

# Memorandum

Date : OCT 6 1998

To : Nasar Bateni, Chief  
Northern District

Karl P. Winkler, Chief  
Central District

From : Department of Water Resources

Subject: Proposition 204 Sites Reservoir Conveyance Study, Revised Interim Status Report

Per your request, we have revised the subject report. Revisions include changing the Chico Landing diversion and intertie designations to "Near Sacramento River Mile 188," adding Environmental Services Office's and Division of Engineering's inputs to the "Introduction," clarifying preliminary cost criteria, updating tables, eliminating superfluous information, and making other minor text changes suggested by your staff.

We have also included the alternative of using the existing Tehama-Colusa and Glenn-Colusa diversions and conveyance capacities, which will provide a maximum diversion of 6,900 cfs to Funks Reservoir. The other five alternatives will provide a maximum diversion of 8,000 cfs to Funks Reservoir. We propose to include all six alternatives in the final status report, which will be sent to you in mid-October.

Please contact Doug Osugi at (916) 227-7587 or Al Lind at (916) 227-7553 if you have any other comments or proposed changes to the Interim Status Report.

Attachment

SURNAME

DWR 155 (Rev. 2/86)

<i>Al Lind</i> 10/6/98	<i>Doug Osugi</i> 10-6-98	<i>N. Bateni</i> 10/6/98	<i>K. Winkler</i> 10/6/98
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# Prop. 204 Sites Reservoir Conveyance Study

## Interim Status Report

### Introduction

The Central District (CD) is assisting the Northern District (ND) in a Proposition 204-funded study of alternative diversion points and conveyance routes for delivery of diverted water from the Sacramento River to the Sites offstream storage option. The CD task is to study the feasibility of providing 5000 cfs of total conveyance capacity from one or more Sacramento River diversion locations. This interim report also includes preliminary facility cost information from DOE and ESO.

The conveyance alternatives include the potential use of existing facilities such as the Tehama-Colusa Canal, Glenn-Colusa Canal, and the Colusa Basin Drain, the construction of new conveyance facilities, and combinations of new and existing facilities. The Colusa drain flow is estimated at 3000 cfs maximum, and when added to the 5000 cfs Sacramento River diversions, could allow up to 8000 cfs to be diverted to Funks Reservoir for lifting to the proposed Sites Reservoir.

Funks Reservoir on the T-C Canal would become the forebay for a large or small Sites Reservoir storage option. Funks would also be the terminal point for the Sacramento River conveyance alternatives and water diverted from the Colusa Basin Drain.

### Study Area

The location of the Sites Reservoir offstream storage option is shown on a map of the study area (Figure 1). The conveyance alternatives for the reservoir are located within the counties of Tehama, Glenn, and Colusa.

### Description of Conveyance Alternatives

The following general assumptions were used to guide the development of alternatives:

- Up to 5000 cfs total conveyance capacity from the Sacramento River for an enlarged existing canal(s) and/or new canal(s).
- Up to 5000 cfs total capacity for river diversions using existing and/or new facilities.
- A new Sacramento River diversion, if proposed, would be located below river mile RM 200.5, with a fish screen and pumping plant. A new canal would connect any new diversion to an existing canal or directly to Funks Reservoir.
- Up to 3000 cfs of additional water diverted from the Colusa Drain to Funks Reservoir would be additional to the water diverted from the Sacramento River; and be included in all alternatives. The conveyance capacities would

**Figure 1**

**Alt I: TC+GC+CD/NC**

New 2100 cfs RB diversion, existing 2100 cfs TC and enlarged 2900 cfs GC canals, plus added 3000 cfs from Colusa Drain to New Canal for total of 8000 cfs to Funks Reservoir.

**Alt II(A): TC+CD/NC**

New 5000 cfs RB diversion, 5000 cfs TC canal enlargement, plus added 3000 cfs from Colusa Drain to New Canal for total of 8000 cfs to Funks Reservoir.

**Alt II(B): TC/CLI+CD/NC**

New 5000 cfs SR diversion near Chico Landing, 5000 cfs TC canal enlargement, plus added 3000 cfs from Colusa Drain to New Canal for total of 8000 cfs to Funks Reservoir.

**Alt III(A): GC+CD/NC**

Enlarge existing 3000 cfs GC canal diversion at Hamilton City to 5000 cfs, 5000cfs GC canal enlargement, plus added 3000 cfs from Colusa Drain to New Canal for total of 8000 cfs to Funks Reservoir.

**Alt III(B): GC+CD/NC**

New 2000 cfs SR diversion near Chico Landing, 5000cfs GC canal enlargement, plus added 3000 cfs from Colusa Drain to New Canal for total of 8000 cfs to Funks Reservoir.

**Alt IV: NC+CD/NC**

New 5000 cfs SR diversion opposite Moulton Weir, plus added 3000 cfs from Colusa Drain to New Canal for total of 8000 cfs to Funks Reservoir.

