importance to the long-term security of a community.
2. Provision of an adequate supply of high quality water is a fundamental responsibility of the City.
3. The value of water will rise significantly in the future and water supply options will diminish.
4. The planning horizon should be as long as possible.
5. The city must meet applicable requirements for water quality, water treatment, and water reuse and/or dispersal.

### **WATER SECURITY AND RELIABILITY**

With increasing demands for water, the availability of a secure and reliable source of water supply is of critical importance to the long-term sustainability of a community. The security and reliability of a water supply is determined by the probability of loss or interruption. Recognizing the critical importance of water, many communities have sought to develop multiple sources of supply as a means of improving system security. In 1955, with a population of less than 6,000, the City's groundwater supply could be considered very secure for the foreseeable future. Today, the groundwater supply is less secure because of growing demand on the aquifers and decreasing quality of the groundwater and the City has limited alternatives available in the development of new sources of water supply.

Reliability of a water supply is determined by the physical system used for treatment and delivery to consumers and characteristics of the water source. The current groundwater supply system is very reliable with respect to the physical delivery

system due to incorporation of a large number of wells (sources) and minimal treatment requirements. However, questions remain about the deteriorating quality of the groundwater and long-term sustainability of the aquifer. Surface water sources are less reliable in general because of temporal variations in source quantity and quality and, in the case of the Sacramento River, the necessity of transporting the water for considerable distances. Thus, any water supply system in particular is subject to circumstances that can affect overall reliability.

### **RESPONSIBILITY OF THE CITY**

The provision of an adequate supply of high quality water is essential for a functioning community and, therefore, a fundamental responsibility of the city. Without adequate water a community is constrained in the types of choices that can be made for future development, aesthetically, environmentally, and commercially. Limited water supplies do not control growth at a desirable level but result in a community with limited functionality and at risk when drought or other threats to the supply occur.

### **VALUE OF WATER**

Based on what the City of Davis consumers now pay, water is an undervalued resource. In the past five years, the price of water has doubled in many metropolitan areas. In California, the price of water is particularly sensitive to changing demographics, changing weather patterns, and periodic drought events, such as the one California appears to be entering currently. It is anticipated that the value of surface water suitable for use as a source of potable water will increase by a minimum factor of two or three within the next five years. Similarly, the value of treated wastewater suitable for reuse applications will also increase significantly. Although the value of potable water and treated wastewater will increase significantly over the next five years, it is anticipated that the cost of the supporting infrastructure will increase at somewhere near the inflation rate. Thus, in planning for water resources projects, the projected value of water must be used to evaluate possible alternatives.

### **PLANNING HORIZON**

The planning horizon for water supply projects should be based on planned

community growth, water use, and the long-term availability of regional water sources. Fifty years ago, the City made a decision to stay with groundwater sources rather than obtain Solano Project water on the basis of relative cost, the apparently abundant and high quality groundwater supply, and the expected growth of the community and region. Today, the City must select a planning horizon knowing the quality and quantity limitations of the groundwater supply, the increasing competition for regional water supplies, and the predicted decrease in precipitation in Northern California resulting from climate change.

### **MEETING APPLICABLE DRINKING WATER AND REUSE AND/OR DISPERSAL REQUIREMENTS**

Water and wastewater treatment systems are designed to remove specific constituents. The most common target constituents in water supplies are particulates (usually measured as turbidity) and pathogenic organisms. Conventional wastewater treatment systems are designed to remove particulates, readily biodegradable organic material, and pathogenic organisms added to the water supply during usage. In both water and wastewater treatment, dissolved inorganic constituents are difficult and expensive to remove.

Davis groundwater has a high concentration of dissolved inorganic constituents including a number that pose particular health and environmental issues. Treatment to meet new and anticipated more stringent Federal and State drinking water standards will incur treatment costs in the future. Although Sacramento River water has low concentrations of inorganic constituents, it does contain trace concentrations of agricultural chemicals, which may or may not need to be removed.

In addition to the dissolved inorganic constituents in the water supply, wastewater also contains a variety of trace constituents including a myriad of pharmaceuticals and personal care products and heavy metals added by pipe corrosion and other sources. While the presence of these trace constituents does not appear to have observable long-term effects on humans, their presence in treated wastewater discharged to receiving waters has been found to cause environmental and ecological impacts. As more is understood about these trace constituents, it is anticipated that the discharge standards for treated effluents will become more

stringent, necessitating more advanced treatment methods beyond conventional secondary.

While modern water and wastewater systems must be able to meet applicable water quality criteria, they should also have the capacity to be expanded or upgraded to address future demands.

## WATER SUPPLY ALTERNATIVES

The analysis of alternatives, as noted above, has been divided into three parts dealing with: (1) water supply alternatives, (2) wastewater treatment alternatives, and (3) wastewater dispersal alternatives. Water supply alternatives are considered in this section. Wastewater treatment and dispersal are considered in the following sections. The water supply alternatives available to the City of Davis are as follows:

1. Use of surface water from the Sacramento River with supplemental water from deep wells and surface water purchases.
2. Continued use of current well system supplemented by Solano Project water .
3. Continued use of current groundwater well system with addition of new wells as necessary
4. Continued use of current groundwater well system with extensive conservation measures

It should be noted that some of these alternatives have been examined in detail in previous reports.

