WATER QUALITY PROGRAM
Bromide Expert Panel

MEETING PACKAGE

September 8-9, 1998
Sacramento Convention Center
1400 J Street, Room 103
Sacramento, California

CALFED
BAY-DELTA
PROGRAM

CONTENTS

Page

1. Meeting Agenda

2. Location Maps

3. Sources of Bromide

4. Existing Water Quality Conditions

5. Predicted Water Quality Conditions Resulting from CALFED Alternatives

   Specific Conductance (Electrical Conductivity)

   Bromide

6. Existing Treatment Plants and Processes

7. Water Quality Degradation in Transit

8. Populations Receiving Drinking Water from the Delta

CALFED
BAY-DELTA
PROGRAM

1416 Ninth Street, Suite 1155
Sacramento, California 95814

(916) 657-2666
FAX (916) 654-9780

September 3, 1997

WATER QUALITY PROGRAM
Bromide Expert Panel

Tuesday and Wednesday, **September 8 and 9, 1998**
9:00 a.m. - 5:00 p.m.

LOCATION

Sacramento Convention Center
1400 J Street, Room 103
Sacramento, CA

AGENDA

The overall charge to the panel is to provide the CALFED Policy Group with information to help them understand the significance of bromide to their selection of a Preferred Alternative for the Program.

Day 1 - September 8

Objective: **Discuss and evaluate the significance of bromide in drinking water supplies, in general, considering the most up-to-date information and research.**

9:00 - 9:15	**1.**	**Introductions of Panel Members and Modeling Support Team.**
9:15 - 9:30	**2.**	**Meeting Overview**
9:30 - 10:30	**3.**	**Panelist Presentations**

- Describing General significance of Bromide to Panelists' areas of expertise

10:30 - 12:30	**5.**	**Panel Deliberations**

- Nationwide occurrence of bromide in drinking water sources in comparison to the Delta
- Health concerns, available health effects information, directions of health effects research

12:30 - 1:30	**5.**	**Lunch**

1:30 - 4:30		• Capabilities of current treatment technologies to control brominated DBP's • Directions of treatment technology research and development • Development of drinking water regulations for DBP's
4:30 - 5:00	**6.**	**Wrap-up** • Critical information CALFED needs to consider in developing a long term solution, as related to bromide.
5:00	**7.**	**Adjourn for the day**

CALFED
BAY-DELTA
PROGRAM

1416 Ninth Street, Suite 1155
Sacramento, California 95814

(916) 657-2666
FAX (916) 654-9780

September 3, 1998

WATER QUALITY PROGRAM
Bromide Expert Panel

Tuesday and Wednesday, **September 8 and 9, 1998**
9:00 a.m. - 3:30 p.m.

LOCATION
Sacramento Convention Center
1400 J Street, Room 103
Sacramento, CA

AGENDA

Day 2 - September 9

Objective: **Evaluate the significance of bromide occurrence in Bay-Delta water supplies and apply the findings if Day 1 Panel deliberations to the Bay-Delta specifically.**

9:00 - 10:00 **1. Introduction to the Sacramento - San Joaquin Delta, the Bromide Problem, and the CALFED Alternatives**

10:00 - 12:00 **2. Panel Deliberations**

- Capabilities of existing treatment plants using Delta water, and treatment modifications that may enable future regulations to be reliably met.
- Source control options for bromide and feasibility of operational changes

1:00 - 2:00

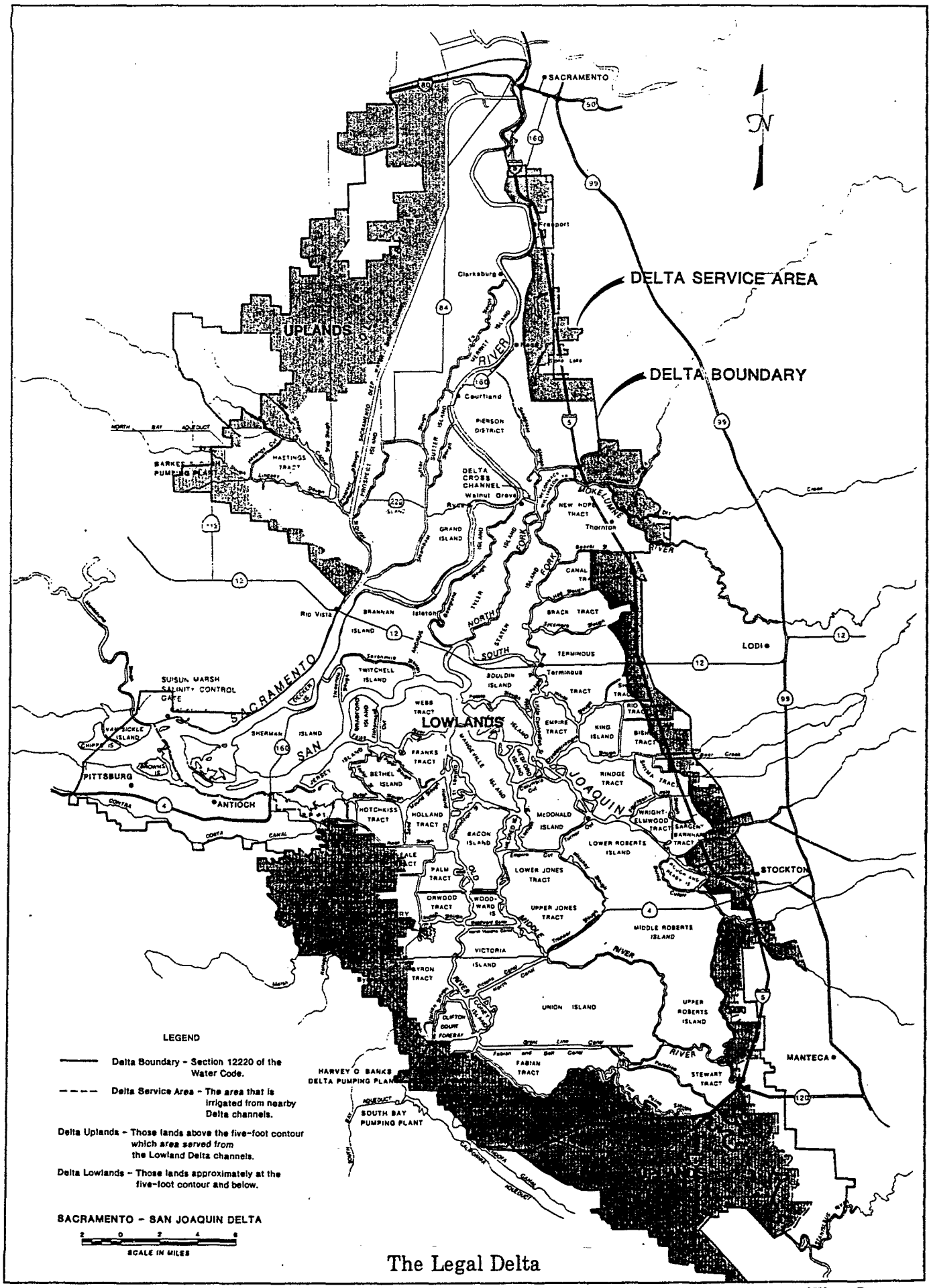
- Identification of specific activities that CALFED should undertake in the first years of program implementation, in order to more fully determine the significance of bromide to CALFED decisions.