**Alt V(A): TC/NC+CD/NC**

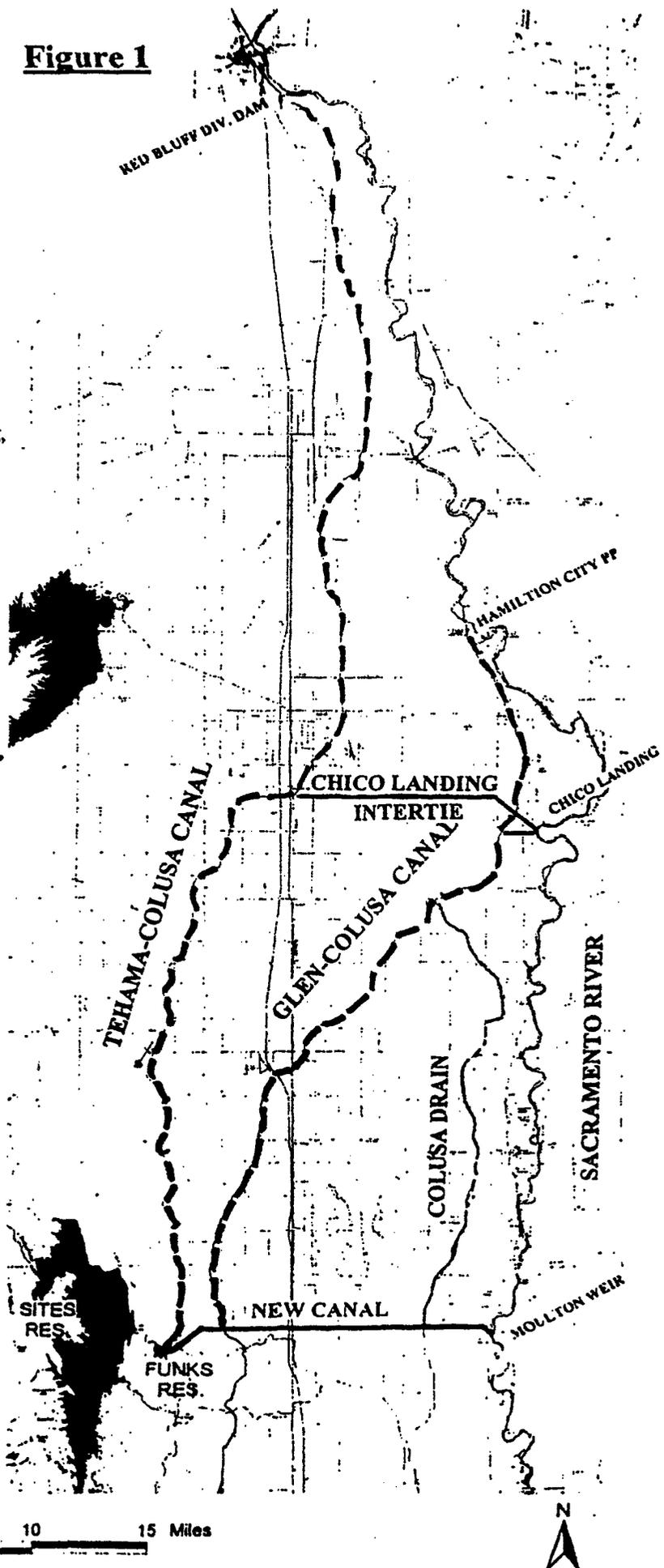
New 2100 cfs RB diversion, existing 2100 cfs TC, new 2900 cfs SR diversion and canal opposite Moulton Weir, plus added 3000 cfs from Colusa Drain to New Canal for total of 8000 cfs to Funks Reservoir.

**Alt V(B): GC/NC+CD/NC**

Existing GC diversion, existing 1800 cfs GC canal, new 3200 cfs SR diversion and canal opposite Moulton Weir, plus added 3000 cfs from Colusa Drain to New Canal for total of 8000 cfs to Funks Reservoir.

**Alt VI: TC+GC+CD/NC**

Existing RB and HC diversions, existing 2100 cfs TC and 1800 GC canals, plus added 3000 cfs from Colusa Drain to New Canal for total of 6900 cfs to Funks Reservoir



**Proposed Sites Reservoir Conveyance Alternatives**

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be enlarged above 5000 cfs, where needed, to accommodate the Colusa Drain additional water.

All conveyance options would primarily be for winter non-irrigation season diversion of flood flows. There may be other yet to be determined criteria. The evaluation of potential diversion flows that affect the design of diversion structures and fish screens would utilize existing and ongoing operation studies. The alternatives include a conveyance system with a diversion facility, canals, pumping plants, penstocks, and appurtenant works necessary to deliver the water to Funks Reservoir for subsequent lifting into Sites Reservoir. The alternatives include using existing canal systems, enlarged systems, or new systems that will require modifications to existing or new diversion and fish facilities on the Sacramento River.