Regardless of the water supply alternative selected, an extensive conservation program based on positive inducements and focused particularly on the reduction of outdoor water use and on the introduction of technology for graywater reuse should be initiated. Positive inducements for homeowners and businesses to install water saving devices, appropriate levels of graywater technology, and landscaping together with changes in landscaping and management of public spaces that emphasize use of native plants and xeriscaping could greatly decrease water demand over time. Requiring xeriscaping and use of native plants in new development would be a conservation benefit. At present, the average demand during the months of November through March, when landscape irrigation is minimal, is approximately 125 gallons per person per day. Extensive conservation in homes and businesses can reduce this value to 50 gallons per person per day. Average demand during the months of April through October is nearly 280 gallons per person per day and could be reduced considerably using positive inducements

for better irrigation management, improved landscaping, proactive leak detection (particularly of irrigation systems), and other practices. Using positive inducements such as help with leak detection, guidance in appropriate landscaping, and providing low water use appliances, as has been done elsewhere, will bring community support and pride and speed the conservation process.

### **DEVELOPMENT OF PARTNERED PROJECT TO USE SACRAMENTO RIVER WATER**

This alternative involves using the City's water rights to Sacramento River water, constructing a water treatment plant jointly with the City of Woodland and the University, and constructing a pipeline to convey treated water to Davis. Even with a permit to take water from the Sacramento River, the available quantity will vary. The expected water rights would be available only during periods when the State's commitments for water from the Sacramento River watershed do not exceed the supply. In most years water will not be available during July and August and the period may be extended during droughts or if increased flow is required for management of Delta water quality. Construction of the peripheral canal around the Delta, climate change, and growth in other northern California communities having priority may result in decreased availability. Supplemental water will therefore be necessary during a portion of most years and would be supplied from groundwater and through purchases from other agencies having water rights to Sacramento River water. Because supplemental surface water will be purchased, conservation measures will have a direct benefit of saving the community money. At present, a major drought that may be more severe than that of the late 1980's appears to be forming and will impact both the competition for and price of available water. The advantages and disadvantages of the use of a partnered project to use Sacramento River water are presented in Table 3-1.

### **CONTINUED USE OF CURRENT WELL SYSTEM SUPPLEMENTED BY SOLANO PROJECT WATER**

The University of California, Davis has rights to 4,000 ac-ft/yr (acre-feet per year) of Solano Project (Lake Berryessa) water that is currently used for experimental crop irrigation. The City's current average usage is approximately 125 gal/capita·d during the months of November through March when irrigation uses are minimal. If the

municipal demand could be reduced to 100 gal/capita·d, similar to usage observed in other communities of the same size, then 4,000 ac-ft/yr would supply approximately 35,000 people or half the population of Davis.

Table 3-1  
Analysis of the development of partnered project to use Sacramento River water

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Improved water quality for consumption</li> <li>• Elimination of current problem constituents in water and wastewater</li> <li>• Improves water security and reliability for City</li> <li>• The City would have two sources of water: the Sacramento River and groundwater from the existing system</li> </ul>	<ul style="list-style-type: none"> <li>• High cost of treatment and transmission</li> <li>• Limited water rights to Sacramento River may necessitate the purchase of potable water from other sources</li> <li>• Groundwater will continue to be a required component</li> <li>• Potential uneven distribution of high quality water to consumers</li> </ul>

Risk Assessment

- Reduces risk of future water shortages
- Available quantity is variable, depending on flow in the Sacramento River and other downstream demands
- Drought events will impact availability and price of purchased water
- Negotiations with partners will be necessary

This alternative involves construction of a relatively short pipeline to bring Solano Project water from the current discharge point on the West Campus to a new treatment plant on City property, connection to the City distribution system, and reworking parts of the distribution system to allow groundwater to be dedicated to irrigation of public areas.

During the months of April through October when irrigation requirements are heavy, the average demand is nearly 280 gal/capita·d, and thus groundwater, or some other source, would be required in addition to Solano Project water. However, much of the groundwater could be dedicated to irrigation and thus have no impact on wastewater discharge requirements. Supplements of deep well water could be added for a substantial period to accommodate commercial, industrial, or population growth.

With extensive conservation in homes and commercial buildings, water demand can be reduced to 50 gal/capita·d and 4000 ac-ft/yr would then be enough to supply the current city population's domestic requirements. Such a level of conservation would take many years to achieve, but using positive inducements, substantial improvements could be made quickly, as described above.

Under this alternative it would be appropriate for the City to supply the University's domestic demand, decreasing the quantity available for the City supply. However, blending of Solano Project Water with the City groundwater at the rate necessary to satisfy the demand would result in a higher aesthetic quality, lower hardness, decreased demand on the stressed aquifer, and elimination of problems of selenium and salinity in the wastewater discharge.

The advantages and disadvantages of the continued use of the current well system supplemented by Solano Project Water are presented in Table 3-2.

Table 3-2  
Analysis of the continued use of the current well system supplemented by Solano Project Water.