2:00 - 2:30 **3. Public Comment**

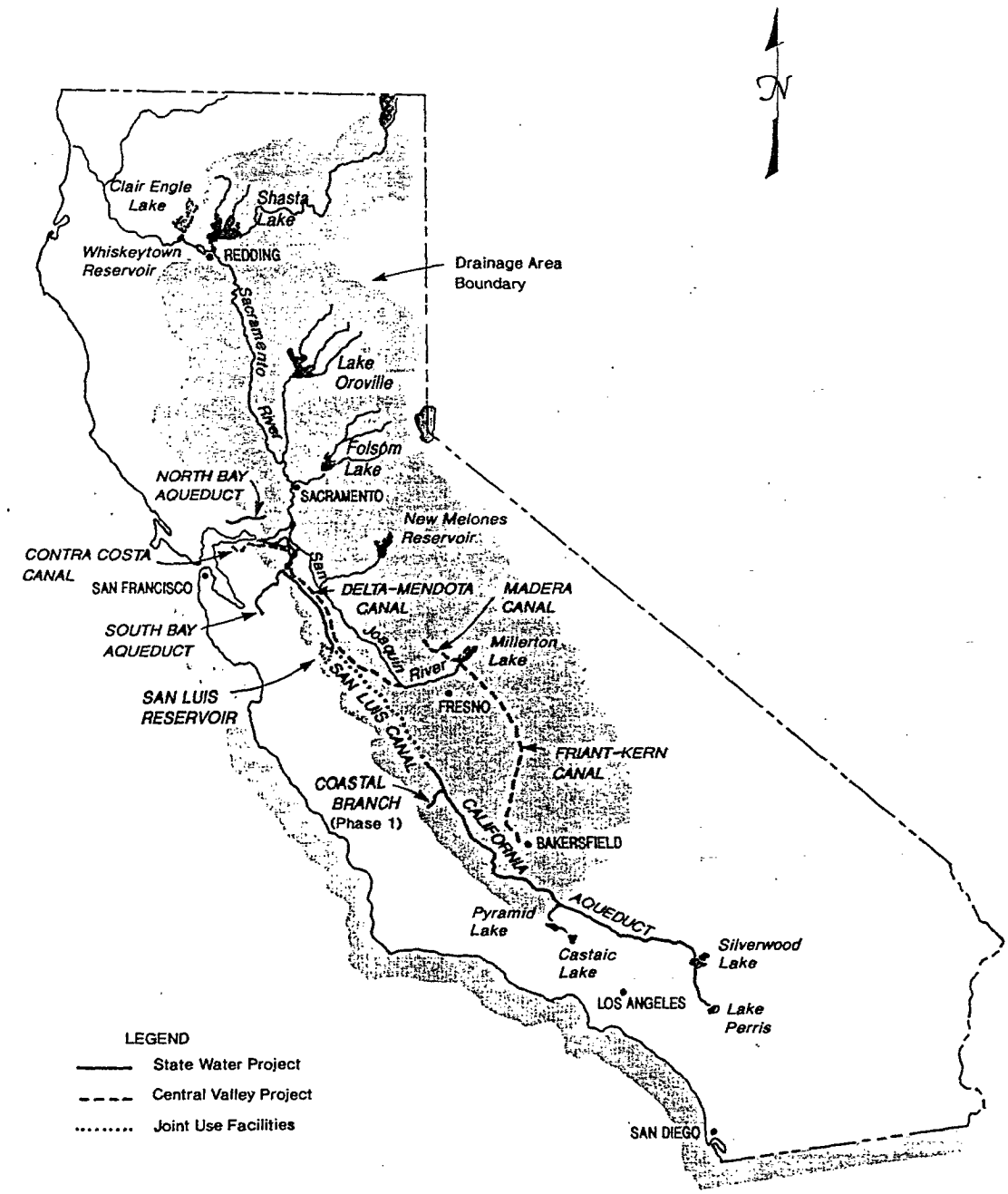
2:30 - 3:30 **4. Summary of Deliberations - Statements by Panelist**

- Perspectives on the Panel Deliberations
- Looking to the future

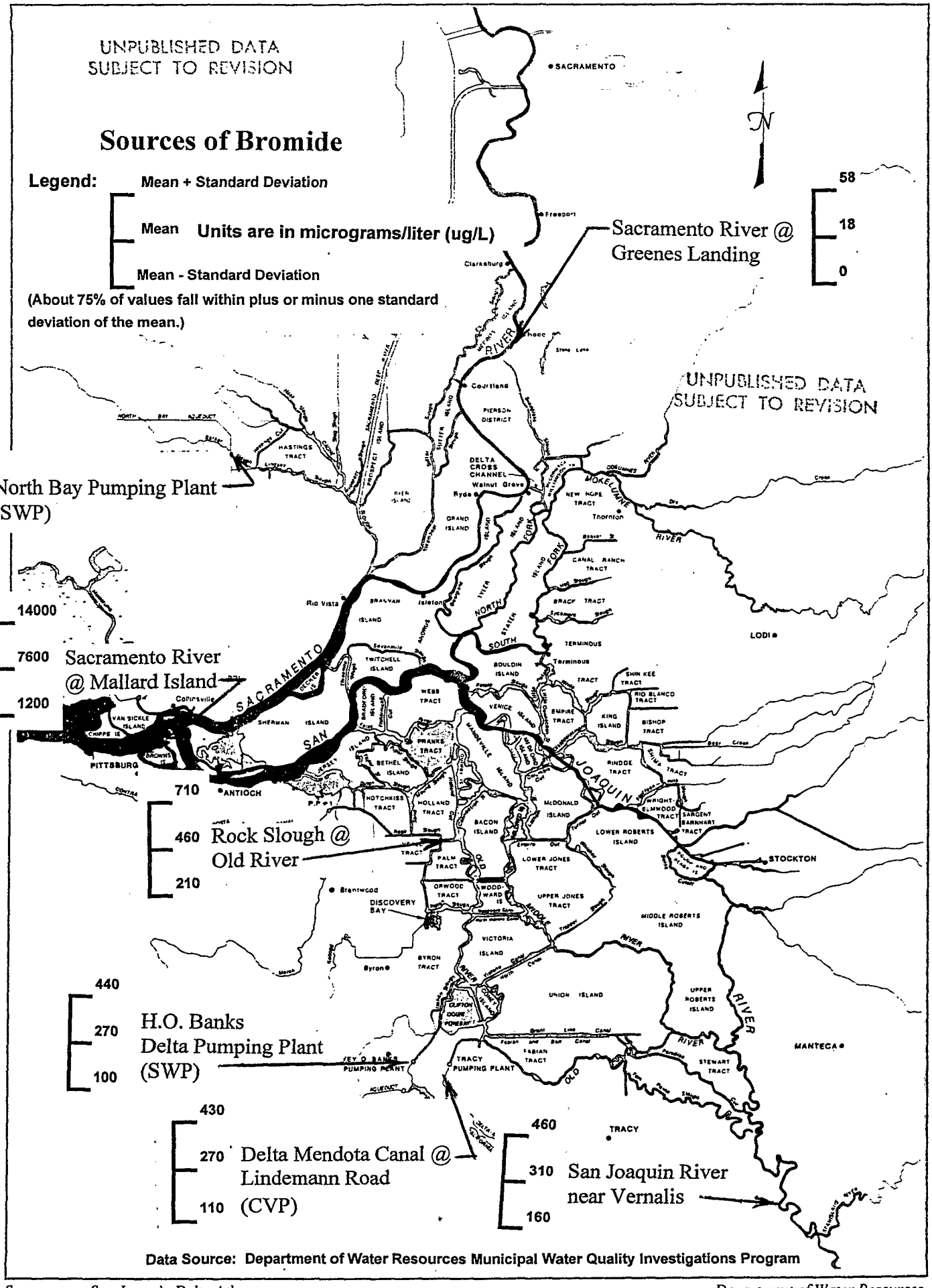
3:30 **5. Adjourn for the day**



The Legal Delta



Major Features of State Water Project and Central Valley Project


UNPUBLISHED DATA
SUBJECT TO REVISION
Sources of Bromide
Legend:
Mean + Standard Deviation
Mean
Units are in micrograms/liter (ug/L)
Mean - Standard Deviation
(About 75% of values fall within plus or minus one standard deviation of the mean.)
Sacramento River @ Greenes Landing
58
18
0
UNPUBLISHED DATA
SUBJECT TO REVISION
North Bay Pumping Plant (SWP)
78
51
24
Sacramento River @ Mallard Island
14000
7600
1200
Rock Slough @ Old River
710
460
210
H.O. Banks Delta Pumping Plant (SWP)
440
270
100
Delta Mendota Canal @ Lindemann Road (CVP)
430
270
110
San Joaquin River near Vernalis
460
310
160
SACRAMENTO
Freeport
Clarksburg
Courtland
Walnut Grove
Ryde
Rio Vista
Isleton
Collinsville
PITTSBURG
ANTIOCH
Brentwood
DISCOVERY BAY
Byron
TRACY
LODI
STOCKTON
MANTECA
SACRAMENTO
SAN
JOAQUIN
RIVER
Data Source: Department of Water Resources Municipal Water Quality Investigations Program

UNPUBLISHED DATA
SUBJECT TO REVISION

Water Quality Conditions at Selected Delta Locations
Summary of Data from Department of Water Resources
Municipal Water Quality Investigations Program

