



TECHNICAL MEMORANDUM

DATE: November 15, 2011 Project No.: 376-00-11-06

TO: Diane Phillips, City of Davis Public Works
Doug Baxter, City of Woodland Public Works

CC: Dennis Diemer, Woodland-Davis Clean Water Agency

FROM: Andy Smith, R.C.E. #74673

REVIEWED BY: Jim Yost

SUBJECT: Summary Evaluated Alternatives to the Davis-Woodland Water Supply Project

PURPOSE

The purpose of this technical memorandum (TM) is to provide a convenient and well-referenced source of information that provides summary information on the alternatives to the Davis-Woodland Water Supply Project (DWWSP) that have been studied over the past 20 years, and to demonstrate in broad terms why the DWWSP is the preferred project. An additional goal of this TM is to present cost information for the alternatives studied on a consistent cost basis, to facilitate comparison by DWWSP stakeholders. This TM may be revised or appended in the future as additional information is developed to address comments and questions raised by the general public.

This TM is organized as follows:

- Purpose
- Background
- Alternatives Studied
- Estimated Costs of Alternatives
- Summary

BACKGROUND

This section presents the objectives of the DWWSP, describes the preferred project, and provides an overview of past attempts to summarize alternatives studied and their order-of-magnitude estimated costs.

DWWSP Objectives

The primary objectives of the Woodland-Davis Clean Water Agency (WDCWA) and the DWWSP are summarized below:

- Improve drinking water quality
- Improve drinking water reliability
- Improve the quality of treated wastewater

The viability of alternatives considered over the long planning history of the DWWSP, including the preferred project, have been judged according to these broad objectives, in addition to estimated project cost and the ability to meet schedule requirements.

Table 1 summarizes current groundwater quality information for Woodland and Davis, as well as Sacramento River water quality, regulatory drinking water quality limits, and current and anticipated regulatory wastewater discharge limits.

Preferred Project

The planned DWWSP includes an intake on the Sacramento River jointly owned and operated with Reclamation District 2035 (RD 2035), raw water pipelines connecting the intake to a new regional water treatment plant (WTP) near Woodland, and separate pipelines delivering treated water to Woodland, Davis and University of California (UC) Davis. Local improvements to existing water supply systems will vary for Woodland and Davis and will include facilities such as distribution pipelines, water storage tanks and booster pump stations.

The project will divert water from the Sacramento River under a water right acquired in March 2011, and will be subject to conditions imposed by the State. Water diversions will be limited during summer and other dry periods. To fill the needs occurring these periods, surface water diversions permitted under this right will be supplemented by diversion of surface water permitted through a purchase of water from the Conaway Preservation Group (CPG). Groundwater will continue to be used by Woodland and Davis during peak summer demand periods when demand for water cannot be met entirely with surface water.

Table 1. Water Quality Information

Constituent & Unit of Measurement	Measured Concentrations			Drinking Water Limit ^(c)	Wastewater Discharge Limits
	City of Woodland Ground-water ^{(a), (i)}	City of Davis Ground-water ^{(a), (i)}	Sacramento River Water ^{(b), (i)}		
Nitrate (as NO ₃), ppm	2.4 - 38	ND - 39	ND (2.0)	45 (MCL and PHG)	45 ^(d)
Arsenic, ppb	ND - 2.5	ND - 7.1	2.4 - 2.9	10 (MCL) ^(e) ; 0.004 (PHG)	Anticipated: 100 Davis Current: none Woodland Current: none
Total Chromium, ppb	14 - 32	ND - 40	ND (10)	50 (MCL); 100 (PHG)	none
Hexavalent Chromium, ppb	ND - 27	ND - 40	ND (1.0)	0.02 (PHG)	none
Manganese, ppb	ND - 24	ND - 49	ND (10) - 95 ^(f)	50 (SMCL)	Anticipated: 200 Davis Current: none Woodland Current: none
Iron, ppb	ND - 720	ND - 230	410 - 2,300 ^(g)	300 (SMCL)	Anticipated: 800 monthly/2,000 daily Davis Current: 4,000 daily Woodland Current: none
TDS, ppm	550 - 630	280 - 1,000	110 - 150	500-1,500 (SMCL)	Anticipated ^(h) : 450 Davis Current ^(h) : none Woodland Current ^(h) : none
Boron, ppb	1,600 - 2,300	520 - 1,100	ND (100)	None	Anticipated: 700 Davis Current: 1,300-1,800 Woodland Current: 2,100-3,100
Selenium, ppb	3.6 - 21	ND - 52	ND (5.0)	30 (MCL and PHG)	Anticipated: 3.2-4.4 (monthly) Davis Current: 7.1 daily Woodland Current: 3.2 monthly/31 daily

Notes:

- (a) Source: City of Davis 2010 Annual Water Quality Report and City of Woodland 2009 Annual Water Quality Report.
- (b) From WDCWA Water Quality sampling at RD2035 intake.
- (c) Drinking water limits include primary maximum contaminant levels (MCL), secondary maximum contaminant levels (SMCL), and public health goals (PHG).
- (d) Groundwater limitation for WWTP. Monitoring required for effluent discharge.
- (e) EPA is evaluating arsenic and considering lowering the MCL to 5.0 ppb.
- (f) These results are for total manganese. Dissolved manganese, however, is the constituent that presents a treatment concern. Dissolved manganese levels have been in the range of ND (2.0) – 8.8.
- (g) These results are for total iron. Dissolved iron, however, is the constituent that presents a treatment concern. Dissolved iron levels have been in the range of ND (6.8) – 88.
- (h) Wastewater limits for salinity are measured through both EC and TDS. TDS mg/L units are approximately equal to 0.6 x EC µmhos/cm units. The interim EC limit for Davis is 2,050 µmhos/cm. The interim EC limit for Woodland is 1,835 µmhos/cm.
- (i) Where ND (non-detect) is followed by parentheses, the number in parentheses is the detection limit.

Past Attempts to Summarize Alternatives Studied

A variety of documents have presented potential alternatives to the DWWSP, and they are listed below in descending chronological order:

- DWWSP Community Report, WDCWA, Spring 2010
- Sacramento River Intake Alternatives Evaluation, West Yost Associates, October 2010
- DWWSP Delivery Schedule/Financing Alternatives Evaluation, West Yost Associates, November 2009
- DWWSP Additional Evaluation of Tehama-Colusa Canal as Potential Surface Water Intake, West Yost Associates, November 2009
- Review of City of Davis Water Resources Master Plan, George Tchobanoglous and Ed Schroeder, February 2009
- DWWSP Community Report, DWWSP Partners, December 2007
- DWWSP Information and Analysis Related to the City of Woodland's Question "Why Surface Water & Why Now", West Yost Associates, October 2007
- DWWSP Draft EIR, ESA, April 2007
- City of Woodland Surface Water Feasibility Study, LTD Engineering, June 2004
- City of Davis and UC Davis Joint Water Supply Feasibility Study, West Yost Associates, 2002

Recently, two additional documents have been developed to summarize the alternatives introduced in the documents listed above:

- DWWSP Analysis of Project Alternatives, West Yost Associates, February 2011
- Summary tables describing alternatives considered, West Yost Associates, May 2010

ALTERNATIVES STUDIED

This section provides a brief introduction of 26 distinct DWWSP alternatives that have received moderate to detailed study in the past, organized according to the primary approach of the alternative (e.g., conjunctive use). Where alternatives are described elsewhere in greater detail, a reference to the applicable document is provided. Table 2 summarizes the alternatives studied and their order-of-magnitude cost estimates in November 2011 dollars.