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Improved water and wastewater quality relative to both groundwater and Sacramento River water</li> <li>• Elimination of current problem constituents from water and wastewater</li> <li>• Potential for improved water quality on campus if University chooses to tie into City system</li> <li>• Decreased cost relative to Sacramento River source.</li> <li>• Allow the existing wells to serve as a reserve and dedicated water supply for irrigation demand</li> </ul>	<ul style="list-style-type: none"> <li>• Cost of treatment will be significantly greater than current cost of groundwater</li> <li>• Current users of Solano Project water may be very resistant to change</li> <li>• Quantity of water available is limited to 4,000 acre-ft</li> <li>• Distribution of high quality water will be uneven. Consumers may be resistant to paying for water quality they do not receive.</li> <li>• Potentially available supply of Solano Project Water is considerably less than required</li> <li>• Utilization of the deep aquifer may be necessary in the future</li> </ul>
<p>Risk Assessment</p>	
<ul style="list-style-type: none"> <li>• City may lose water rights to Sacramento River water if rights are not exercised in the near future</li> <li>• Negotiations with University will be necessary</li> <li>• Use of deep aquifer may eventually be necessary to supplement other sources</li> </ul>	

### **CONTINUED USE OF CURRENT WELL SYSTEM WITH ADDITION OF NEW DEEP WELLS**

This alternative involves increased dependence on the deep aquifer due to high selenium and other constituents of concern in water from the intermediate aquifer. Considerable reworking of the distribution system to allow the intermediate aquifer wells having high selenium concentrations to be dedicated to irrigation of parks and other public areas would be required to implement this alternative. Using the water from the intermediate aquifer wells for irrigation would reduce the concentration of selenium in the wastewater. Many currently used wells will need to be replaced and new wells will need to be added in the future. It is anticipated that the rate of failure of wells in the intermediate aquifer will increase in an extended drought, such as the one of the late 1980's and the one that may be beginning at present.

Extensive conservation, as described above, would be a necessity because of questions about the security of the deep aquifer. The water in the deep aquifer has been estimated to be several thousand years old and the source of water is unknown, although there is at least some interconnection with the intermediate aquifer. Increased withdrawals from the deep aquifer may result in significant contamination with constituents from the intermediate aquifer or subsidence due to collapse of the empty pores. The advantages and disadvantages of the use of the current well system with addition of new deep wells and extensive conservation are presented in table 3-3.

### **CONTINUED USE OF CURRENT WELL SYSTEM AND EXTENSIVE CONSERVATION**

This alternative is similar to the previous alternative and is the least desirable of those considered. Continued use of current wells, removal of aging wells, drilling of new deep aquifer wells as necessary, and aggressively increasing the level of conservation, as described above, would be required. Where accomplished easily, upper aquifer wells may be dedicated to irrigation. Well head treatment of some wells using reverse osmosis is a possibility that would address the selenium and salinity problems, also. Brines from reverse osmosis could be treated in evaporation ponds.

The advantages and disadvantages of the use of the current well system with

extensive conservation are presented in table 3-4. Note that this and the previous alternatives essentially extend the decision to depend on groundwater made 50 years ago when the population of Davis was approximately 6,000, the University was expected to enroll no more than 19,000 students, the nature and demands of the University's research facilities was unimagined. Today, with a population of 65,000 the City is still drawing from the same supply.

Table 3-3  
Analysis of the continued use of current well system with addition of new deep wells

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Essentially all of the needed short-term distribution infrastructure is in place.</li> <li>• No new Environmental Impact Report is required.</li> <li>• Costs will remain relatively low compared to other alternatives.</li> </ul>	<ul style="list-style-type: none"> <li>• Continued/increased dependence on deep aquifer to meet wastewater discharge requirements for Se and metals.</li> <li>• Intermediate aquifer quality is deteriorating both aesthetically and with respect to specific constituents (e.g., Se and NO<sub>3</sub>).</li> <li>• Intermediate and deep aquifers are interconnected and increased pumping of deep aquifer may result in transport (leakage) of constituents from the upper to the lower aquifer.</li> <li>• Deep aquifer capacity may be limited and may not support long-term water requirements. Over drafting may result in subsidence.</li> <li>• Costs of reworking the distribution system and redirecting problematic wells to irrigation will be significant.</li> <li>• The city may find itself with an unsustainable water supply.</li> </ul>

Risk Assessment

<ul style="list-style-type: none"> <li>• City may lose water rights to Sacramento River water if rights are not exercised in the near future</li> <li>• Potential sources of purchased surface water may be taken by other users</li> <li>• Intermediate aquifer well failure rates will increase with extended drought events</li> <li>• Increased water demand may result in mining of deep aquifer, unsustainable supply, and subsidence.</li> <li>• Increased use of water from the deep aquifer by the city may interfere with UC Davis domestic supply</li> <li>• Increased use of deep aquifer may result in contamination from upper aquifer due to leakage</li> </ul>
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Table 3-4

Analysis of the continued use of the current well system with extensive conservation.