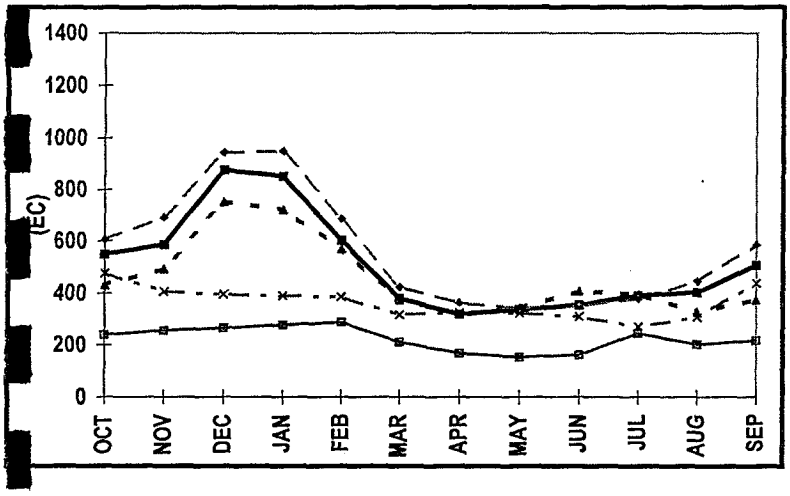
Location	Analyte	Units	Beg Date	End Date	Min	Avg	Max	Std_Dev	#Samples
Location of State Water Project Pumps in South Delta - operates through Clifton Court									
Delta P.P. Headworks	Alkalinity	mg/L	7/2/86	7/2/97	30	66	96	12	115
Delta P.P. Headworks	Bromide, Dissolved	mg/L	1/24/90	7/2/97	0.040	0.269	0.650	0.169	155
Delta P.P. Headworks	Chloride, Diss.	mg/L	3/30/82	7/2/97	14	81	186	48	294
Delta P.P. Headworks	Dissolved Organic Carbon	mg/L	7/5/89	3/13/97	1.9	3.7	10.5	1.3	345
Delta P.P. Headworks	Total Dissolved Solids	mg/L	7/2/86	7/2/97	101	258	475	94	115
Delta P.P. Headworks	Ultra-violet analysis of DOC	Abs/cm	3/20/90	7/2/97	0.041	0.122	0.363	0.050	384
Location of State Water Project Pumps in North Delta									
Barker Sl @ North Bay PP	Alkalinity	mg/L	1/23/90	6/4/97	48	98	150	22	103
Barker Sl @ North Bay PP	Bromide, Dissolved	mg/L	2/21/90	6/4/97	0.000	0.051	0.230	0.027	114
Barker Sl @ North Bay PP	Chloride, Diss.	mg/L	9/15/88	6/4/97	5	26	74	11	122
Barker Sl @ North Bay PP	Dissolved Organic Carbon	mg/L	7/11/89	3/12/97	2.8	5.3	23.5	3.1	156
Barker Sl @ North Bay PP	Total Dissolved Solids	mg/L	1/23/90	6/4/97	84	192	297	49	103
Barker Sl @ North Bay PP	Ultra-violet analysis of DOC	Abs/cm	3/21/90	6/4/97	0.071	0.182	0.882	0.130	192
Sacramento River Inflow to the Delta									
Sacramento River at Greene's Ldg.	Alkalinity	mg/L	3/13/86	3/2/98	30	58	86	11	215
Sacramento River at Greene's Ldg.	Bromide, Dissolved	mg/L	1/24/90	3/2/98	0.000	0.018	0.520	0.040	182
Sacramento River at Greene's Ldg.	Chloride, Diss.	mg/L	7/21/83	3/2/98	1	7	22	3	268
Sacramento River at Greene's Ldg.	Dissolved Organic Carbon	mg/L	7/11/89	6/13/97	1.4	2.5	13.6	1.1	1163
Sacramento River at Greene's Ldg.	Total Dissolved Solids	mg/L	3/13/86	3/2/98	49	100	374	27	213
Sacramento River at Greene's Ldg.	Ultra-violet analysis of DOC	Abs/cm	3/21/90	3/2/98	0.016	0.059	0.648	0.036	1228
Point of Diversion for Contra Costa Water District									
Rock Slough @ Old River	Alkalinity	mg/L	7/2/86	10/20/94	46	66	89	8	40
Rock Slough @ Old River	Bromide, Dissolved	mg/L	1/24/90	10/20/94	0.040	0.455	0.920	0.248	89
Rock Slough @ Old River	Chloride, Diss.	mg/L	7/26/83	10/20/94	12	109	303	78	169
Rock Slough @ Old River	Dissolved Organic Carbon	mg/L	7/5/89	10/20/94	2.2	3.4	9.2	1.2	92
Rock Slough @ Old River	Total Dissolved Solids	mg/L	7/2/86	10/20/94	86	305	544	125	41
Rock Slough @ Old River	Ultra-violet analysis of DOC	Abs/cm	3/20/90	10/20/94	0.068	0.122	0.800	0.094	84
San Joaquin River Inflow to Delta									
San Joaquin R. nr. Vernalis	Alkalinity	mg/L	3/4/86	3/24/98	36	104	155	26	184
San Joaquin R. nr. Vernalis	Bromide, Dissolved	mg/L	1/23/90	3/24/98	0.020	0.313	0.650	0.153	114
San Joaquin R. nr. Vernalis	Chloride, Diss.	mg/L	3/30/82	3/24/98	7	102	221	47	250
San Joaquin R. nr. Vernalis	Dissolved Organic Carbon	mg/L	12/17/86	3/13/97	1.4	3.9	11.4	1.6	102
San Joaquin R. nr. Vernalis	Total Dissolved Solids	mg/L	3/4/86	3/24/98	92	459	897	157	185
San Joaquin R. nr. Vernalis	Ultra-violet analysis of DOC	Abs/cm	3/20/90	3/24/98	0.043	0.109	0.449	0.057	110
Outflow from Delta to West Delta and San Francisco Bay									
Sacramento River @ Mallard Island	Alkalinity	mg/L	2/27/86	2/5/98	37	70	105	14	147
Sacramento River @ Mallard Island	Bromide, Dissolved	mg/L	1/22/90	2/5/98	0.020	7.67	22.6	6.37	144
Sacramento River @ Mallard Island	Chloride, Diss.	mg/L	5/8/85	2/5/98	7	2246	6060	1684	198
Sacramento River @ Mallard Island	Dissolved Organic Carbon	mg/L	7/11/89	3/12/97	1.6	2.8	11.0	1.1	129
Sacramento River @ Mallard Island	Total Dissolved Solids	mg/L	2/27/86	2/5/98	80	3907	11000	3209	147
Sacramento River @ Mallard Island	Ultra-violet analysis of DOC	Abs/cm	3/21/90	2/5/98	0.038	0.089	0.287	0.040	143
090298KeyStationsMWQI.xls									

UNPUBLISHED DATA
SUBJECT TO REVISION

Comparison of Clifton Court Water Quality

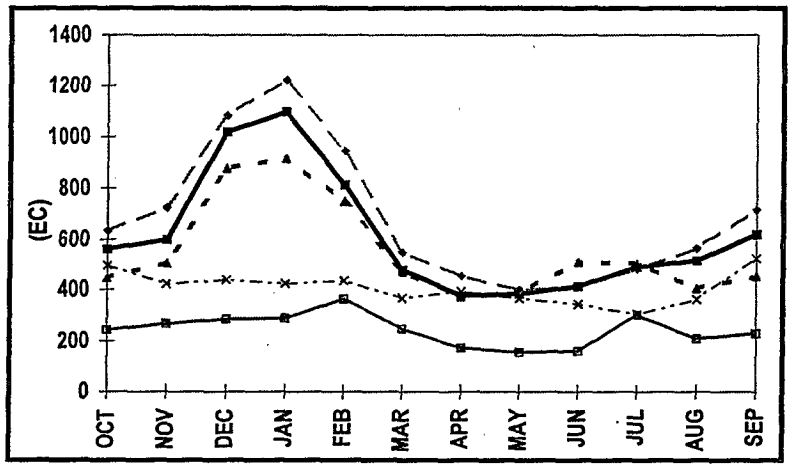
Monthly Average

LONG TERM (16 YR AVG)



Existing Conditions (1995 LOD)
No Action (2020 LOD)
Alt. 1C (2020 LOD) *
Alt. 2B (2020 LOD) **
Alt. 3X (2020 LOD) ***

DRY AND CRITICAL YEARS



UNPUBLISHED DATA
SUBJECT TO REVISION

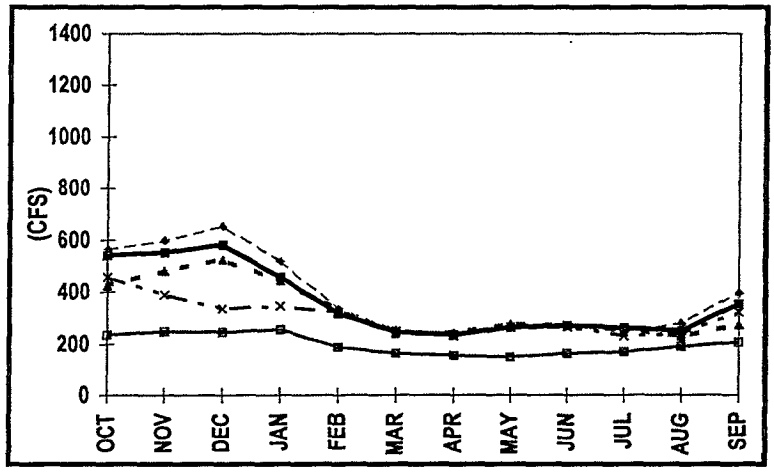
*** Alternative 1C**
New Northeast Forebay Intake, Old River Dredged, South Delta Salinity Control Structures, Head of Old River Barrier Tracy/Clifton Court Intertie, 10,300 cfs Max. Bank Pumping