Table 2. Summary of Alternatives Studied

Alternative No.	May 2010 Summary Table Alternative No.	Project Participants		Water Supply Approach	Project Components	Improves			Viable Alternative?	Reasons Not Viable	Order-of-Magnitude Estimated Capital Cost (November 2011 Dollars)	Cost Relative to Participants' Share(s) of Preferred Project	Source Document(s) for Original Presentation of Alternative
		Davis & UC Davis	Woodland			Drinking Water Quality	Water Supply Reliability	Wastewater Discharge Quality					
Preferred Project	3-A	●	●	Conjunctive Use (e.g., Surface Water & Groundwater)	New Sacramento R. Intake New Raw Water Pipelines to Woodland New WTP near Woodland Treated Water Pipelines to Davis and Woodland	●	●	●	Yes		329,000,000	Equal	b,c
1	1-D	●		Surface Water Only	Use West Sac Intake Expand West Sac WTP New Pipeline to Davis	●	●	●	No	West Sacramento has chosen not to participate	402,000,000	More	i
2	1-E	●		Surface Water Only	New Sacramento R. Intake New Pipeline to Davis New WTP in Davis	●	●	●	Yes		420,000,000	More	i
3	2-E		●	Groundwater Only	New Remote Well Field in Woodland		●		No	Does not meet objectives; requires WW treatment	-	More*	h
4	3-B	●	●	Groundwater Only	Wellhead Treatment Pipeline Brine Disposal to Carquinez Strait	●	●	●	No	Difficulty finding land for treatment equipment; high costs of brine disposal	1,122,000,000	More	f,g,a
5	3-C	●	●	Groundwater Only	Wellhead Treatment Evap Pond Brine Disposal	●	●	●	No	Difficulty finding land for treatment equipment; excessive area required for brine ponds (3,000 ac); unacceptable environmental risk associated with contaminants in brine ponds	-	More*	i
6	3-D	●	●	Groundwater Only	Wellhead Treatment Injection Well Brine Disposal	●	●	●	No	Difficulty finding land for treatment equipment; injection wells not likely to be permitted in Yolo Co	-	More*	i,g
7	3-E	●	●	Groundwater Only	Wellhead Treatment Trucked Brine Disposal to Bay Area	●	●	●	No	Difficulty finding land for treatment equipment; significant environmental impacts; approx \$100-200M/yr in trucking costs alone	-	More*	g
8	3-F	●	●	Groundwater Only	New Groundwater WTPs in Davis and Woodland Brine Disposal (Truck or Pipe)	●	●	●	No	Excessive infrastructure to bring water from wells to WTPs; high costs of brine disposal	-	More*	g
9	3-G	●	●	Groundwater Only	Upgrade WW Treatment			●	No	Does not meet objectives; high costs of brine disposal	294,000,000	Less	a
10	1-A	●		Conjunctive Use	Use West Sac Intake Expand West Sac WTP New pipeline to Davis	●	●	●	No	West Sacramento has chosen not to participate	187,000,000	More	i
11	1-B	●		Conjunctive Use	Use Available West Sac WTP Capacity New Pipeline to Davis	●	●	●	No	West Sacramento has chosen not to participate	194,000,000	More	i
12	1-C	●		Conjunctive Use	Use Available West Sac WTP Capacity New Pipeline to Davis Some Surface Water for Groundwater Recharge	●	●	●	No	West Sacramento has chosen not to participate	204,000,000	More	i
13	1-F	●		Conjunctive Use	UCD Solano Project Water New WTP in Davis				No	Does not meet objectives; no water available	-	Equal*	c
14	2-A		●	Conjunctive Use	New Sacramento R. Intake New WTP in Woodland New Pipeline to Woodland Storage Reservoir		●	●	No	Does not meet objectives; drinking water quality diminished by algae growth in storage reservoir	112,000,000	Less	h
15	2-D		●	Conjunctive Use	New Sacramento R. Intake New WTP in Woodland Storage Reservoir Surface Water for Ag Irrigation		●		No	Does not meet objectives	97,000,000	Less	h
16	2-C		●	Conjunctive Use	New Sacramento R. Intake New Pipeline to Woodland New WTP in Woodland		●		No	Does not meet objectives; insufficient surface water in summer to satisfy water quality objectives	96,000,000	Less	h
17	2-B		●	Conjunctive Use	Groundwater for Municipal Demands Untreated Surface Water for Ag Irrigation		●		No	Does not meet objectives	65,000,000	Less	h

Table 2. Summary of Alternatives Studied, Cont'd...

Alternative No.	May 2010 Summary Table Alternative No.	Project Participants		Water Supply Approach	Project Components	Improves			Viable Alternative?	Reasons Not Viable	Order-of-Magnitude Estimated Capital Cost (November 2011 Dollars)	Cost Relative to Participants' Share(s) of Preferred Project	Source Document(s) for Original Presentation of Alternative
		Davis & UC Davis	Woodland			Drinking Water Quality	Water Supply Reliability	Wastewater Discharge Quality					
18	1-G	●		Do Nothing (Groundwater Only)	New Deep Wells Additional WW Treatment***	●			No	Does not meet objectives; requires WW treatment	319,000,000	More	i
18	2-F		●	Do Nothing (Groundwater Only)	Repair/Replace Existing Wells Additional WW Treatment***				No	Does not meet objectives; requires WW treatment	340,000,000	More	f
18	n/a		●	Do Nothing (Groundwater Only)	New Deep Wells Additional WW Treatment***	●			No	Does not meet objectives; requires WW treatment	306,000,000	More	n
18	3-H	●	●	Do Nothing (Groundwater Only)	Additional WW Treatment***				No	Does not meet objectives; requires WW treatment	490,000,000	More	f,g,d
19	1-H, 2-G, 3-I	●	●	Do Nothing (Groundwater Only)	Aggressive Conservation Additional WW Treatment***				No	Does not meet objectives; requires WW treatment	294,000,000	Less	d,c,g
20	4-E	●	●	Source of Surface Water Supply	Utilize Surface Water-Influenced Groundwater from Ranney Collectors	● ^(o)	● ^(o)	● ^(o)	No	Extensive field investigations req'd to verify project objectives met; would exceed project schedule; high cost for collector wells	63,000,000	More*	i
21	4-D	●	●	Source of Surface Water Supply	Utilize Surface Water from Tehama-Colusa Canal	●	●	●	No	Uncertainties about water rights and municipal delivery priority through ag conveyance facilities; excessive cost to extend canal	426,000,000	More	m, j
22	n/a	●	●	Source of Surface Water Supply	Utilize Surface Water from Lake Berryessa or Putah Creek				No	Does not meet objectives; no water available	-	Equal*	j
23	n/a	●	●	Source of Surface Water Supply	Surface Water Exchange with YCFC&WCD	●	●	●	Yes		-	Equal**	j
24	4-C	●		Source of Surface Water Supply	Partial Surface Water Use West Sac Intake and WTP	●	●	●	No	West Sacramento has chosen not to participate	420,000,000	More	i
25	4-B	●		Source of Surface Water Supply	New Sacramento R. Intake at West Sac	●	●	●	Yes		401,000,000	More	i
26	n/a	●	●	Source of Surface Water Supply	Tie into New North Bay Aqueduct	●	●	●	No	Likely to exceed schedule; uncertain if DWR and member NBA agencies can identify funding; legal uncertainty about CPG water agreement	-	More*	n