CALFED staff recommended<sup>1</sup> that diversion structures have the ability to divert water from the Sacramento River when flows are as low as 15,000 cfs. After several iterations of formulating and screening alternatives, five basic alternatives were identified for this study (Figure 1) and are described below. Three of the alternatives have options based on different diversion locations or use of existing facilities. Table 1 summarizes the reach, length, lining, and number of pumping plants for each of the five alternatives.

In addition to the five basic alternatives which are all capable of delivering 8000 cfs maximum to Funks Reservoir, a sixth alternative has been added. Alternative IV is a scaled down version of Alternative I, but is only capable of delivering 6900 cfs maximum to Funks Reservoir.

**Alternative I. Use the existing T-C & enlarge the G-C canal facilities.**

This alternative would utilize the existing capacity of the Tehama-Colusa canal and enlarge the lower reaches of the Glenn-Colusa canal to convey water to Funks Reservoir. The canals' delivery capacities are limited by the sections of canal at the downstream end of the system. The present T-C and G-C canal capacities are 2100 cfs and 1800 cfs, respectively, at or near Funks Reservoir for a total combined capacity of 3900 cfs. The G-C canal is unlined and its capacity would be increased to 2900 cfs for a total combined capacity is 5000 cfs. A new canal reach will be required from the G-C canal to Funks Reservoir.

This alternative would also require modifications to the T-C diversion facility at Red Bluff to accommodate diversions during winter periods. Since the existing T-C pumping plant and fish facilities do not meet current fishery agency standards, a new 2100 cfs fish facility and pumping structure is proposed at the head of the T-C canal. The T-C canal is concrete lined and would not require and modifications or enlargement between Red Bluff and Funks Reservoir.

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<sup>1</sup> CALFED/ESO/CD meeting on March 18, 1998.

# Table 1

## Funks Reservoir Conveyance Alternative Costs Proposition 204 North of the Delta Storage Facility Studies (\$ millions D.P. only)