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Extensive conservation may significantly decrease dependence on intermediate aquifer.</li> <li>• Essentially all of the needed infrastructure is in place.</li> <li>• No new Environmental Impact Report is required.</li> <li>• Costs will remain relatively low compared to other alternatives.</li> <li>• Public attitude toward/understanding of water conservation will be focused.</li> <li>• Potential for City to become center for development of community water conservation.</li> </ul>	<ul style="list-style-type: none"> <li>• Intermediate aquifer quality is deteriorating both aesthetically and with respect to specific constituents (e.g., Se and NO<sub>3</sub>-).</li> <li>• Even with extreme conservation, use of the deep aquifer will be necessary because of the quality issues with the intermediate aquifer.</li> <li>• Exacerbates some of the wastewater issues (i.e., salinity and selenium)</li> </ul>

Risk Assessment

<ul style="list-style-type: none"> <li>• City may lose water rights to Sacramento River water if rights are not exercised in the near future.</li> <li>• Potential sources of purchased surface water may be taken by other users.</li> <li>• City demand may result in future mining of deep aquifer.</li> </ul>
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## ***WASTEWATER TREATMENT ALTERNATIVES***

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Wastewater treatment alternatives were developed based on the need to meet specific criteria as discussed in Section 2. In all cases preliminary treatment that includes grit removal and primary clarification will be necessary. Problem constituents include salinity, ammonia, selenium, and several metals, notably aluminum and copper. Salinity and selenium discharge requirements can be met by changes to the water supply as described above and hence wastewater management alternatives are subject to decisions made about the City's water supply. The necessity for meeting Title 22 requirements occurs if the discharge is to effluent dominated receiving waters (e.g., Willow Slough) or used for beneficial reuse applications that offset potable water demand. Selection of the best alternative will depend on the effluent dispersal method. The following wastewater treatment alternatives are available to the City of Davis:

1. Conventional treatment to meet Title 22 requirements
2. Conventional treatment to meet Title 22 requirements as modified by the value engineering recommendations
3. Continued use of modified existing system
4. Membrane bioreactor activated sludge to meet Title 22 requirements for satellite reclamation and reuse

The relationship of these treatment alternatives to the available dispersal options is considered in the following section.

### **CONVENTIONAL TREATMENT TO MEET TITLE 22 REQUIREMENTS**

This alternative involves construction of an extended aeration activated sludge process with deep secondary clarifiers followed by membrane filtration and disinfection. The activated sludge process can be any of several configurations including sequencing batch reactor (SBR), an oxidation ditch, and other similar processes. Such a system was proposed by the City's consultants (Carollo Engineers) and was subjected to value engineering in a workshop held January 14, through 16, 2009. In the proposed treatment system, it is important to note that the

problem of meeting selenium discharge requirements will be resolved by eliminating or controlling the presence of selenium in the water supply source.

At the time the conventional system was selected as the best alternative by Carollo Engineers, the range of effluent dispersal options did not include land dispersal on Conaway Ranch or joining with Sacramento Regional Treatment Plant, as described in Section 5. Deep secondary clarifiers, even though more expensive initially, are recommended because under normal operation they typically produce an effluent that can meet the Title 22 turbidity standard without filtration. However, filtration will be required by the State to insure process reliability against occasional system upset. Conceptually, filtration also provides multiple barriers against the discharge of solids.

The extended aeration process is favored because it can be operated with relatively high solids concentrations, which are important with respect to the removal of trace constituents, particularly metals. In addition, the process can be operated to nitrify and denitrify reliably. The advantages and disadvantages of the proposed conventional treatment process to meet Title 22 requirements are presented in Table 4-1.

#### **CONVENTIONAL TREATMENT TO MEET TITLE 22 REQUIREMENTS AS MODIFIED BY THE VALUE ENGINEERING RECOMMENDATIONS**

This alternative involves construction of essentially the same treatment process as described above, as modified by the value engineering recommendations. Although a number of valuable process and cost saving suggestions were made, two of the recommendations are highlighted below.

1. Replace the membrane filters with deep-bed gravity filters.
2. Use one of the exiting algal ponds as a storage basin for off specification treated effluent.

Both of the above recommendations are focused on the management of ammonia. With chemical addition, additional nitrification can be achieved with deep-bed granular medium filters. The storage basin could be used to divert effluent in which the ammonium concentration exceeded the very stringent limits imposed by the

Table 4-1  
 Analysis of conventional treatment to meet Title 22 requirements

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Stable operation.</li> <li>• Complete nitrification.</li> <li>• Denitrification can be incorporated, if required.</li> <li>• With disinfection will meet Title 22.</li> </ul>	<ul style="list-style-type: none"> <li>• Metals removal may be problematic and chemical addition may be required.</li> <li>• Requires upstream control of selenium and salinity</li> <li>• Little factor of safety for the exceedance of the ammonia limits.</li> <li>• Constructing a conventional wastewater treatment facility simultaneously with a surface water supply system will approximately double the increase in utility rates.</li> </ul>

Risk Assessment

<ul style="list-style-type: none"> <li>• For discharge to receiving water, ammonia, metals, selenium, and salinity will need to be addressed.</li> <li>• Extended aeration processes are widely used, known to be stable, and will be easily supported by regulators.</li> </ul>
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discharge permit. The idea of using storage ponds for off specification treated effluent can be utilized with the existing system, as described subsequently. The advantages and disadvantages of the proposed conventional treatment process to meet Title 22 requirements as modified by the value engineering recommendations are presented in Table 4-2.