Notes

- a. DWWSP Community Report, Author, Spring 2010
- b. DWWSP Delivery Schedule/Financing Alternatives Evaluation, West Yost Associates, November 2009
- c. Review of City of Davis Water Resources Master Plan, George Tchobanoglous and Ed Schroeder, February 2009
- d. DWWSP Community Report, Author, December 2007
- e. DWWSP Information and Analysis Related to the City of Woodland's Question
- f. "Why Surface Water & Why Now", West Yost Associates, October 2007
- g. DWWSP Draft EIR, ESA, April 2007
- h. City of Woodland Surface Water Feasibility Study, LTD Engineering, June 2004
- i. City of Davis and UC Davis Joint Water Supply Feasibility Study, West Yost Associates, Month 2002
- j. DWWSP Analysis of Project Alternatives, West Yost Associates, February 2011
- k. Summary tables describing alternatives considered, West Yost Associates, May 2010
- l. Sacramento River Intake Alternatives Evaluation, West Yost Associates, October 2010
- m. DWWSP Additional Evaluation of Tehama-Colusa Canal as Potential Surface Water Intake, West Yost Associates, November 2009
- n. Recently proposed by members of the general public; has received only preliminary study
- o. It is possible that Ranney Collectors could meet these objectives, but there are many unknowns without conducting extensive field investigation
- * Estimated costs for this alternative were never formally developed due to infeasibility of the alternative; relative cost indicated is a rough approximation based on knowledge of alternative
- ** Estimated costs for this alternative have not been developed yet, but are being investigated currently
- *** Not explicitly included as part of the alternative as proposed in source document(s), but likely necessary to comply with future wastewater standards

Entirely Surface Water Alternatives

1. Convert Davis and UC Davis Entirely to Surface Water by Expanding West Sacramento's Water Treatment Plant

This alternative (which was studied prior to Woodland joining with Davis and UC Davis to develop a regional water supply solution) was discussed in the City of Davis and UC Davis Joint Water Supply Feasibility Study (2002), and was denoted Alternative 1-D in the May 2010 summary tables. The project would involve a large expansion of the City of West Sacramento's existing Bryte Bend WTP to provide additional capacity for the City of Davis and UC Davis, as well as a treated water pipeline from West Sacramento to Davis. Existing groundwater wells would be abandoned.

Although this alternative would improve drinking water and treated wastewater quality, it would not increase water supply reliability. This alternative would be more expensive than the preferred project. Most importantly, West Sacramento declined at that time to participate in a project with Davis and UC Davis, rendering this alternative infeasible.

2. Convert Davis and UC Davis Entirely to Surface Water by Constructing a New Sacramento River Intake and Water Treatment Plant

This alternative was discussed in the City of Davis and UC Davis Joint Water Supply Feasibility Study (2002), and was denoted Alternative 1-E in the May 2010 summary tables. The project would involve construction of a new raw water intake on the Sacramento River, a new surface water treatment plant, and new pipelines to convey the water to Davis and UC Davis. Existing groundwater wells would be abandoned.

Although this alternative would improve drinking water and treated wastewater quality, it would not increase water supply reliability. Additionally, it would be more expensive than the preferred project.

Entirely Groundwater Alternatives

3. Construct a Remote Well Field to Provide Woodland's Entire Municipal Supply

This alternative was discussed in the City of Woodland Surface Water Feasibility Study (2004) prior to their joining with Davis and UC Davis in a regional project, and was denoted Alternative 2-E in the May 2010 summary tables. The project would involve construction of a new well field southeast of Woodland to replace existing City wells, and would require new pipelines to convey the water to Woodland.

This alternative would not improve drinking water or treated wastewater quality, and was determined to be non-viable by Woodland; as a result, estimated costs for this alternative were never developed.

4. [Wellhead Treatment of Davis and Woodland Groundwater Supplies with Brine Disposal by Pipeline](#)

This alternative was discussed in several documents: the DWWSP Information and Analysis Related to the City of Woodland's Question "Why Surface Water & Why Now" TM (2007); the DWWSP Draft EIR (2007); and the Spring 2010 DWWSP Community Report. This alternative was denoted Alternative 3-B in the May 2010 summary tables. The project would involve installation of split-stream reverse osmosis (RO) wellhead treatment systems on 25 groundwater wells in Woodland and 17 wells in Davis, as well as the construction of five new deep wells in Davis and the construction of conventional treatment systems on three deep wells Davis. No facilities are assumed for UC Davis. The RO systems would treat approximately half of the flow at wells with RO installed. Brine generated during the RO process would be collected and disposed of via a pipeline to the Carquinez Strait.