**** Alternative 2B**
Alt. 1C* improvements plus 10,000 cfs Screened Hood Intake Sandgrass Slough & North Fork Mokelumne Enlarged Flooded McCormack-Williamson Tract,

***** Alternative 3X**
All 1C* & 2B**improvements plus 10,000 cfs Screened Isolated Facility Diversion near Hood

NOTE: All Hydrologies included WQCP & Delta (b)(2) Actions, All Alternative included ERPP Flows, 1.25 MAF Env. Storage, 4.75 MAF Ag/Urban Storage

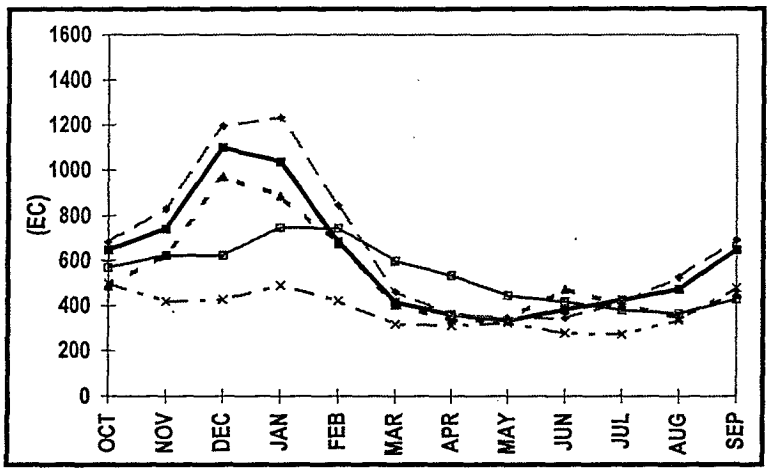
ABOVE NORMAL AND WET YEARS



Comparison of Rock Slough Water Quality

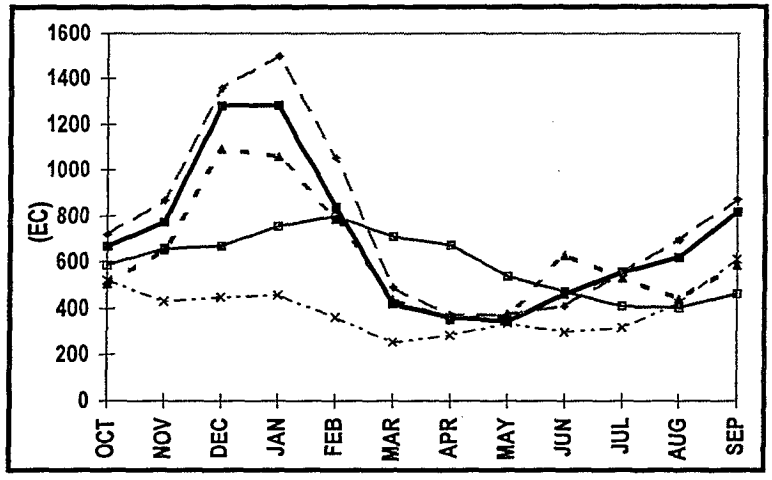
Monthly Average

LONG TERM (73 YR AVG)



Existing Conditions (1995 LOD)
No Action (2020 LOD)
Alt. 1C (2020 LOD) *
Alt. 2B (2020 LOD) **
Alt. 3X (2020 LOD) ***

DRY AND CRITICAL YEARS



UNPUBLISHED DATA
SUBJECT TO REVISION

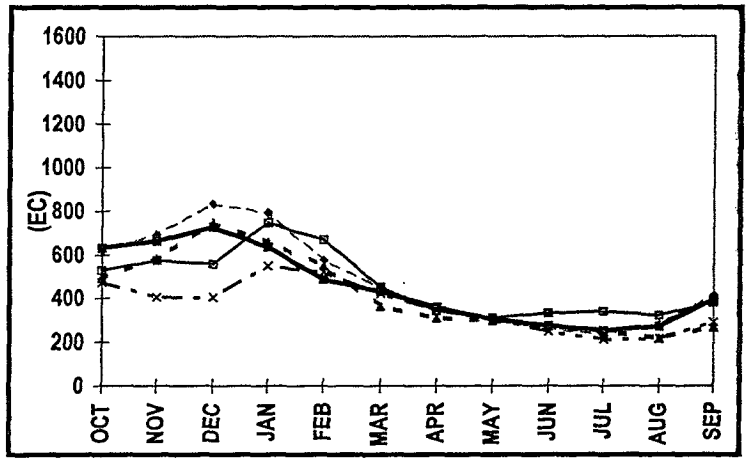
*** Alternative 1C**
New Northeast Forebay Intake, Old River Dredged, South Delta Salinity Control Structures, Head of Old River Barrier Tracy/Clifton Court Intertie, 10,300 cfs Max. Bank Pumping

**** Alternative 2B**
Alt. 1C* improvements plus 10,000 cfs Screened Hood Intake Snodgrass Slough & North Fork Mokelumne Enlarged Flooded McCormack-Williamson Tract,

***** Alternative 3X**
Alt. 1C* & 2B**improvements plus 10,000 cfs Screened Isolated Facility Diversion near Hood

NOTE: All Hydrologies included WQCP & Delta (b)(2) Actions, All Alternative included ERPP Flows, 1.25 MAF Env. Storage, 4.75 MAF Ag/Urban Storage

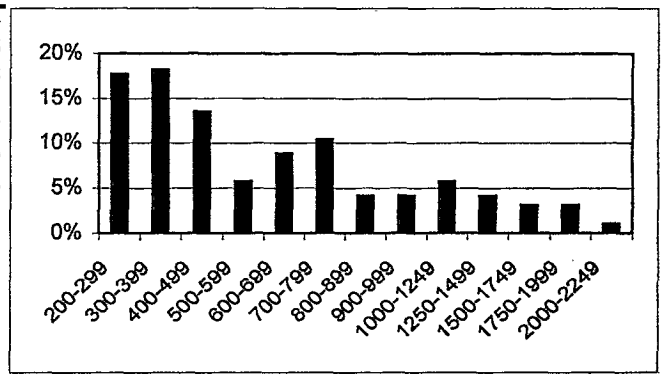
ABOVE NORMAL AND WET YEARS



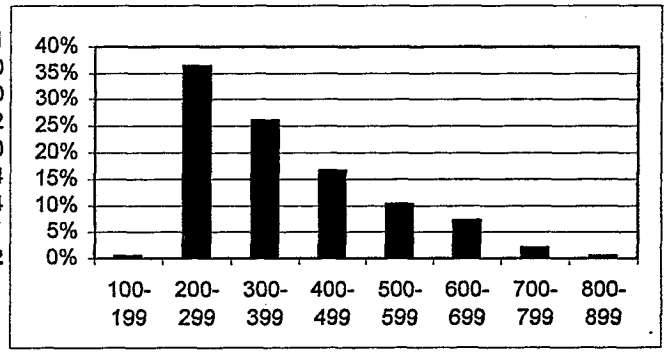
Frequency Distribution of Specific Conductance (uS/cm)
Predicted by May 1998 DSM Modeling Results for CALFED Alternatives
Based on 1976-1991 hydrology

Y Axis of graphs depict the number of months during the 16 year modelling period (1976-1991) that predicted Specific Conductance (electrical conductivity) values are within the range stated on the X axis

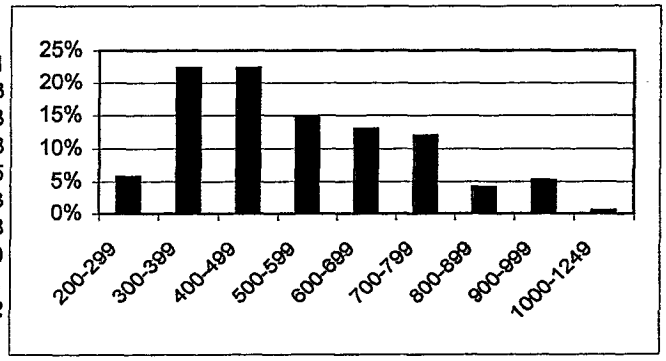
Station	Alt.	Range	%	# Months
CCC Intake	1A	200-299	18%	34
CCC Intake	1A	300-399	18%	35
CCC Intake	1A	400-499	14%	26
CCC Intake	1A	500-599	6%	11
CCC Intake	1A	600-699	9%	17
CCC Intake	1A	700-799	10%	20
CCC Intake	1A	800-899	4%	8
CCC Intake	1A	900-999	4%	8
CCC Intake	1A	1000-1249	6%	11
CCC Intake	1A	1250-1499	4%	8
CCC Intake	1A	1500-1749	3%	6
CCC Intake	1A	1750-1999	3%	6
CCC Intake	1A	2000-2249	1%	2
		Sum	**100%**	**192**