No.	Alternative	Diversion to Funks (cfs)	Canal	No.	Q(max) (cfs)	Length			Status	From	To	Canal Lined	Pumping Plants	Canal Costs (a x b)
						Station	Distance							
						(1000 ft)	(unit cost)	(Miles)						
I	TC+GC+CD/NC	8,000	TC	all	2,100	352.52	--	66.77	Existing	RBDD	Funks	Yes	1	--
	Includes new		GC	1	2,900	72.60	--	13.75	Existing	HCPP	JC	No	0	--
	2100 cfs RBDD		GC	2	2,900	139.40	0.44	26.4	Enlarge	JC	NC	No	0	61.3
	Diversion		NC	1	3,000	30.40	0.20	5.76	New	CD	PP1	No	0	6.1
	Facilities		NC	2	3,000	17.00	0.54	3.22	New	PP1	PP2	Yes	1	9.1
			NC	3	5,900	2.50	0.69	0.47	New	PP2	PP3	Yes	1	1.7
			NC	4	5,900	11.00	0.69	2.08	New	PP3	Funks	Yes	1	7.6
	<b>Total</b>													<b>\$86</b>
II A	TC+CD/NC	8,000	TC	all	5,000	352.52	0.44	66.77	Enlarge	RBDD	Funks	Yes	1	155.1
	Includes new		NC	1	3,000	30.40	0.20	5.76	New	CD	PP1	No	0	6.1
	5000 cfs RBDD		NC	2	3,000	17.00	0.54	3.22	New	PP1	PP2	Yes	1	9.1
	Diversion		NC	3	3,000	2.50	0.69	0.47	New	PP2	PP3	Yes	1	1.7
	Facilities		NC	4	3,000	11.00	0.69	2.08	New	PP3	Funks	Yes	1	7.6
	<b>Total</b>													<b>\$180</b>
B	TC/CLI+CD/NC	8,000	CLI	1	5,000	6.00	0.64	1.14	New	SR	PP1	Yes	1	3.8
	Includes new		CLI	2	5,000	22.20	0.64	4.20	New	PP1	PP2	Yes	1	14.2
	5000 cfs CLI		CLI	3	5,000	22.00	0.64	4.17	New	PP2	PP3	Yes	1	14.1
	Diversion		CLI	4	5,000	7.40	0.64	1.40	New	PP3	TC	Yes	1	4.7
	Facilities		TC	2	5,000	169.83	0.44	32.17	Enlarge	CLI	Funks	Yes	0	74.7
			NC	1	3,000	30.40	0.20	5.76	New	CD	PP1	No	0	6.1
			NC	2	3,000	17.00	0.54	3.22	New	PP1	PP2	Yes	1	9.1
			NC	3	3,000	2.50	0.69	0.47	New	PP2	PP3	Yes	1	1.7
			NC	4	3,000	11.00	0.69	2.08	New	PP3	Funks	Yes	1	7.6
	<b>Total</b>													<b>\$136</b>
III A	GC+CD/NC	8,000	GC	all	5,000	212.00	0.18	40.15	Enlarge	HCPP	NC	No	1	37.1
	Includes new		NC	1	3,000	30.40	0.20	5.76	New	CD	PP1	No	0	6.1
	2000 cfs HCPP		NC	2	3,000	17.00	0.54	3.22	New	PP1	PP2	Yes	1	9.1
	Diversion		NC	3	8,000	2.50	0.76	0.47	New	PP2	PP3	Yes	1	1.9
	Facilities		NC	4	8,000	11.00	0.76	2.08	New	PP3	Funks	Yes	1	8.4
	<b>Total</b>													<b>\$63</b>
B	GC/CLI+CD/NC	8,000	CLI	1	2,000	7.20	0.46	1.40	New	SR	GC	No	1	3.3
	Includes new		GC	1	2,900	56.00	--	10.61	Existing	HCPP	CLI	No	0	--
	2000 cfs CLI		GC	2	5,000	16.60	0.17	3.14	Enlarge	CLI	JC	No	0	2.8
	Diversion		GC	3	5,000	139.40	0.17	26.40	Enlarge	JC	NC	No	0	23.7
	Facilities		NC	1	3,000	30.40	0.20	5.76	New	CD	PP1	No	0	6.1
			NC	2	3,000	17.00	0.54	3.22	New	PP1	PP2	Yes	1	9.1
			NC	3	8,000	2.50	0.76	0.47	New	PP2	PP3	Yes	1	1.9
			NC	4	8,000	11.00	0.76	2.08	New	PP3	Funks	Yes	1	8.4
	<b>Total</b>													<b>\$56</b>
IV	NC/SR+CD/NC	8,000	NC	1A	5,000	15.20	0.28	2.88	New	SR	CD	No	No	4.2
	Includes new		NC	1	8,000	30.40	0.36	5.76	New	CD	PP1	No	0	10.9
	5000 cfs NC		NC	2	8,000	17.00	0.76	3.22	New	PP1	PP2	Yes	1	12.9
	Diversion		NC	3	8,000	2.50	0.76	0.47	New	PP2	PP3	Yes	1	1.9
	Facilities		NC	4	8,000	11.00	0.76	2.08	New	PP3	Funks	Yes	1	8.4
	<b>Total</b>													<b>\$38</b>
V A	TC+NC/SR+CD/NC	8,000	TC	all	2,100	352.52	--	66.70	Existing	RBDD	Funks	Yes	0	--
	Includes new		NC	1A	2,900	15.20	0.20	2.88	New	SR	CD	No	0	3.0
	2100 cfs RBDD & new Diversion		NC	1	5,900	30.40	0.31	5.76	New	CD	PP1	No	0	9.4
	Facilities opposite		NC	2	5,900	17.00	0.69	3.22	New	PP1	PP2	Yes	1	11.7
	Moulton Weir		NC	3	5,900	2.50	0.69	0.47	New	PP2	PP3	Yes	1	1.7
			NC	4	5,900	11.00	0.69	2.08	New	PP3	Funks	Yes	1	7.6
	<b>Total</b>													<b>\$33</b>
B	GC+NC/SR+CD/NC	8,000	GC	all	1,800	212.00	--	40.15	Existing	HCPP	NC	No	0	--
	Includes 3200 cfs new Diversion		NC	1A	3,200	15.20	0.21	2.88	New	SR	CD	No	0	3.1
	Facilities opposite		NC	1	6,200	30.40	0.32	5.76	New	CD	PP1	No	0	9.7
	Moulton Weir		NC	2	6,200	17.00	0.70	3.22	New	PP1	PP2	Yes	1	11.9
			NC	3	6,200	2.50	0.70	0.47	New	PP2	PP3	Yes	1	1.8
			NC	4	6,200	11.00	0.70	2.08	New	PP3	Funks	Yes	1	7.7
	<b>Total</b>													<b>\$34</b>
VI*	TC+GC+CD/NC	8,900	TC	all	2,100	352.52	--	66.77	Existing	RBDD	Funks	Yes	1	--
			GC	1	2,900	72.60	--	13.75	Existing	HCPP	JC	No	0	--
			GC	2	1,800	139.40	--	26.4	Existing	JC	NC	No	0	--
			NC	1	3,000	30.40	0.20	5.76	New	CD	PP1	No	0	6.1
			NC	2	3,000	17.00	0.54	3.22	New	PP1	PP2	Yes	1	9.1
			NC	3	4,800	2.50	0.69	0.47	New	PP2	PP3	Yes	1	1.7
			NC	4	4,800	11.00	0.69	2.08	New	PP3	Funks	Yes	1	7.6
	<b>Total</b>													<b>\$24.8</b>

\* Alt VI does not meet the same capacity and Sacramento River diversion fishery criteria, as Alts I thru V.