This alternative would improve water supply reliability, as well as drinking water and treated wastewater quality. Major challenges would include locating land adjacent to existing wells for placement of RO equipment, as well as permitting and construction of a long brine pipeline. This alternative would be significantly more expensive than the preferred project. Even without the cost for the brine disposal pipeline, this alternative would still be significantly more expensive than the preferred project.

The following three alternatives are similar to this alternative, differing only in the method of brine disposal.

5. [Wellhead Treatment of Davis, Woodland and UC Davis Groundwater Supplies with Brine Disposal by Evaporation Ponds](#)

This alternative, denoted Alternative 3-C in the May 2010 summary tables, is similar to the above alternative, except that brine generated during the RO process would be collected in evaporation ponds. Water would evaporate from the ponds, leaving behind salts and other minerals that could be disposed of in landfills.

This alternative would improve water supply reliability, as well as drinking water and treated wastewater quality. Major challenges would include locating land adjacent to existing wells for placement of RO equipment, purchasing the necessary 3,000 acres for the evaporation ponds, and mitigating the potential impacts to waterfowl and other wildlife associated with contaminants in the brine. This alternative was determined to be infeasible due to the area requirement for ponds and the anticipated severe impacts to wildlife; as a result, estimated costs for this alternative were never developed.

6. [Wellhead Treatment of Davis, Woodland and UC Davis Groundwater Supplies with Brine Disposal by Injection Wells](#)

This alternative, denoted Alternative 3-D in the May 2010 summary tables, is similar to the above alternatives, except that brine generated during the RO process would be injected deep underground. Injected brine would dissipate into confined, porous rock formations below the groundwater aquifer and remain there.

This alternative would improve water supply reliability, as well as drinking water and treated wastewater quality. This alternative was determined to be infeasible due to Yolo County's strict regulation, and possible prohibition, of brine injection; as a result, estimated costs for this alternative were never developed.

7. Wellhead Treatment of Davis, Woodland and UC Davis Groundwater Supplies with Brine Disposal by Tanker Trucks

This alternative, denoted Alternative 3-E in the May 2010 summary tables, is similar to the above alternatives, except that brine generated during the RO process would be collected in tanker trucks and transported to a suitable disposal site (e.g., an ocean outfall).

This alternative would improve water supply reliability, as well as drinking water and treated wastewater quality. To dispose of brine, up to 600 truck trips, at a round trip distance of over 150 miles, would be required each day. Annual costs for the trucking operations would be very large (as much as \$200 million per year), making this alternative significantly more expensive than the preferred project.

8. Groundwater Treatment for Davis and Woodland at Two New Water Treatment Plants

This alternative was discussed in the DWWSP Draft EIR (2007), and was denoted Alternative 3-F in the May 2010 summary tables. The project would involve two centralized RO groundwater treatment systems for Woodland and Davis. Brine generated during the RO process would be collected in tanker trucks and transported to a suitable disposal site.

This alternative would improve water supply reliability, as well as drinking water and treated wastewater quality. This alternative was determined to be infeasible due to costs associated with brine disposal and piping required to connect the water treatment plants and distribution systems; as a result, a formal cost estimate for this alternative was never developed.

9. Treatment of Wastewater Effluent

This alternative was discussed in the Spring 2010 DWWSP Community Report, and was denoted Alternative 3-G in the May 2010 summary tables. The project would involve upgraded wastewater treatment processes at both the Woodland and Davis wastewater treatment plants (WWTPs) to remove adequate levels of contaminants (e.g., salts) to comply with waste discharge requirements. The treatment process upgrades would likely involve RO. Brine generated during the RO process would be collected and transported or conveyed to a suitable disposal site.

Although this alternative would improve treated wastewater quality, it would not improve water supply reliability or drinking water quality, as was therefore deemed not viable; as a result, a formal cost estimate for this alternative was never developed. However, performance data from similar RO wastewater treatment facilities operating elsewhere in California indicate that the WWTP improvements necessary under this alternative, when added to brine disposal capital and operating costs, would approach the cost of the preferred project.

Conjunctive Use Alternatives

10. [Convert Davis and UC Davis to Partial Surface Water Supply by Expanding West Sacramento's WTP](#)

This alternative was discussed in the City of Davis and UC Davis Joint Water Supply Feasibility Study (2002), and was denoted Alternative 1-A in the May 2010 summary tables. The project would involve an expansion of West Sacramento's then existing WTP to provide additional capacity for the City of Davis and UC Davis, as well as a treated water pipeline from West Sacramento to Davis. Existing groundwater wells would be maintained and used in conjunction with the new surface water supply.