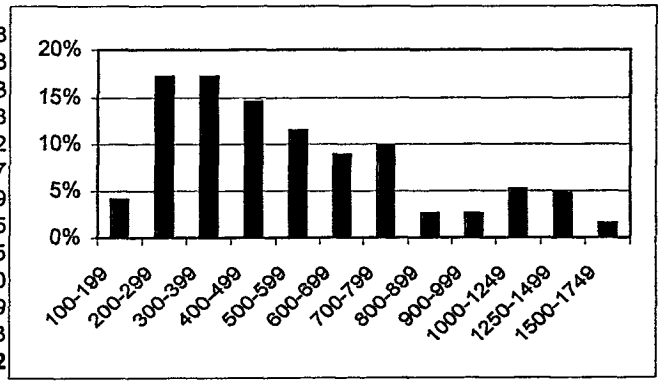
CCC Intake	2B	100-199	1%	1
CCC Intake	2B	200-299	36%	70
CCC Intake	2B	300-399	26%	50
CCC Intake	2B	400-499	17%	32
CCC Intake	2B	500-599	10%	20
CCC Intake	2B	600-699	7%	14
CCC Intake	2B	700-799	2%	4
CCC Intake	2B	800-899	1%	1
			100%	**192**



CCC Intake	3X	200-299	6%	11
CCC Intake	3X	300-399	22%	43
CCC Intake	3X	400-499	22%	43
CCC Intake	3X	500-599	15%	28
CCC Intake	3X	600-699	13%	25
CCC Intake	3X	700-799	12%	23
CCC Intake	3X	800-899	4%	8
CCC Intake	3X	900-999	5%	10
CCC Intake	3X	1000-1249	1%	1
		Sum	**99%**	**192**

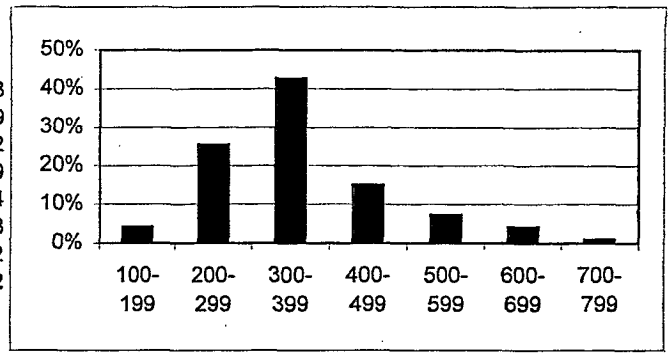


Clifton Ct Forebay	1A	100-199	4%	8
Clifton Ct Forebay	1A	200-299	17%	33
Clifton Ct Forebay	1A	300-399	17%	33
Clifton Ct Forebay	1A	400-499	15%	28
Clifton Ct Forebay	1A	500-599	11%	22
Clifton Ct Forebay	1A	600-699	9%	17
Clifton Ct Forebay	1A	700-799	10%	19
Clifton Ct Forebay	1A	800-899	3%	5
Clifton Ct Forebay	1A	900-999	3%	5
Clifton Ct Forebay	1A	1000-1249	5%	10
Clifton Ct Forebay	1A	1250-1499	5%	9
Clifton Ct Forebay	1A	1500-1749	2%	3
		Sum	**100%**	**192**

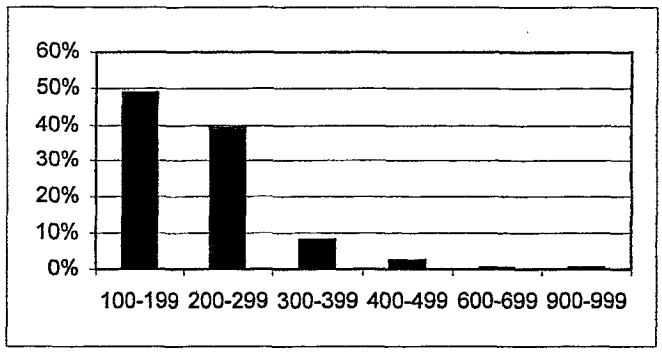


UNPUBLISHED DATA
SUBJECT TO REVISION

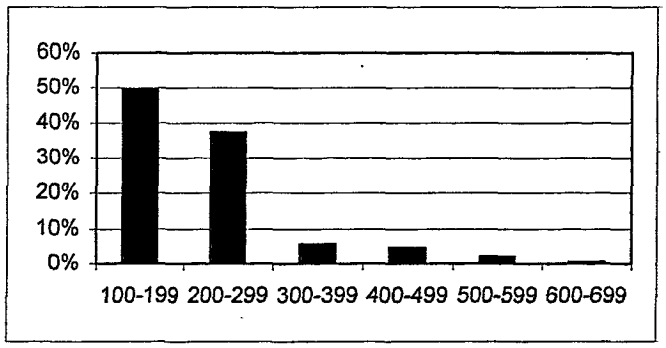
Clifton Ct Forebay	2B	100-199	4%	8
Clifton Ct Forebay	2B	200-299	26%	49
Clifton Ct Forebay	2B	300-399	43%	82
Clifton Ct Forebay	2B	400-499	15%	29
Clifton Ct Forebay	2B	500-599	7%	14
Clifton Ct Forebay	2B	600-699	4%	8
Clifton Ct Forebay	2B	700-799	1%	2
		Sum	**100%**	**192**



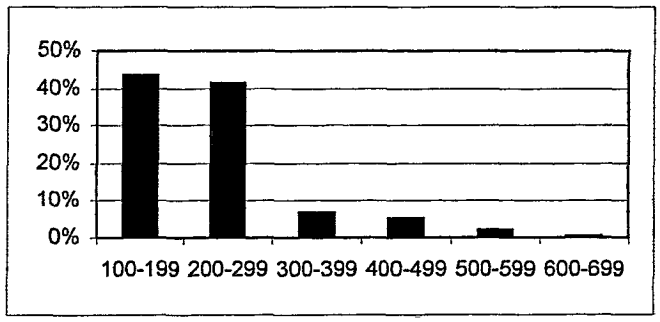
Clifton Ct Forebay	3X	100-199	49%	94
Clifton Ct Forebay	3X	200-299	39%	75
Clifton Ct Forebay	3X	300-399	8%	16
Clifton Ct Forebay	3X	400-499	3%	5
Clifton Ct Forebay	3X	600-699	1%	1
Clifton Ct Forebay	3X	900-999	1%	1
		Sum	**100%**	**192**



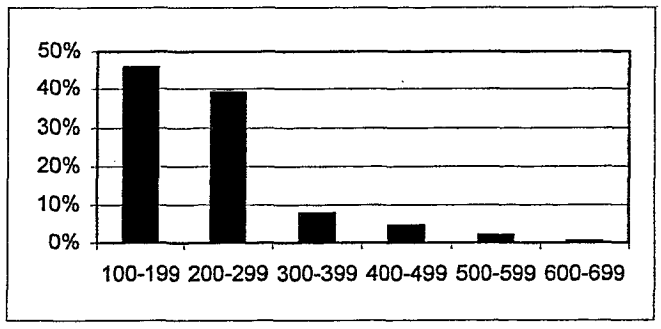
NBay Aqueduct	1A	100-199	49%	95
NBay Aqueduct	1A	200-299	38%	72
NBay Aqueduct	1A	300-399	6%	11
NBay Aqueduct	1A	400-499	5%	9
NBay Aqueduct	1A	500-599	2%	4
NBay Aqueduct	1A	600-699	1%	1
		Sum	**100%**	**192**