**CONTINUED USE OF MODIFIED EXISTING SYSTEM**

This alternative involves the continued use of the existing wastewater treatment system with extensive equipment and operational modifications. Selection of this alternative would be less expensive than constructing a new secondary treatment system and allow spreading the total costs for water supply and wastewater treatment over a longer time period. However, the modified system may have a shorter operating life than the alternatives above. Important modifications would include conversion of several ponds to aerated ponds, using one covered pond as a settling unit, and reworking of the existing overland flow slopes. Operationally, the practice of discharging nutrient poor, algae rich, partially treated wastewater to the

Table 4-2  
 Analysis of conventional treatment to meet Title 22 requirements as modified by the value engineering recommendations

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Stable operation.</li> <li>• Complete nitrification.</li> <li>• Recommended modifications offer greater reliability in meeting ammonia discharge limits.</li> <li>• Denitrification can be incorporated, if required.</li> <li>• With disinfection will meet Title 22.</li> </ul>	<ul style="list-style-type: none"> <li>• Metals removal may be problematic</li> <li>• Chemical addition may be required for metals removal may be problematic.</li> <li>• Requires upstream control of selenium and salinity.</li> </ul>
Risk Assessment	
<ul style="list-style-type: none"> <li>• For discharge to receiving water, metals, selenium, and salinity will need to be addressed</li> <li>• Extended aeration processes are widely used, known to be stable, and will be easily supported by regulators</li> </ul>	

overland flow system has led to violations of effluent discharge limits. For example, with respect to suspended solids violations, during certain times of the year the size of the algae produced in the existing ponds is so small that they will pass through the overland flow slopes unimpeded, and, in fact, without the addition of chemicals will pass through conventional gravity filters. Clearly, the current mode of operation is unacceptable and unsustainable.

The advantages and disadvantages of the continued used of modified existing system are presented in Table 4-3.

**MEMBRANE BIOREACTOR ACTIVATED SLUDGE TO MEET TITLE 22 REQUIREMENTS FOR SATELLITE WATER RECLAMATION AND REUSE**

Membrane bioreactors (MBR) combine biological treatment with an integrated membrane system to provide enhanced removal of organics and suspended solids. Membranes are used to replace sedimentation and filtration (see previous discussion) for separating the biomass from the treated water in suspended growth activated sludge systems. A major advantage of the MBR process is a smaller space (footprint) for treatment.

Table 4-3  
 Analysis of continued use of modified existing system.

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Major infrastructure and treatment units are in place.</li> <li>• In past pilot studies, it has been demonstrated that the existing overland flow system could produce a very high quality effluent.</li> <li>• Selenium (Se) removal occurs in overland flow system at present.</li> <li>• Initial cost would be lower than new secondary treatment system.</li> </ul>	<ul style="list-style-type: none"> <li>• Operational problems over past years have discouraged staff and regulators</li> <li>• Considerable alteration of current systems will be necessary</li> <li>• Although overland flow system has never been operated as recommended, some issues (e.g., erosion) may remain</li> <li>• Groundwater contamination due to the use of unlined ponds may be an issue in the future</li> <li>• Modified system may not meet future discharge standards.</li> <li>• Requires upstream control of salinity.</li> </ul>
<p>Risk Assessment</p>	
<ul style="list-style-type: none"> <li>• History of current process leads to questions about stability</li> <li>• Meeting groundwater salinity requirements may be dependent on surface water source</li> </ul>	

In the future, for new developments extraction of wastewater near the point of generation (also known as sewer mining) and treatment with an MBR process could be used for localized reuse applications. The smaller required footprint allows MBR plants to be located in sites with limited area or completely enclosed in buildings that look like residences. Further, it is reasonable to assume the installation of localized treatment systems using MBRs in future projects could be financed based on the value of water for landscape irrigation. The advantages and disadvantages of the use of membrane bioreactor activated sludge to meet Title 22 requirements for satellite water reclamation and reuse are presented in Table 4-4.

Table 4-4

Analysis of the use of membrane bioreactor activated sludge to Meet Title 22 requirements for satellite water reclamation and reuse

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Very stable operation.</li> <li>• Complete nitrification is achieved and denitrification can be incorporated.</li> <li>• Pathogen removal is relatively high.</li> <li>• Units can be phased in as needed.</li> <li>• Water reuse can be implemented without extensive dual distribution system.</li> </ul>	<ul style="list-style-type: none"> <li>• Metals removal may be problematic.</li> <li>• Energy intensive with respect to aeration.</li> <li>• Requires upstream control of selenium and salinity.</li> </ul>
Risk Assessment	
<ul style="list-style-type: none"> <li>• For discharge to receiving water metals, selenium, and salinity will need to be addressed.</li> <li>• Site availability may be restricted.</li> </ul>	

## ***EFFLUENT DISPERSAL ALTERNATIVES***

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The following alternatives are available to the City of Davis for the dispersal of wastewater following treatment.

1. Discharge to Conaway Ranch with Water Reuse
2. Discharge to City Land Summer/Winter with Water Reuse
3. Combined Conaway Ranch/Receiving Water Discharge
4. Continued Discharge to Receiving Waters
5. Discharge to Sacramento Regional Treatment Plant

The advantages and disadvantages of each of these alternatives and the corresponding risks are assessed in the following discussion. Alternatives 1 and 2, take into account the increasing value of water and the fact that highly treated effluent with relatively low salinity (based on a new source of water) will be a desirable commodity. Implementation of water reuse for applications such as landscape irrigation and non-potable urban uses will reduce demand for potable supply.