This alternative would meet all project objectives, with estimated costs approximately equal to those of the preferred project. However, West Sacramento at that time declined to participate in a project with Davis and UC Davis, rendering this alternative infeasible.

11. [Convert Davis and UC Davis to Partial Surface Water Supply by Utilizing Existing Capacity at West Sacramento's WTP](#)

This alternative, denoted Alternative 1-B in the May 2010 summary tables, is similar to the above alternative, except that no expansion of West Sacramento's existing WTP would take place. A smaller amount of surface water would be provided to Davis and UC Davis using existing capacity at the WTP. Existing groundwater wells would be maintained and used in conjunction with the new surface water supply.

This alternative would meet all project objectives, with estimated costs approximately equal to those of the preferred project. However, West Sacramento at that time declined to participate in a project with Davis and UC Davis, rendering this alternative infeasible.

12. [Convert Davis and UC Davis to Partial Surface Water Supply by Utilizing Existing Capacity at West Sacramento's WTP; Use Surface Water for Groundwater Recharge](#)

This alternative, denoted Alternative 1-C in the May 2010 summary tables, is similar to the above alternative, except that surface water would be also used for groundwater recharge during months in which available capacity from the West Sacramento WTP exceeds Davis and UC Davis demands. Existing groundwater wells would be maintained and used in conjunction with the new surface water supply, drawing either "native" groundwater or injected surface water.

This alternative would meet all project objectives, with estimated costs approximately equal to those of the preferred project. However, West Sacramento at that time declined to participate in a project with Davis and UC Davis, rendering this alternative infeasible.

13. [Supplement Davis and UC Davis Groundwater Use with Surface Water from UC Davis' Solano Project Water](#)

This alternative was discussed in the Review of City of Davis Water Resources Master Plan (2009), and was denoted Alternative 1-F in the May 2010 summary tables. The project would involve treating surface water available under UC Davis' water right to Solano Project water (i.e., from Lake Berryessa) to supplement the existing Davis and UC Davis groundwater systems.

UC Davis has plans to use all of its contracted 4,000 acre-feet of Solano Project water, leaving no surface water available for Davis. As a result, this alternative would not meet project objectives. Estimated costs for this alternative were never developed.

14. [Convert Woodland to Partial Surface Water Supply by Constructing a New Sacramento River Intake, Water Treatment Plant and Storage Reservoir](#)

This alternative was discussed in the City of Woodland Surface Water Feasibility Study (2004), and was denoted Alternative 2-A in the May 2010 summary tables. The project would involve construction of a new raw water intake on the Sacramento River, a new surface water treatment plant, a new raw water storage reservoir and new pipelines to convey treated water to Woodland. Existing groundwater wells would be maintained and used in conjunction with the new surface water supply. Raw water would be stored during periods of low demand (i.e., winter months) and treated and distributed during high demand periods.

Challenges for this alternative would include obtaining sufficient land for the raw water storage reservoir, and potential taste and odor concerns during the summer months created by algae growth in the raw water storage reservoir. Estimated costs from the 2004 Woodland study for this alternative are less than those of the preferred project, but the alternative does not satisfy project objectives and is therefore not viable.

15. [Convert Woodland to Partial Surface Water Supply by Constructing a New Sacramento River Intake, Water Treatment Plant and Storage Reservoir; Provide Surface Water for Agricultural Irrigation](#)

This alternative, denoted Alternative 2-D in the May 2010 summary tables, is similar to the above alternative, except that surface water would also be provided to meet agricultural demands near Woodland.

This alternative would increase water supply reliability, but would not address water or treated wastewater quality concerns during summer months. Estimated costs from the 2004 Woodland study for this alternative are less than those of the preferred project, but the alternative does not satisfy all project objectives and is therefore not viable.

16. [Convert Woodland to Partial Surface Water Supply by Constructing a New Sacramento River Intake and Water Treatment Plant, without a Storage Reservoir](#)

This alternative, denoted Alternative 2-C in the May 2010 summary tables, is similar to the above alternative, except that no raw water storage reservoir would be constructed, and no surface water would be provided to agricultural irrigation. Without a reservoir, surface water would not be available during many summer months, and the City would have to rely more heavily on groundwater during those months.

This alternative would increase water supply reliability, but would not address water or treated wastewater quality concerns during summer months when no surface water was available. Estimated costs for this alternative are less than those of the preferred project, but the project does not satisfy all project objectives.

17. Provide Surface Water Only for Agricultural Irrigation Near Woodland

This alternative was discussed in the City of Woodland Surface Water Feasibility Study (2004), and was denoted Alternative 2-B in the May 2010 summary tables. The project would involve sending untreated Sacramento River water to agricultural users that presently rely on groundwater, increasing the supply of groundwater available to the City of Woodland. A new intake on the Sacramento River, as well as a storage reservoir for use during winter months, would be required.