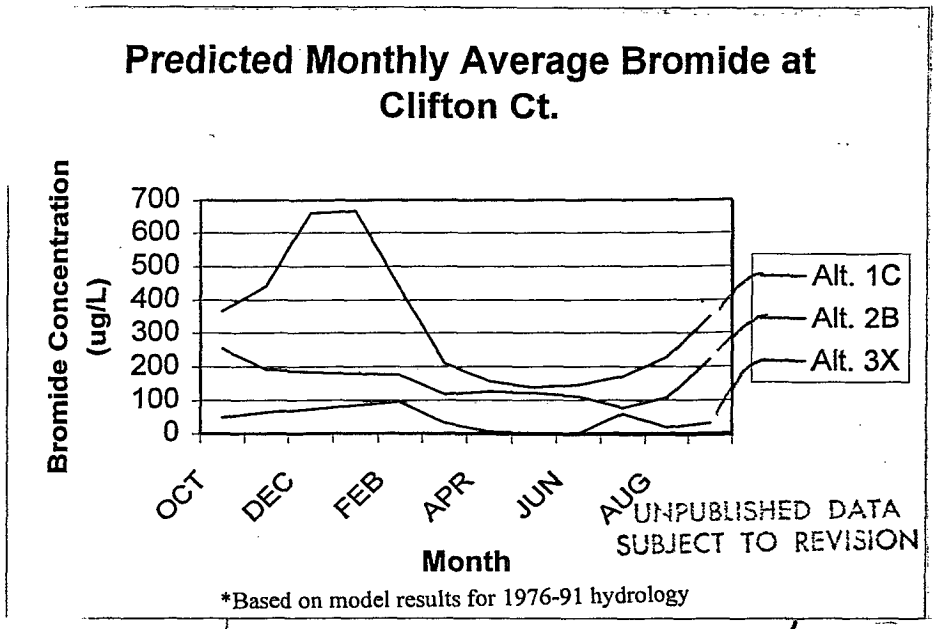
NBay Aqueduct	2B	100-199	44%	84
NBay Aqueduct	2B	200-299	42%	80
NBay Aqueduct	2B	300-399	7%	13
NBay Aqueduct	2B	400-499	5%	10
NBay Aqueduct	2B	500-599	2%	4
NBay Aqueduct	2B	600-699	1%	1
		Sum	**100%**	**192**



NBay Aqueduct	3X	100-199	46%	88
NBay Aqueduct	3X	200-299	39%	75
NBay Aqueduct	3X	300-399	8%	15
NBay Aqueduct	3X	400-499	5%	9
NBay Aqueduct	3X	500-599	2%	4
NBay Aqueduct	3X	600-699	1%	1
		Sum	**100%**	**192**

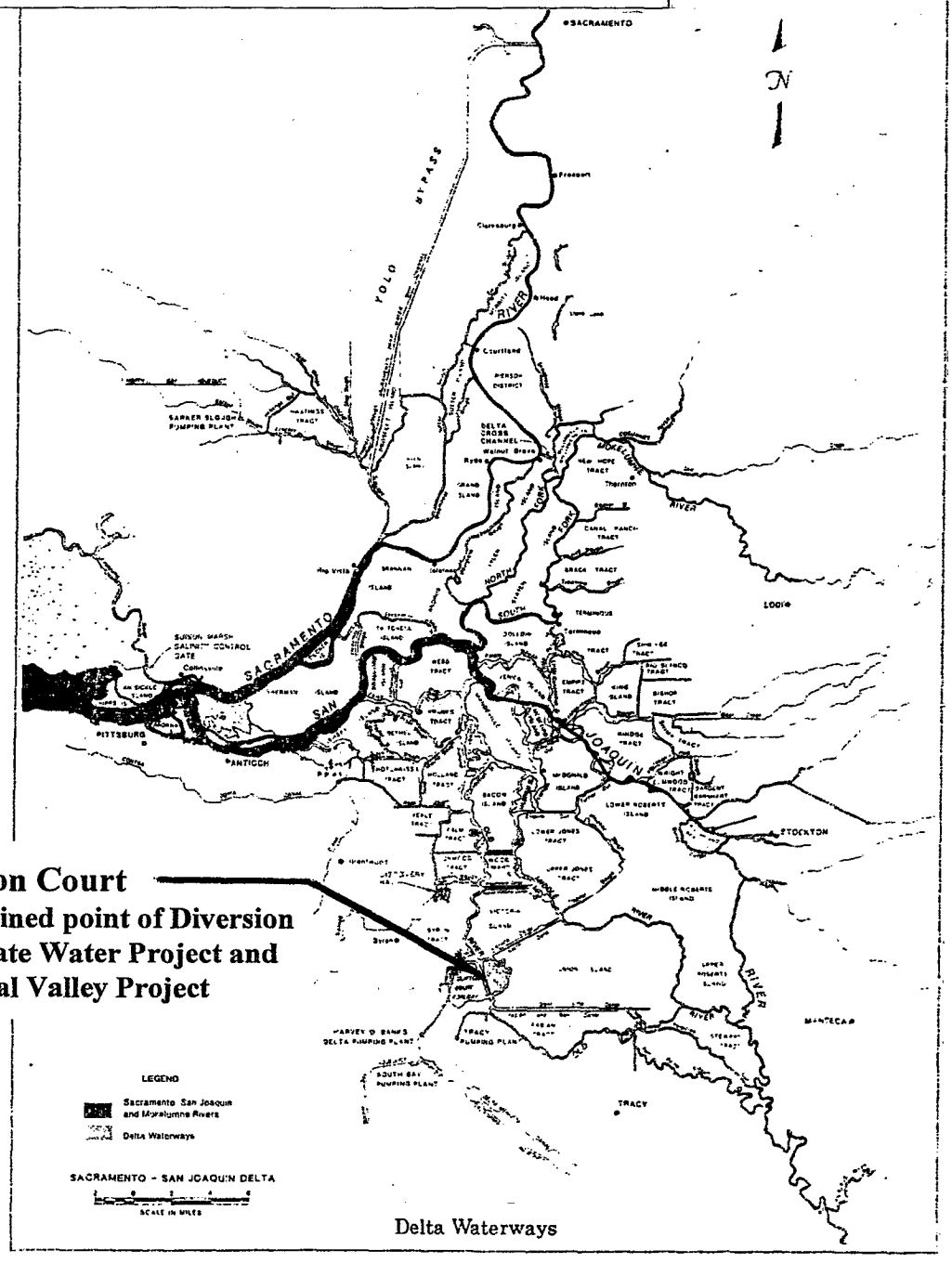


UNPUBLISHED DATA
SUBJECT TO REVISION



*Based on model results for 1976-91 hydrology

UNPUBLISHED DATA SUBJECT TO REVISION

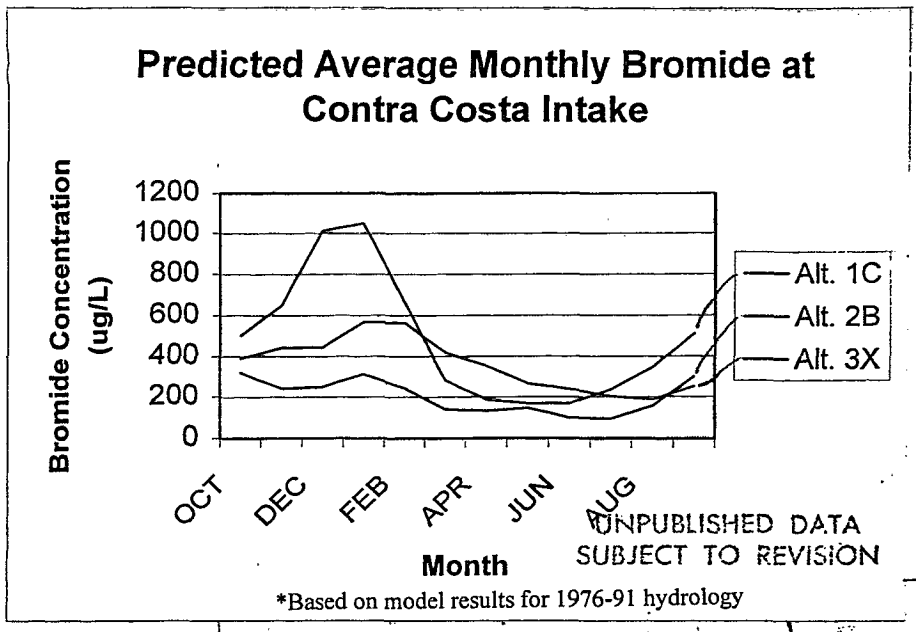


Clifton Court
Combined point of Diversion for State Water Project and Central Valley Project