The G-C canal would be enlarged from the point the capacity drops below 2900 cfs by widening and deepening the existing section. It is assumed that the enlarged canal will remain unlined, although it may be necessary to line or pipe the canal in restricted urban areas. At the junction of the G-C canal and New Canal (NC, described below and in Alternative IV), it will be necessary to provide control gates to allow operational flexibility for (1) continued G-C flow south of the NC, (2) G-C diversions to Funks Reservoir, and (3) NC diversion only to Funks Reservoir. Enlargement of the G-C canal will also require enlargement or replacement of existing check structures, siphons, bridges, drainage structures, and other facilities. No modifications to the Hamilton City Pumping Plant are required under this alternative.

Water from the Colusa Basin Drain would be diverted into a new canal (NC) and conveyed along an alignment for delivery to Funks Reservoir. It is assumed that the design capacity of a diversion and conveyance structure for water from the Colusa Basin Drain is 3000 cfs. (The optimum design capacity of a CBD diversion is unknown at this time.) The last reach of the NC would be increased from the G-C canal to Funks. The total design capacity at Funks under this alternative from the T-C, G-C, and Colusa Basin Drain is 8000 cfs.

**Alternative II. Enlarge the capacity of the T-C canal system. (CALFED report)**

This alternative would enlarge the T-C canal system to deliver 5000 cfs at Funks Reservoir, plus 3000 cfs from the Colusa Drain as noted above. This alternative would either require major improvements (or a new structure) to the existing diversion facility at Red Bluff (**Option A**, see Alternative I), or the construction of a new facility on the Sacramento River (**Option B**). A new facility under Option B is assumed to be located near Sacramento River Mile 188 (between Chico Landing and Ord Ferry) with a capacity of 5000 cfs. An intertie would deliver water from the new diversion at near Sacramento River Mile 188 to the T-C canal.

The T-C canal would be enlarged to 5000 cfs capacity from the near Sacramento River Mile 188 intertie to Funks Reservoir. The enlargement would be accomplished by widening the existing concrete lined section. This alternative will also require enlargement or replacement of existing check structures, siphons, bridges, drainage structures, and other facilities.

Up to 3000 cfs of water from the Colusa Basin Drain could be diverted and conveyed along a "New Canal" alignment (see Alternative IV) for delivery to Funks Reservoir. The total design capacity at Funks under this alternative from the T-C and Colusa Basin Drain is 8000 cfs.

**Alternative III. Enlarge the capacity of the G-C canal system.**

This alternative would enlarge the G-C canal system to deliver 5000 cfs and would require a new 8000 cfs canal reach from the G-C canal to Funks Reservoir. This alternative would either require major improvements to the existing diversion facility at Hamilton City from 3000 cfs to 5000 cfs (**Option A**) or the construction of a new diversion facility on the Sacramento River downstream from the existing facility. A new diversion facility is assumed to be located at near Sacramento River Mile 188 with a capacity of 2000 cfs (**Option B**). Under Option B, the combined capacity of the existing G-C diversion and a new diversion is 5000 cfs.

The G-C canal would be enlarged to 5000 cfs from the Hamilton City Pumping Plant (Option A), or from the near Sacramento River Mile 188 intertie (Option B) to the New Canal. Similar to Alternative I, Alternative III would also require control gates and modifications to existing structures.

Water from the Colusa Basin Drain would be diverted and conveyed along a "New Canal" alignment that would also be sized to receive water from the G-C canal for delivery to Funks Reservoir. The total design capacity at Funks under this alternative from the G-C and Colusa Basin Drain is 8000 cfs.

**Alternative IV. A new diversion and conveyance facility (New Canal) from the Sacramento River.**

The new diversion would have a capacity of 5000 cfs and be located across from the Moulton Weir on the Sacramento River. Water would be conveyed west to Funks Reservoir in an open channel along an alignment that is located between the Delevan and Sacramento National Wildlife Refuges. As referenced by the other alternatives, this alignment is referred to as the "New Canal".

Water from the Colusa Drain would be diverted into the new conveyance facility where they cross, and the capacity of the new conveyance facility at this location would be increased to accommodate the diversions from the drain. The conveyance facility from this location to Funks Reservoir would have a design capacity of 8000 cfs.

**Alternative V. Use either the T-C or G-C canal existing facilities with a new smaller diversion on the Sacramento River; the total diversion capacity would be 5000 cfs.**

This alternative would use either of the T-C or G-C existing facilities with a smaller new diversion from the Sacramento River for a total capacity of 5000 cfs. The two options would be as follows:

**Option A:** Use existing T-C capacity of 2100 cfs with a new diversion on the Sacramento River with a capacity of 2900 cfs.