This alternative would increase water supply reliability, but would not address water or treated wastewater quality concerns. Challenges include overcoming financial disincentives for agricultural users to switch to more expensive surface water, as well as obtaining easements for water distribution across private land. This alternative would be less expensive than the preferred project, but would not meet all project objectives.

“Do Nothing” Alternatives

18. Supply All Demands with Groundwater

Components of this alternative were discussed in several documents: the City of Davis and UC Davis Joint Water Supply Feasibility Study (2002); the City of Woodland Surface Water Feasibility Study (2004); the DWWSP Information and Analysis Related to the City of Woodland’s Question “Why Surface Water & Why Now” TM (2007); the DWWSP Community Report (2007); and the DWWSP Draft EIR (2007). Components of this alternative are defined in the May 2010 summary tables as Alternatives 1-G (Davis and UC Davis), 2-F (Woodland) and 3-H (all agencies). Because this alternative would likely result in the need for additional wastewater treatment, Alternative 3-G from the May 2010 summary tables is also applicable.

In Davis and UC Davis, the project would involve either construction of new deep wells in Davis, or wellhead treatment at some intermediate depth wells. In Woodland, the project would involve construction of new groundwater facilities, and the repair or replacement of existing groundwater facilities. Alternatively, Woodland could construct new deep wells to meet some or all of their demands (this sub-alternative was proposed by members of the general public and was not discussed in the documents referenced above).

This alternative would not significantly improve water quality or reliability, and would not address treated wastewater quality. Without additional wastewater treatment plant improvements, the project would be less expensive than the preferred project. However, if additional wastewater treatment plant improvements are included to meet future standards (along with a requisite disposal system for brine generated from RO processes in both cities), this alternative becomes more expensive than the preferred project.

19. Rely on Conservation Only

Components of this alternative were discussed in several documents: the Review of City of Davis Water Resources Master Plan (2009); the DWWSP Community Report (2007); and the DWWSP Draft EIR (2007). This alternative is defined in the May 2010 summary tables as Alternatives 1-H (Davis and UC Davis), 2-G (Woodland) and 3-I (all agencies). The alternative would involve increased conservation efforts resulting in lower demands.

This alternative would increase water supply reliability, but would not improve drinking water quality. Treated wastewater quality could worsen under this alternative, as the concentration of salt in the effluent could increase. Without additional wastewater treatment plant improvements, the project would be significantly less expensive than the preferred project. However, if additional wastewater treatment improvements are included to meet future standards (along with a requisite disposal system for brine generated from RO processes in both cities), this alternative approaches the cost of the preferred project, but is not viable because all project objectives are not met.

Surface Water Source Alternatives

20. [Ranney Collectors](#)

This alternative was discussed in detail in the DWWSP Analysis of Project Alternatives TM (2011), and was denoted Alternative 4-E in the May 2010 summary tables. While not a project in and of itself, this alternative could replace in-river intakes required for several of the surface water and conjunctive use alternatives described above. The alternative would involve construction of approximately 6-10 patented Ranney collector wells near the Sacramento River to collect surface water-influenced groundwater. The collector wells consist of a vertical shaft, or caisson, with horizontal lateral arms projected out into the aquifer underlying the river.

If used in conjunction with existing groundwater supplies, this alternative could increase water supply reliability. If the water collected were sufficiently influenced by surface water, water quality and treated wastewater quality could also be improved. Due to limited modeling conducted on this alternative and a number of unknowns, it is possible that neither drinking water nor treated wastewater quality would be improved. Based on the estimated number of collector wells required, this alternative would be more expensive than an in-river intake. Due to the need for extensive additional field investigation, numerous unknowns and the potential to exceed the project schedule, this alternative has been deemed not viable.

21. [Tehama Colusa Canal](#)

This alternative was discussed in detail in the DWWSP Analysis of Project Alternatives TM (2011), and was denoted Alternative 4-D in the May 2010 summary tables. While not a project in and of itself, this alternative could replace in-river intakes required for several of the surface water and conjunctive use alternatives described above. This alternative would consist of extending the existing Tehama-Colusa Canal (TCC), which obtains water from the Sacramento River near Red Bluff, from its current terminus to the DWWSP WTP.

Similar to alternatives using in-river intakes, this alternative could increase water supply reliability and improve drinking water and treated wastewater quality. This alternative would be considerably more expensive than in-river intake alternatives, however, due to the expense associated with extending the TCC. Due to additional concerns regarding water rights, conveyance issues and agricultural chemical contamination, this alternative has been deemed not viable.

22. Lake Berryessa or Putah Creek

This alternative was discussed in the DWWSP Analysis of Project Alternatives TM (2011), but was not included in the May 2010 summary tables. While not a project in and of itself, this alternative could replace in-river intakes required for several of the surface water and conjunctive use alternatives described above. This alternative would consist of utilizing Solano Project water from Lake Berryessa or Putah Creek.