### **DISCHARGE TO CONAWAY RANCH WITH WATER REUSE**

This alternative involves dispersal of the treated effluent to the Conaway Ranch where it will be used for irrigation. A pipeline with necessary pumping facilities will be needed to transport treated wastewater from the City's treatment plant to a reservoir on Conaway Ranch. The reservoir will need to be large enough to provide winter storage when irrigation is not used. A minimum of secondary treatment will be required, but additional treatment to Title 22 standards may be desired to facilitate non-potable water reuse. Advanced treatment will increase the value of the water because irrigation of a wider variety of crops will be permitted. If the City selects a surface water supply alternative the value of the treated wastewater will increase further due to the lowered salinity.

The advantages, disadvantages, and risks associated with the discharge to Conaway Ranch with recycling are presented in Table 5-1.

Table 5-1  
Analysis of discharge to Conaway Ranch

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• All of the flow can be discharged to land.</li> <li>• Secondary effluent is acceptable for proposed application.</li> <li>• Depending on type of contract, local use of a portion of the wastewater is still possible.</li> <li>• Water reuse can be used to offset potable demand</li> </ul>	<ul style="list-style-type: none"> <li>• New transport and reuse infrastructure is required.</li> <li>• Must provide winter storage for treated effluent.</li> <li>• City must continue to operate treatment plant.</li> <li>• Depending on type of contract, local use of a portion of the wastewater may not be possible</li> </ul>

Risk Assessment

- More stringent groundwater discharge requirements could increase treatment costs significantly in the future

**DISCHARGE TO CITY LAND SUMMER/WINTER WITH WATER REUSE**

This alternative involves the dispersal of treated effluent to land owned by the City or other purchased or contracted lands, and implementation of other localized water reuse opportunities. The advantages and disadvantages and the risks associated with this method of dispersal are detailed in Table 5-2.

Table 5-2  
Analysis of the continued discharge to City land summer/winter

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• City currently owns most of the land required</li> <li>• Gives city flexibility in what use can be made of the wastewater</li> </ul>	<ul style="list-style-type: none"> <li>• More land may need to be purchased</li> <li>• New, and possibly complex, transport and reuse infrastructure is required</li> <li>• City must continue to operate treatment plant</li> </ul>

Risk Assessment

- More stringent groundwater discharge requirements could increase treatment costs significantly in the future

**COMBINED CONAWAY RANCH/RECEIVING WATER DISCHARGE**

This alternative involves a combined discharge to the Conaway Ranch during the summer coupled with a discharge to receiving waters during the winter. Winter water supply could be primarily from the deep aquifer and any intermediate aquifer

wells used should be low in selenium. The advantages and disadvantages and the risks associated with combined Conaway Ranch/receiving water discharge are detailed in Table 5-3.

Table 5-3  
Analysis of the discharge to Conaway Ranch in summer and receiving waters in winter

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• All of the flow can be discharged to land.</li> <li>• Secondary effluent is acceptable for proposed application.</li> <li>• Depending on type of contract, local use of a portion of the wastewater is still possible</li> <li>• Winter storage for treated effluent is not required.</li> </ul>	<ul style="list-style-type: none"> <li>• New transport infrastructure is required.</li> <li>• City must continue to operate treatment plant.</li> <li>• Must meet stringent discharge requirements during the winter discharge period.</li> <li>• A new treatment plant will be needed or the current system will need substantial modification.</li> </ul>
Risk Assessment	
<ul style="list-style-type: none"> <li>• More stringent discharge requirements both for land dispersal and receiving water discharge could increase treatment costs significantly in the future.</li> </ul>	

### **CONTINUED DISCHARGE TO RECEIVING WATERS**

This alternative involves a continuation of the current City of Davis dispersal method. Because for most of the year the City’s discharge dominates flow in Willow Slough Bypass, Title 22 requirements must be met. Some consideration should be given to possible future changes in Title 22 requirements related to trace constituents and personal care products. As the ability to detect and measure these compounds improves, impacts on aquatic organisms are likely to be detected and discharge requirements made more stringent. The advantages and disadvantages and the risks associated with continued discharge to receiving waters are detailed in Table 5-4.

### **DISCHARGE TO SACRAMENTO REGIONAL WASTEWATER TREATMENT PLANT**

This alternative involves building a pipeline to West Sacramento to connect to the Sacramento Regional Wastewater Treatment Plant (SRWTTP). Of particular importance is that the City would lose control of a valuable resource and would need

to pay its share for future improvements necessary to meet Delta discharge requirements. The advantages and disadvantages and the risks associated with discharge to the SRWWTP are detailed in Table 5-5.

Table 5-4  
Analysis of the continued discharge to receiving waters

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>Essentially all of the needed infrastructure is in place.</li> <li>No new Environmental Impact Report is required.</li> <li>Future dispersal requirements are known for at least five years.</li> <li>City controls the wastewater, which could be used for other purposes including agricultural irrigation.</li> </ul>	<ul style="list-style-type: none"> <li>Title 22 discharge requirements must be met.</li> <li>Little or no control over future dispersal limits.</li> <li>Current problems in meeting discharge limits will necessitate increased investment in wastewater treatment processes.</li> <li>Designation of dispersal location could change in the future.</li> </ul>
Risk Assessment	
<ul style="list-style-type: none"> <li>More stringent future discharge requirements could (and are likely to) increase treatment costs significantly.</li> </ul>	