**Option B:** Use existing G-C capacity of 1800 cfs with a new diversion on the Sacramento River with a capacity of 3200 cfs.

The new conveyance facility for both options would be at the same location as Alternative IV and increased in capacity to accommodate a 3000 cfs diversion from the Colusa Basin Drain where the drain crosses the new conveyance facility. Under Option B, the new conveyance facility would be designed to receive water from the G-C canal.

Under both options, the total design capacity at Funks Reservoir, including water from the Colusa Basin Drain, is 8000 cfs.

**Alternative VI. Use the existing T-C and G-C canal facilities.**

This alternative, similar to Alternative I, would utilize the existing capacity of the Tehama-Colusa canal, but not enlarge the lower reaches of the Glenn-Colusa canal to convey water to Funks Reservoir. The canals' delivery capacities are limited by the sections of canal at the downstream end of the system. The present T-C and G-C canal capacities are 2100 cfs and 1800 cfs, respectively, at or near Funks Reservoir for a total combined capacity of 3900 cfs. The G-C canal would not be improved in this alternative. A new canal reach will be required from the G-C canal to Funks Reservoir.

This alternative does not propose to modify the existing T-C diversion facility at Red Bluff, or make any changes to the existing T-C canal and facilities.

Water from the Colusa Basin Drain would be diverted into a new canal (NC) and conveyed along an alignment for delivery to Funks Reservoir. It is assumed that the design capacity of a diversion and conveyance structure for water from the Colusa Basin Drain is 3000 cfs. (The optimum design capacity of a CBD diversion is unknown at this time.) The last reach of the NC would be increased from the G-C canal to Funks. The total design capacity at Funks under this alternative from the T-C, G-C, and Colusa Basin Drain is 6900 cfs.

**Cost of Alternatives**

The main purpose of developing cost estimates for this study was to provide a reasonable estimate of the cost of the alternatives but more importantly, allow for the comparison of alternatives. A comparison of costs seeks to identify any large differences in the cost of alternatives at the earliest point in the decision process. Such information is useful in determining whether to proceed with or defer an alternative.

Initial cost estimates were based on the October 1997 CALFED " Facility Descriptions and Cost Estimates" for the (1) Red Bluff Diversion and Tehama-Colusa (TC) Canal Enlargement, and (2) near Sacramento River Mile 188 (CL)

**Table 2**  
**Funks Reservoir Alternatives Summary Costs**  
**Proposition 204 North of the Delta Storage Facility Studies**  
(\$ millions)