This alternative is not viable because all of the water in the Solano Project is fully subscribed to water users in Solano and Yolo counties, excluding Davis and Woodland (UC Davis obtains 4,000 acre-feet annually from this source, but has plans to use all of that amount). Therefore, no project objectives could be met under this alternative.

23. Yolo County Flood Control & Water Conservation District

This alternative was discussed in detail in the DWWSP Analysis of Project Alternatives TM (2011), but was not included in the May 2010 summary tables. While not a project in and of itself, this alternative could provide an additional supplemental summer water supply. This alternative would consist of diverting additional surface water from the Sacramento River through the in-river intakes described in other alternatives. The additional surface water would be made available through one of two mechanisms:

1. An exchange between the Yolo County Flood Control & Water Conservation District (District) and CPG, thereby reducing CPG's Sacramento River diversions and increasing the quantity of Sacramento River water available to the DWWSP.
2. An exchange of Sacramento River discharge and diversion water, thereby increasing the amount of surface water in the Sacramento River upstream of the DWWSP in-river intake.

This alternative could further improve water supply reliability, drinking water quality and treated wastewater quality. The feasibility and potential costs of this alternative are currently being studied in further detail.

24. Sacramento River Water from Existing West Sacramento Intake

This alternative (which was studied prior to Woodland joining with Davis and UC Davis to develop a regional water supply solution) was discussed in various forms in the City of Davis and UC Davis Joint Water Supply Feasibility Study (2002), and was a component of alternatives 1-A through 1-D and 4-C in the May 2010 summary tables. The project would involve use of the City of Sacramento's existing in-river intake. Sacramento River water would then be treated at West Sacramento's WTP, either using available capacity or with an expansion to serve Davis and UC Davis demands.

This alternative would improve drinking water and treated wastewater quality, and would increase water supply reliability if used in conjunction with continued groundwater use. This alternative would be more expensive than the preferred project. West Sacramento declined at that time to participate in a project with Davis and UC Davis, rendering this alternative infeasible.

25. Sacramento River Water from New Intake Near West Sacramento

This alternative (which was studied prior to Woodland joining with Davis and UC Davis to develop a regional water supply solution) was discussed in various forms in the City of Davis and UC Davis Joint Water Supply Feasibility Study (2002), and was a component of alternatives 1-E and 4-B in the May 2010 summary tables. The project would involve construction of a new in-river intake near West Sacramento, a pipeline bringing raw water to Davis, and a new WTP in Davis.

This alternative would improve drinking water and treated wastewater quality, and would increase water supply reliability if used in conjunction with continued groundwater use. This alternative would be more expensive than the preferred project.

26. Sacramento River Water from New North Bay Aqueduct

This alternative has not received detailed study. The project would involve tying into a proposed alternative North Bay Aqueduct (NBA) in Yolo or Solano County, construction of a new raw water pipeline between the tie-in and Davis, and a new WTP near Davis. Treated water would be sent to Woodland and Davis. The California Department of Water Resources (DWR) is currently studying two potential alignments of the new NBA, and the alignment nearest to the Davis area would bring the NBA within approximately 6.5 miles of the existing Davis WWTP.

This alternative would improve drinking water and treated wastewater quality, and would increase water supply reliability if used in conjunction with continued groundwater use. Assuming all other aspects of the preferred DWWSP are unchanged (e.g., type and capacity of treatment, total length and capacity of treated water pipelines, and Woodland and Davis cost share for a joint intake facility), this alternative could be more expensive than the preferred project, due to equal or higher costs for the raw water pipeline construction from the NBA tie-in. Additionally, a number of risk factors outside the WDCWA's or the cities' control make this alternative non-viable: a draft EIR for the NBA project is not yet complete, and the DWWSP schedule would very likely be exceeded under this alternative; funding for the project has not been identified by DWR or the agencies that use the NBA; and, it is unclear how the WDCWA's current agreement to purchase supplemental water from CPG would be affected under this alternative.

ESTIMATED COSTS OF ALTERNATIVES

For the majority of the alternatives introduced in this TM, order-of-magnitude capital costs have been estimated and are included in Table 2. Costs for certain alternatives that have been determined to be non-viable (e.g., wellhead treatment with brine disposal by injection well) have not been formally estimated – in these cases, an indication is included in Table 2 of whether the cost would likely be more, less or approximately equal to the preferred project if the alternative were in fact viable. Older cost estimates have been updated to November 2011 dollars in proportion to historical Engineering News Record (ENR) construction cost indices.

SUMMARY

Of the 26 alternatives summarized in Table 2, only three are considered viable. None of the groundwater-only alternatives are considered viable, due primarily to the costs associated with RO treatment and brine disposal. Of the three viable alternatives, two would serve only Davis and UC Davis and have estimated costs that exceed the costs associated with the preferred project. The third viable alternative, Alternative 23, is currently being investigated and may ultimately become a component of the preferred project.