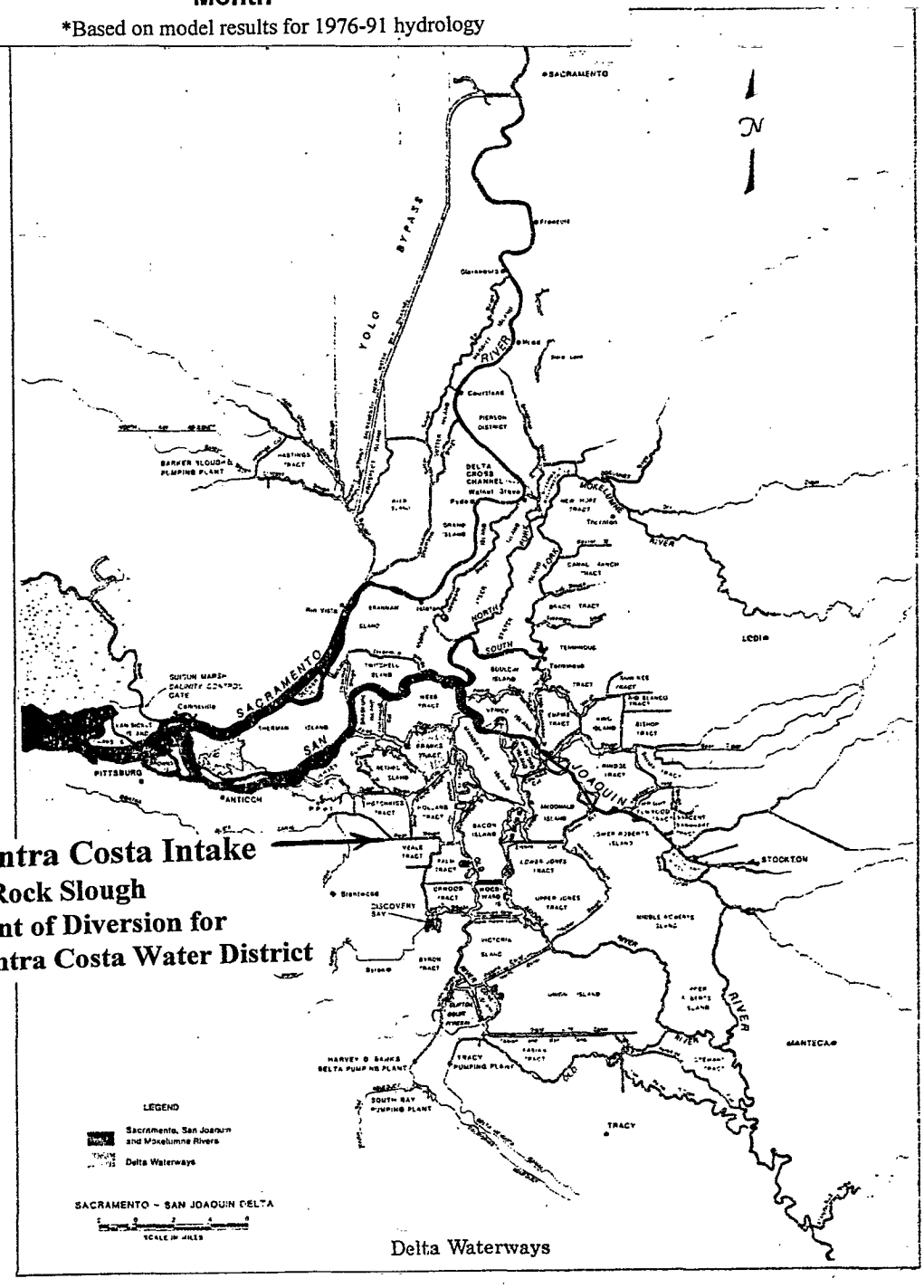
Delta Waterways

D-035840

D-035840



UNPUBLISHED DATA SUBJECT TO REVISION

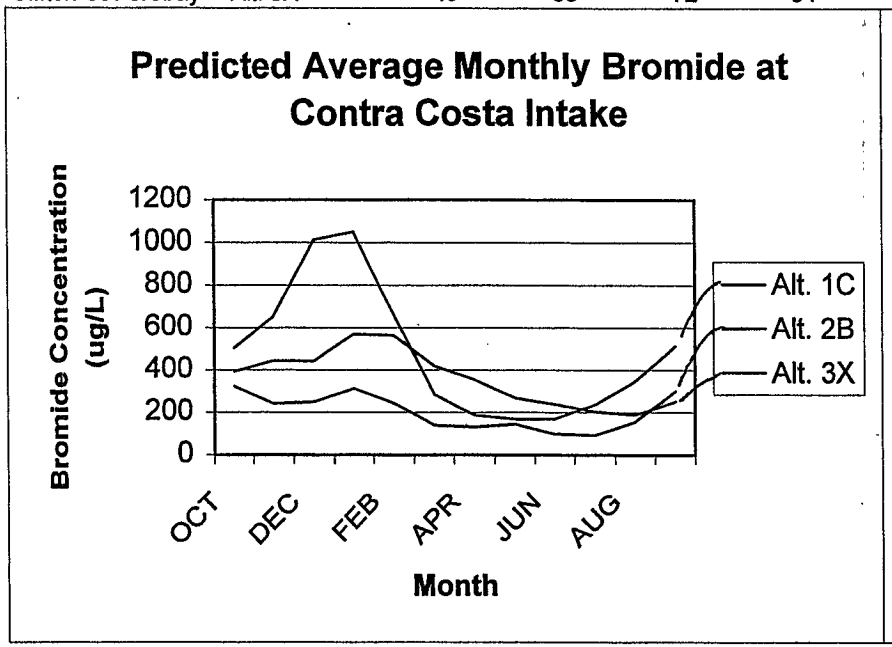


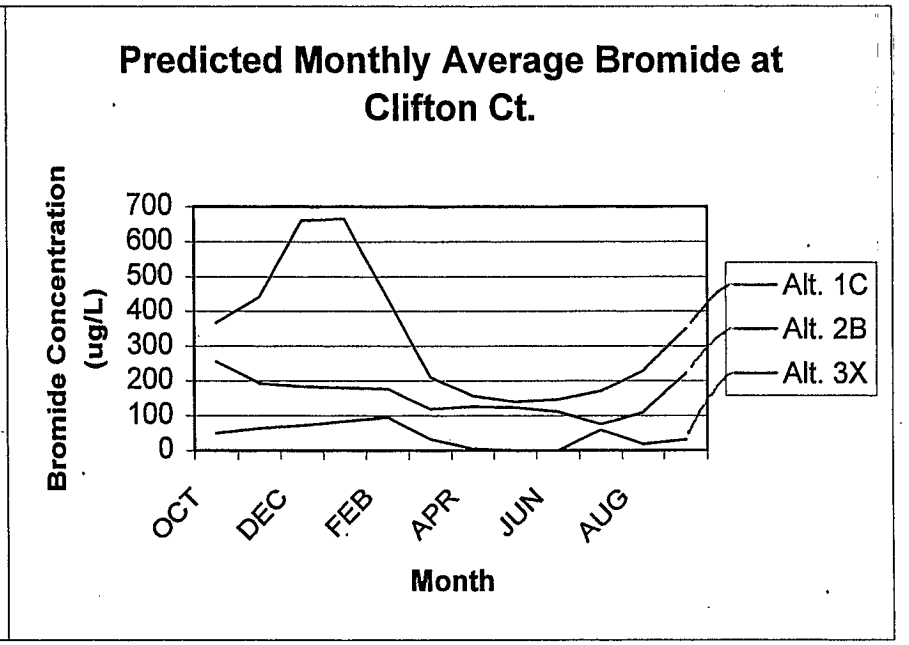
D-035841

D-035841

Station	Alt.	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
CCC Intake	Alt. 1C	503	650	1012	1050	664	284	186	168	168	238	347	511
CCC Intake	Alt. 2B	322	242	250	313	243	140	132	146	99	94	156	300
CCC Intake	Alt. 3X	391	443	443	568	563	419	355	267	240	203	188	251

Station	Alt.	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Clifton Ct Forebay	Alt. 1C	367	442	660	666	436	210	157	139	146	171	228	350
Clifton Ct Forebay	Alt. 2B	255	193	184	180	176	118	126	122	111	76	108	222
Clifton Ct Forebay	Alt. 3X	49	63	72	84	95	32	5	0	0	58	17	30