Alt. No.	Alternative Name	Diversion to Funks (cfs)	Cost Item	DP% Add	Diversion Works	Trapazoidal Canal	Major Features	Pumping Plants	Total Costs
I	TC+GC+CD/NC	8,000	Direct Payment (DP)		25.4	85.8	155.9	97.3	364.5
	Includes new		Constr. Contgcy.	25%	6.4	21.5	39.0	24.3	91.1
	2100 cfs RBDD		Right of Way		--	2.3	--	--	2.3
	Diversion		State Operations(SO)	35%	8.9	30.0	54.6	34.1	127.6
	Facilities		<b>TOTAL ALT COST</b>		<b>40.6</b>	<b>139.6</b>	<b>249.5</b>	<b>155.7</b>	<b>\$585.5</b>
II A	TC+CD/NC	8,000	Direct Payment		63.5	179.6	223.0	102.2	568.3
	Includes new		Constr. Contgcy.	25%	15.9	44.9	55.7	25.6	142.1
	5000 cfs RBDD		Right of Way		--	4.3	--	--	4.3
	Diversion		State Operations	35%	22.2	62.9	78.0	35.8	198.9
	Facilities		<b>TOTAL ALT COST</b>		<b>101.6</b>	<b>291.7</b>	<b>356.8</b>	<b>163.5</b>	<b>\$913.5</b>
B	TC/CLI+CD/NC	8,000	Direct Payment		63.5	136.1	130.2	155.7	485.5
	Includes new		Constr. Contgcy.	25%	15.9	34.0	32.6	38.9	121.4
	5000 cfs CLI		Right of Way		--	4.2	--	--	4.2
	Diversion		State Operations	35%	22.2	47.6	45.6	54.5	169.9
	Facilities		<b>TOTAL ALT COST</b>		<b>101.6</b>	<b>222.0</b>	<b>208.4</b>	<b>249.1</b>	<b>\$781.1</b>
III A	GC+CD/NC	8,000	Direct Payment		26.0	62.5	168.3	105.7	362.5
	Includes new		Constr. Contgcy.	25%	6.5	15.6	42.1	26.4	90.6
	2000 cfs HCPP		Right of Way		--	4.4	--	--	4.4
	Diversion		State Operations	35%	9.1	21.9	58.9	37.0	126.9
	Facilities		<b>TOTAL ALT COST</b>		<b>41.6</b>	<b>104.4</b>	<b>269.2</b>	<b>169.1</b>	<b>\$584.4</b>
B	GC/CLI+CD/NC	8,000	Direct Payment		26.0	55.3	140.3	98.5	320.1
	Includes new		Constr. Contgcy.	25%	6.5	13.8	35.1	24.6	80.0
	2000 cfs CLI		Right of Way		--	3.7	--	--	3.7
	Diversion		State Operations	35%	9.1	19.3	49.1	34.5	112.0
	Facilities		<b>TOTAL ALT COST</b>		<b>41.6</b>	<b>92.2</b>	<b>224.5</b>	<b>157.6</b>	<b>\$515.9</b>
IV	NC/SR+CD/NC	8,000	Direct Payment		63.5	38.3	134.8	90.5	327.1
	Includes new		Constr. Contgcy.	25%	15.9	9.6	33.7	22.6	81.8
	5000 cfs NC		Right of Way		--	2.5	--	--	2.5
	Diversion		State Operations	35%	22.2	13.4	47.2	31.7	114.5
	Facilities		<b>TOTAL ALT COST</b>		<b>101.6</b>	<b>63.8</b>	<b>215.7</b>	<b>144.8</b>	<b>\$525.9</b>
V A	TC+NC/SR+CD/NC	8,000	Direct Payment		63.5	33.4	134.8	100.5	332.2
	Includes new		Constr. Contgcy.	25%	15.9	8.4	33.7	25.1	83.1
	2100 cfs RBDD & new Diversion		Right of Way		--	2.0	--	--	2.0
	Facilities		State Operations	35%	22.2	11.7	47.2	35.2	116.3
			<b>TOTAL ALT COST</b>		<b>101.6</b>	<b>55.5</b>	<b>215.7</b>	<b>160.8</b>	<b>\$533.6</b>
B	GC+NC/SR+CD/NC	8,000	Direct Payment		38.1	34.2	134.8	89.5	296.6
	Includes 3200 cfs new Diversion		Constr. Contgcy.	25%	9.5	8.5	33.7	22.4	74.1
	Facilities opposite Moulton Weir		Right of Way		--	2.0	--	--	2.0
			State Operations	35%	13.3	12.0	47.2	31.3	103.8
			<b>TOTAL ALT COST</b>		<b>61.0</b>	<b>56.7</b>	<b>215.7</b>	<b>143.2</b>	<b>\$476.5</b>
VI *	TC+GC+CD/NC	6,900	Direct Payment (DP)		--	24.5	104.6	79.4	208.5
			Constr. Contgcy.	25%	--	6.1	26.1	19.9	52.1
			Right of Way		--	0.0	--	--	0.0
			State Operations(SO)	35%	--	8.6	36.6	27.8	73.0
			<b>TOTAL ALT COST</b>		<b>0.0</b>	<b>39.2</b>	<b>167.3</b>	<b>127.0</b>	<b>\$333.5</b>

\* Alt VI does not meet the same capacity and Sacramento River diversion fishery criteria, as Alts I thru V.

Intertie. The initial costs were modified by CD and DOE for the preliminary conceptual designs and facility quantity estimates.

Preliminary component costs for each alternative include Sacramento River diversions, conveyance canals, major structures, and pumping plants direct payment (DP) construction costs. In addition to the DP costs it is necessary to add construction contingencies, right of way, and state operation (SO) costs in order to arrive at the total construction cost for each alternative. Operation and maintenance costs are not included in the total construction costs. Table 2 summarizes the component costs for each conveyance alternative.

#### River Diversion Facilities

Enlarged and new river diversion fish screen, bypass, gates, sedimentation basin, pumps, and related works descriptions and costs were developed by ESO staff. Reference memo (and attached diversion cost matrix) to Nasar Bateni dated September 1, 1998.

#### Conveyance Canals

Enlarged and/or new trapezoidal canal costs are based on quantities developed for each alternative. Unit costs for unlined and lined canals were developed from existing studies, past projects, CALFED and USBR data, and engineering judgement. DOE provided unit costs for generic design criteria, and CD staff modified the estimates for the specific pre-design conditions for each alternative canal reach and facility.

#### Major Features

Enlarged and/or new major features costs are based on quantities as noted above for canals. Major features include canal check structures, highway and county road bridges, railroad siphons, and major drainage crossings. Unit costs for specific pre-design conditions for each alternative were derived as noted above for canals.

#### Pumping Plants

Enlarged, replacement, or new pumping plant costs are based on generic cost curves provided by DOE. The cost curve relates plant cost to the pumping power (megawatts) required to lift a given flow to a calculated total dynamic head. Plant cost for specific pre-design conditions for each alternative were derived from the curve.