Table 5-5  
Analysis of discharge to SRWWTP

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>Operation of existing City of Davis wastewater treatment plant is eliminated</li> <li>Long term security with respect to wastewater management is assured</li> <li>Local use of a portion of the wastewater is still possible</li> </ul>	<ul style="list-style-type: none"> <li>Future costs will be based on dispersal limits to the Sacramento River from the Sacramento Regional treatment plant</li> <li>Citizens of Davis will have little control over current and future investments for improved wastewater treatment facilities.</li> <li>Significant hookup fee for the residents of the City of Davis</li> <li>Difficult negotiations over right-of-way access to build pipeline.</li> <li>While local use might be made of a portion of the wastewater, the fees to the Sacramento Regional Authority would remain.</li> </ul>
Risk Assessment	
<ul style="list-style-type: none"> <li>Little control over rate increases to meet future dispersal requirements</li> </ul>	

## *A RECOMMENDED PATH FORWARD*

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Alternatives for water supply, wastewater treatment, and effluent dispersal have been developed and discussed previously in Sections 3 through 5. In this section a recommended path forward is presented, based on the material presented above, an analysis of supporting material developed by the City and its consultants, and by applying the guiding principles set forth in Section 2. The recommended path forward is as follows.

1. The City, together with the University and the City of Woodland, should move forward as rapidly as possible to develop a supply of surface water from the Sacramento River and other sources. Even with such supplies, blending of surface and groundwater may be necessary during dry periods. At this point in time, obtaining water from the Sacramento River is critical to securing a sustainable future for the City of Davis.
2. Make interim modifications to existing water supply infrastructure to reduce the selenium concentration, including the drilling of new deep-aquifer wells and converting wells with high selenium for landscape irrigation.
3. Move ahead with an aggressive water conservation program. An extensive water conservation program focused on outdoor uses should be implemented that includes positive inducements for xeriscaping of homes and commercial properties, inspection and repair of residential irrigation systems, and improved management of park watering and changes in public area plantings
4. Make interim modifications to wastewater treatment system to enhance the performance to meet existing discharge requirements for the interim until the final dispersal alternative is selected. As noted above, interim measures will be used to reduce the selenium concentration in the wastewater. Additionally, interim modifications will make it possible to defer the construction of a new wastewater treatment plant and allow costs to be spread over a longer time period.

5. Undertake a comprehensive analysis of the dispersal of secondary effluent of the dispersal options presented previously in Section 5. The Conway Ranch alternative, which became available recently, as well as the land application alternative, may allow continued use of the current wastewater treatment facility (with upstream selenium control) for some time and thus further decrease the financial impact on the City.
6. Once construction begins on the new water supply from the Sacramento River, reconsider the need a new wastewater treatment plant.

## **Appendix A**

### **Reviewer Biographies**

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Review of City of Davis Water Resources Master Plan  
Davis, California

**Edward Schroeder, Ph. D.**

*Professor Emeritus*

*University of California, Davis (Davis, California)*

Edward Schroeder taught courses and conducted research on water quality, water supply, and water and wastewater treatment at the University of California, Davis for 36 years. During this period Schroeder supervised 25 doctoral and 100 MS students. He served as Visiting Professor at University College, Swansea (Wales), The University of Leeds, The Hong Kong University of Science and Technology, and Canterbury University (New Zealand). Professor Schroeder has authored or coauthored over 160 publications and three textbooks and served as coeditor of *Global Sustainability: The Impact of Cultures*. He has received the Academic Senate and Engineering Alumni awards for distinguished teaching and the Water Environment Federation McKee Medal for research. Schroeder served on the California Regional Water Quality Control Board – Central Valley Region for three years and has served as a consultant to local and state governments, consulting firms, and non-profit environmental groups and as an advisor for a number of university programs in environmental engineering. He received a B.S. in Civil Engineering and M.S. in Sanitary Engineering from Oregon State University and a Ph.D. in Chemical Engineering from Rice University.

**GEORGE TCHOBANOGLIOUS, PH.D., P.E.**

*Professor Emeritus*

*University of California, Davis (Davis, California)*

For over 35 years, wastewater expert George Tchobanoglous has taught courses on water and wastewater treatment and solid waste management at the University of California, Davis, where he is Professor Emeritus in the Department of Civil and Environmental Engineering. He has authored or coauthored over 350 publications, including 13 textbooks and five engineering reference books. Tchobanoglous has been past President of the Association of Environmental Engineering and Science Professors and currently serves as a national and international consultant to both government agencies and private concerns. Among his honors, he received the Athalie Richardson Irvine Clarke Prize from NWRI in 2003, was inducted to the National Academy of Engineers in 2004, and received an Honorary Doctor of Engineering degree from the Colorado School of Mines in 2005. Tchobanoglous received a B.S. in Civil Engineering from the University of the Pacific, an M.S. in Sanitary Engineering from the University of California, Berkeley, and a Ph.D. in Environmental Engineering from Stanford University.

## **Appendix B**

### Summary of Meetings with City Staff and Consultants

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Review of City of Davis Water Resources Master Plan  
Davis, California

## SUMMARY OF MEETINGS WITH CITY STAFF AND CONSULTANTS

### WENDSDAY October 29, 2008

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**Location:** City of Davis Corporation Yard

**Attendees:** City of Davis, Keith Smith, Diane Phillips, and Jacques DeBra  
Reviewers, Edward Schroeder and George Tchobanoglous

**Purpose:**

The purpose of this first meeting was for the reviewers to meet the city staff in charge of the review and to discuss the general parameters of the review.