UNPUBLISHED DATA
SUBJECT TO REVISION

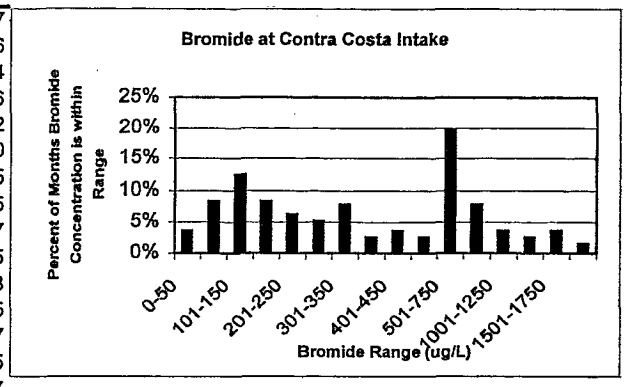
D-035842

D—035842

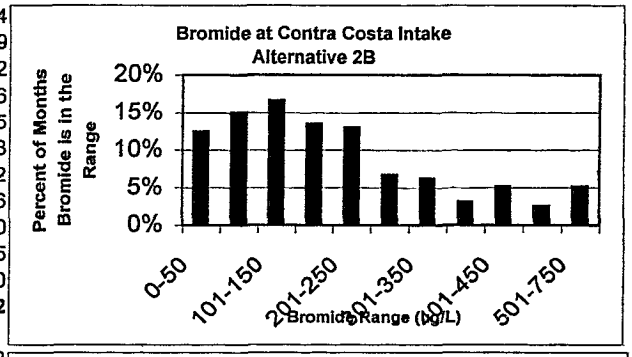
Bromide Frequency Histograms

Based on May 1998 Modeling Results for EC, converted to Bromide *

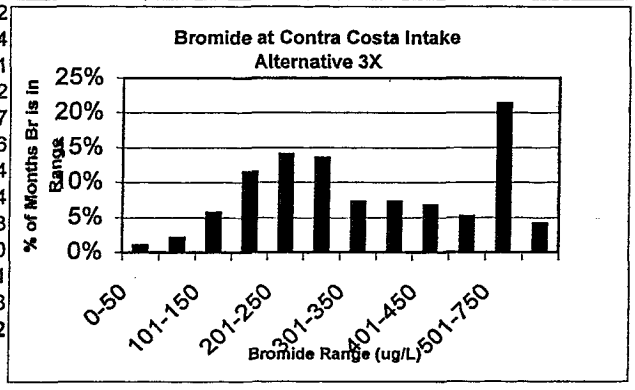
Station	Alterr	Range	%	Months in Range
CCC Intake	1C	0-50	4%	7
CCC Intake	1C	51-100	8%	16
CCC Intake	1C	101-150	13%	24
CCC Intake	1C	151-200	8%	16
CCC Intake	1C	201-250	6%	12
CCC Intake	1C	251-300	5%	10
CCC Intake	1C	301-350	8%	15
CCC Intake	1C	351-400	3%	5
CCC Intake	1C	401-450	4%	7
CCC Intake	1C	451-500	3%	5
CCC Intake	1C	501-750	20%	38
CCC Intake	1C	751-1000	8%	15
CCC Intake	1C	1001-1250	4%	7
CCC Intake	1C	1251-1500	3%	5
CCC Intake	1C	1501-1750	4%	7
CCC Intake	1C	1751-2000	2%	3
		Sum	100%	192



CCC Intake	2B	0-50	13%	24
CCC Intake	2B	51-100	15%	29
CCC Intake	2B	101-150	17%	32
CCC Intake	2B	151-200	14%	26
CCC Intake	2B	201-250	13%	25
CCC Intake	2B	251-300	7%	13
CCC Intake	2B	301-350	6%	12
CCC Intake	2B	351-400	3%	6
CCC Intake	2B	401-450	5%	10
CCC Intake	2B	451-500	3%	5
CCC Intake	2B	501-750	5%	10
		Sum	100%	192

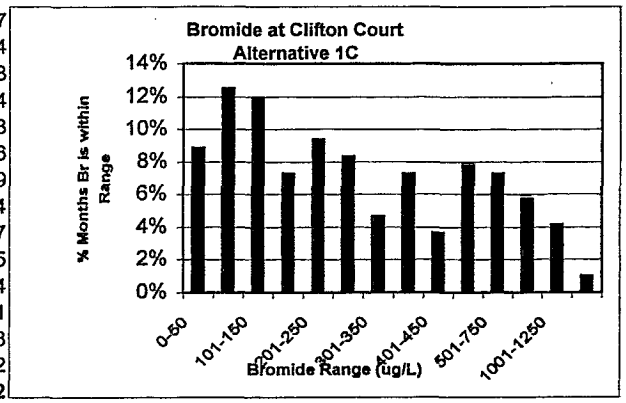


CCC Intake	3X	0-50	1%	2
CCC Intake	3X	51-100	2%	4
CCC Intake	3X	101-150	6%	11
CCC Intake	3X	151-200	11%	22
CCC Intake	3X	201-250	14%	27
CCC Intake	3X	251-300	14%	26
CCC Intake	3X	301-350	7%	14
CCC Intake	3X	351-400	7%	14
CCC Intake	3X	401-450	7%	13
CCC Intake	3X	451-500	5%	10
CCC Intake	3X	501-750	21%	41
CCC Intake	3X	751-1000	4%	8
		Sum	100%	192

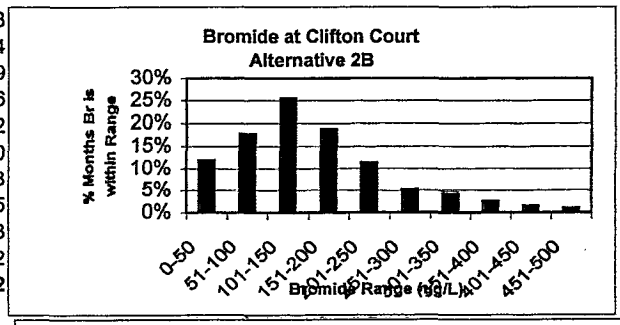


UNPUBLISHED DATA
SUBJECT TO REVISION

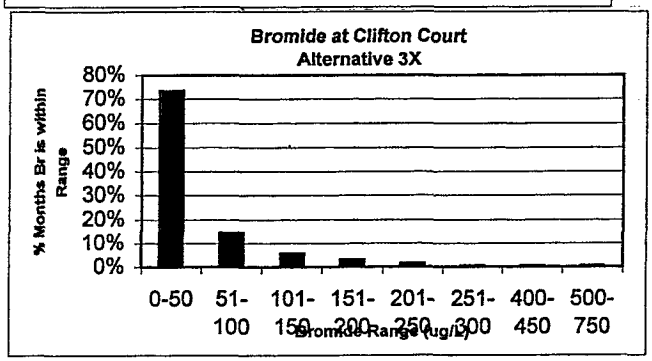
Clifton Ct Forebay	1C	0-50	9%	17
Clifton Ct Forebay	1C	51-100	13%	24
Clifton Ct Forebay	1C	101-150	12%	23
Clifton Ct Forebay	1C	151-200	7%	14
Clifton Ct Forebay	1C	201-250	9%	18
Clifton Ct Forebay	1C	251-300	8%	16
Clifton Ct Forebay	1C	301-350	5%	9
Clifton Ct Forebay	1C	351-400	7%	14
Clifton Ct Forebay	1C	401-450	4%	7
Clifton Ct Forebay	1C	451-500	8%	15
Clifton Ct Forebay	1C	501-750	7%	14
Clifton Ct Forebay	1C	751-1000	6%	11
Clifton Ct Forebay	1C	1001-1250	4%	8
Clifton Ct Forebay	1C	1251-1500	1%	2
		Sum	**100%**	**192**



Clifton Ct Forebay	2B	0-50	12%	23
Clifton Ct Forebay	2B	51-100	18%	34
Clifton Ct Forebay	2B	101-150	26%	49
Clifton Ct Forebay	2B	151-200	19%	36
Clifton Ct Forebay	2B	201-250	11%	22
Clifton Ct Forebay	2B	251-300	5%	10
Clifton Ct Forebay	2B	301-350	4%	8
Clifton Ct Forebay	2B	351-400	3%	5
Clifton Ct Forebay	2B	401-450	2%	3
Clifton Ct Forebay	2B	451-500	1%	2
		Sum	**100%**	**192**



Clifton Ct Forebay	3X	0-50	73%	141
Clifton Ct Forebay	3X	51-100	15%	28
Clifton Ct Forebay	3X	101-150	6%	11
Clifton Ct Forebay	3X	151-200	3%	6
Clifton Ct Forebay	3X	201-250	2%	3
Clifton Ct Forebay	3X	251-300	1%	1
Clifton Ct Forebay	3X	400-450	1%	1
Clifton Ct Forebay	3X	500-750	1%	1
		Sum	**100%**	**192**



*** Bromide Conversions:**

Contra Costa Intake Br (ug/L) = EC * 0.993 -0.174 R^2=0.95 Record Count: 76

Clifton Court (Banks PP) Br (ug/L) = EC * 0.870 -0.160 R^2=0.87 Record Count: 134

May 1998 Model results were based on the hydrologic period October 1976 through September 1991

File: May98BrFreq.XLS

UNPUBLISHED DATA
SUBJECT TO REVISION

Printed by
Department of Water Resources
Reprographics

D—035845

D-035845