#### Right of Way

Enlarged and/or new right of way width is based on canal conditions. Acres of right of way to be acquired was calculated for each alternative, and multiplied by the estimated cost per acre, for the predominately agricultural land. Right for the river diversion facilities, major features, and pumping plants is included in the canal right of way costs.

### Construction Contingencies

Construction contingencies are estimated at 25% of DP. The purpose of the contingency is to provide monies for unexpected construction costs such as change orders, additional work, unforeseen conditions, or other justified or negotiated contractor expenses.

### **Preliminary Findings**

#### Alternative I. (Existing T-C Canal and enlarged G-C Canal)

This alternative ranks fifth in terms of total cost. The most costly elements are the enlargement of the existing G-C canal and major canal structures. Because this alternative emphasizes existing facilities, significant operational and environmental issues will need to be addressed in detailed studies. Issues include agency delivery priority, interagency agreements, river diversion criteria, and other factors. These same issues apply to the other alternatives also. The T-C diversion structure is currently not designed to operate during the non-irrigation season. Operating during this period will need to accommodate fish passage. The G-C canal facilities are capable of year-around operation and would only involve enlarging the lower part of the canal where the existing capacity is less than 2900 cfs.

#### Alternative II. (Enlarged T-C Canal)

This alternative, both options A and B, rank sixth or highest in terms of total cost. The most costly elements are the enlargement of the existing T-C canal and major canal features. This alternative incurs substantial cost to increase the deliverable capacity of the T-C canal system. In order to resolve fishery issues, a new diversion structure may be needed. A new diversion could resolve fishery issues if located at a more suitable site and incorporated design features with less environmental impacts.

#### Alternative III. (Enlarged G-C Canal)

This alternative, 2000 cfs near Sacramento River Mile 188 diversion Option B, ranks third in terms of total cost. The most costly elements are the G-C canal and major structures enlargement downstream of the near Sacramento River Mile 188 intertie connection. Similarly to Alternative II, this alternative incurs substantial cost to increase the deliverable capacity; however, modifications to the existing diversion structure to increase its capacity appear easier and less costly than Alternative II. The cost of a supplemental diversion structure at the near Sacramento River Mile 188 location, in-lieu of an enlarged Hamilton City Pumping Plant, will require additional investigation to determine a suitable site and preliminary design. A major cost component of this alternative involves modifications to the Stony Creek siphon to increase its capacity to 5000 cfs.

Alternative IV. (New Canal)

This 5000 cfs stand alone alternative ranks fourth in terms of total cost. The most costly elements are the New Canal and major canal features. A new diversion and conveyance system would provide the greater flexibility in operating and maintaining the system when compared to the other alternatives; however, this alternative incurs significant cost because of the amount of new construction required. Further investigations may result in more efficient and less costly design of this alternative. Although an open channel was selected for this alternative, a more detailed evaluation of a pipe design option will be considered later.

Alternative V. (Existing T-C or G-C Canal with smaller New Canal)

This alternative, G-C Option B, ranks second with the lowest total cost. Supplementing the existing capacities of the T-C or G-C system with a new diversion on the Sacramento is a compromise of existing facilities and a new canal. Utilization of existing facilities would reduce the size and cost of a new canal while also providing some operational flexibility. A smaller new canal would also reduce the cost of a pipe design option.

Alternative VI. (Existing T-C Canal and existing G-C Canal)

This alternative, although not comparable to the five basic alternatives, ranks first in terms of total cost. The most costly elements are the new canal and pumping plants. Similar to Alternative I, because this alternative emphasizes existing facilities, significant operational and environmental issues will need to be addressed in detailed studies. Issues include agency delivery priority, interagency agreements, river diversion criteria, and other factors.

**Colusa Basin Drain Option (included in all alternatives)**

The current lack of flow data within the watershed limits the analysis of flow conditions that would be needed to properly size a diversion structure on the drain. Flow data is limited to a gage at the Hwy 20 crossing, and a gage at the main outfall gates near Knights Landing. The initial design of this option assumes a 3000 cfs diversion capacity but will be modified based on additional flow data, if available, and on operations studies that would coordinate diversions from the drain with diversions from alternative conveyance systems. Screening of fish from the drain is not assumed in the cost but may be required after fishery investigations are completed.

**Study Refinement**

The study effort is an iterative process of formulating and screening alternatives with the assistance of local agencies, Northern District, and CALFED staff. The current list of alternatives should be viewed as representative of the types of conveyance systems that could potentially divert and convey water from the Sacramento River and Colusa Basin Drain to an offstream storage facility at

Sites. This initial study compares the cost of the alternatives and identifies potential issues associated with their implementation.

As the decision process focuses on specific alternatives, detailed investigations at the feasibility level or greater will be conducted to assess site conditions, environmental impacts, and costs. Further studies may recommend changes to the alignment and design configurations assumed in the alternatives. Further studies may also add, delete or revise alternatives or investigate specific options within each alternative.

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