**Meeting Summary:**

The City Councils directive of September 9, 2008 was discussed. Keith Smith provided a summary of the current status of planning for both water supply and wastewater dispersal, the current and anticipated groundwater quality and quantity situation, and the wastewater discharge regulations. Jacques DeBra provided additional details and historical background. The meeting lasted one hour.

### THURSDAY NOVEMBER 20, 2008

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**Location:** City of Davis Corporation Yard

**Attendees:** City of Davis, Keith Smith, Diane Phillips, and Bob Weir  
Consultants, Lydia Holmes, Steve MacDonald, and Steve Swanback,  
(Carollo Engineers), Dave Anderson and Kathryn Geiss, (West Yost  
Engineers); and Tom Grovhoug, Tess Dunham (Larry Walker and  
Associates).

Reviewers, Edward Schroeder and George Tchobanoglous

**Purpose:**

The purpose of the meeting, organized by the city staff, was to provide background information on how the City of Davis and its consultants arrived at the conclusions they have reached concerning wastewater resources management for the city. To facilitate the discussion, the following informal agenda was set up to provide perspective for the outside reviewers.

Introduction

Why are we here  
Background on Permit (2001-2005)  
Water Supply/NWRI  
Review of Master Plan  
    Process  
    Conclusions  
Review of Process Confirmation  
    Conclusions moved to PDR  
Permit Update (2005-2008)  
Current Developments  
Next Steps  
    Peer Review  
VF of PDR  
Questions

**Meeting Summary:**

The meeting, which lasted about three and half hours, was set up by the city staff. The focus of the general discussion was how the City of Davis and its consultants arrived at the conclusions they have reached concerning wastewater resources management for the city.

**MONDAY DECEMBER 15, 2008**

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**Location:** City of Davis Corporation Yard

**Attendees:** City of Davis, Keith Smith and Diane Phillips

Reviewers, Edward Schroeder and George Tchobanoglous

**Purpose:**

The meeting was requested by the reviewers to discuss the proposed approach to addressing the questions asked by the City Council and to go over questions the reviewers had developed.

**Meeting Summary:**

An outline of the approach taken by the reviewers was discussed with Mr. Smith and Ms. Phillips. The outline incorporated a problem statement, guiding principles of the

review, and advantages, disadvantages, and associated risks of water supply, wastewater treatment, and wastewater dispersal alternatives developed by consultants and the reviewers. The meeting lasted approximately one and one-half hours.

#### **TUESDAY DECEMBER 16, 2008**

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**Location:** City of Davis Corporation Yard

**Attendees:** City of Davis, Keith Smith, Diane Phillips, and Jaques DeBra  
Consultants, Dave Anderson, Steve Macaulay, Monique deBarruel (West Yost Engineers), Jerome Gilbert (Consultant to West Yost Engineers)  
Reviewer, George Tchobanoglous

**Purpose:**

The purpose of the meeting was to discuss the near term objectives and work plan of the Davis/Woodland Water Supply Project. The meeting was originally scheduled by the City. The reviewers were invited for informational purposes. Edward Schroeder was absent due to a conflict.

**Meeting Summary:**

Following a summary of the project history the discussion focused on the relationship between the regional water supply project and the local Davis wastewater treatment and dispersal. The value of and the future competition for water resources and the need to consider water supply and wastewater management as individual or separate issues were discussed. The meeting lasted for approximately two hours.

#### **Wednesday January 14, 2009**

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**Location:** IHOP restaurant, Davis

**Attendees:** Consultants, , Steve McDonald, Lydia Homes (Carollo Engineers)  
Reviewers, Edward Schroeder and George Tchobanoglous

**Purpose:**

Steve McDonald asked to meet prior to value engineering workshop

**Meeting Summary**

The meeting lasted about 60 minutes and was focused general questions of wastewater treatment process selection and George's photography exhibit at the Natsoulas Gallery.

### **Wednesday January 14, 2009**

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**Location:** West Yost Associates, Davis

**Attendees:** City of Davis, City Staff (City has complete list)  
Consultants, Representatives of Brown and Caldwell, Carollo (City has complete list)  
Reviewers, Edward Schroeder and George Tchobanoglous

**Purpose:**

Attend opening of Value Engineering Workshop

**Meeting Summary**

Attended introductory session for informational purposes only. Did not participate and left following introductory session – prior to field trip.

### **Friday January 16, 2009**

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**Location:** West Yost Associates, Davis

**Attendees:** City of Davis, City Staff (City has complete list)  
Consultants, Representatives of Brown and Caldwell, Carollo (City has complete list)  
Reviewers, Edward Schroeder and George Tchobanoglous

**Purpose:**

Attend final debriefing on the results of the Value Engineering Workshop

**Meeting Summary**

Presentation of results of Value Engineering Workshop by individual team members.

### **Monday February 2, 2009**

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**Location:** City of Davis Corporation Yard

**Attendees:** Keith Smith, City Staff  
Reviewers, Edward Schroeder and George Tchobanoglous

**Purpose:**

To determine to whom the report should be addressed, number of copies to be submitted, and related issues.

**Meeting Summary:**

The report will be addressed to the City Manager and 25 copies will be submitted.

There was a brief discussion of water conservation approaches and methods.