CALIFORNIA WATERFIX

South Delta Water Agency Parties
Case-In-Chief Part 2

TESTIMONY OF

DANTE JOHN NOMELLINI, SR.

(WITNESS)

POWER POINT

SDWA 314

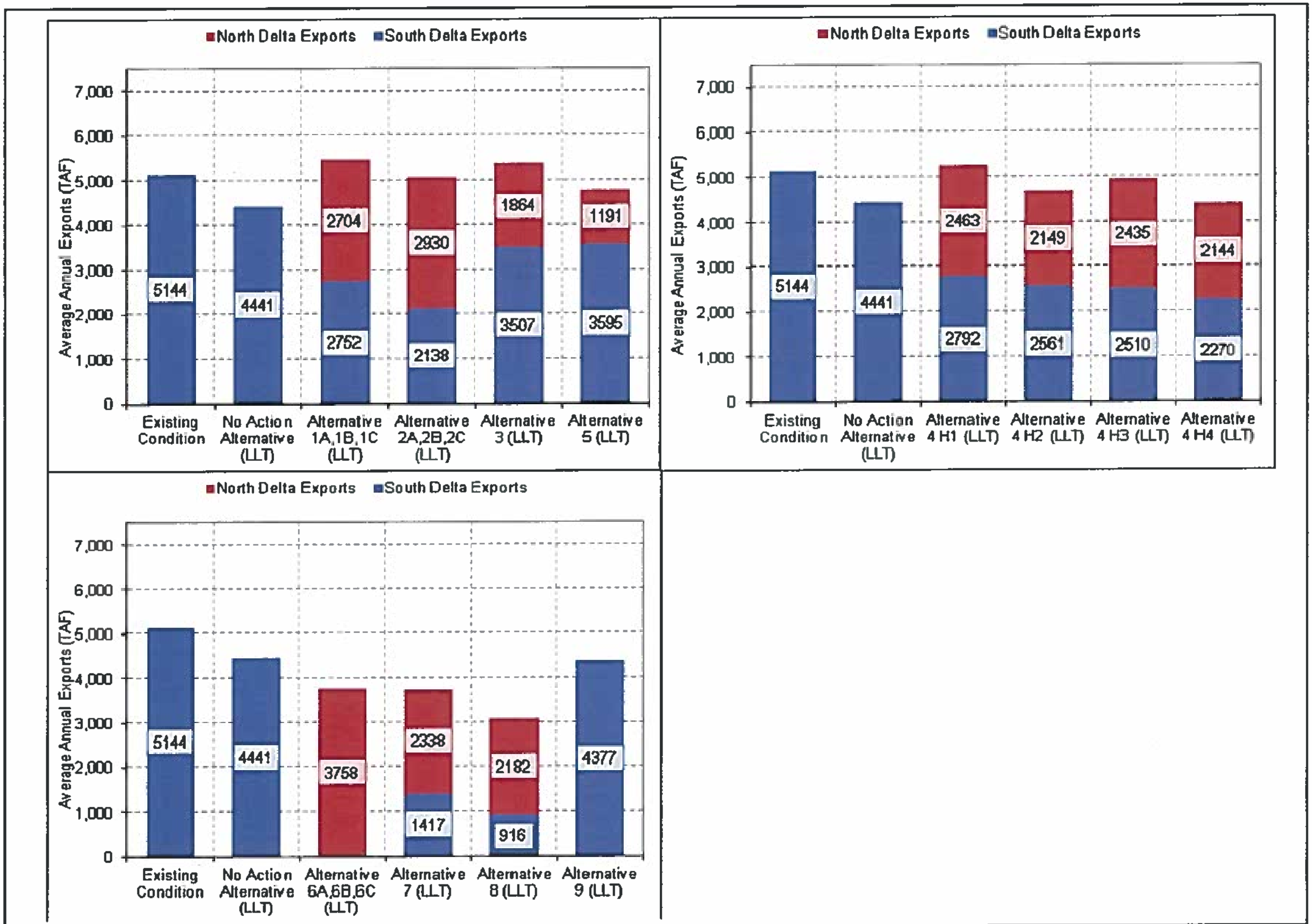


Figure 5-17

North and South Delta Exports—Long-Term Average

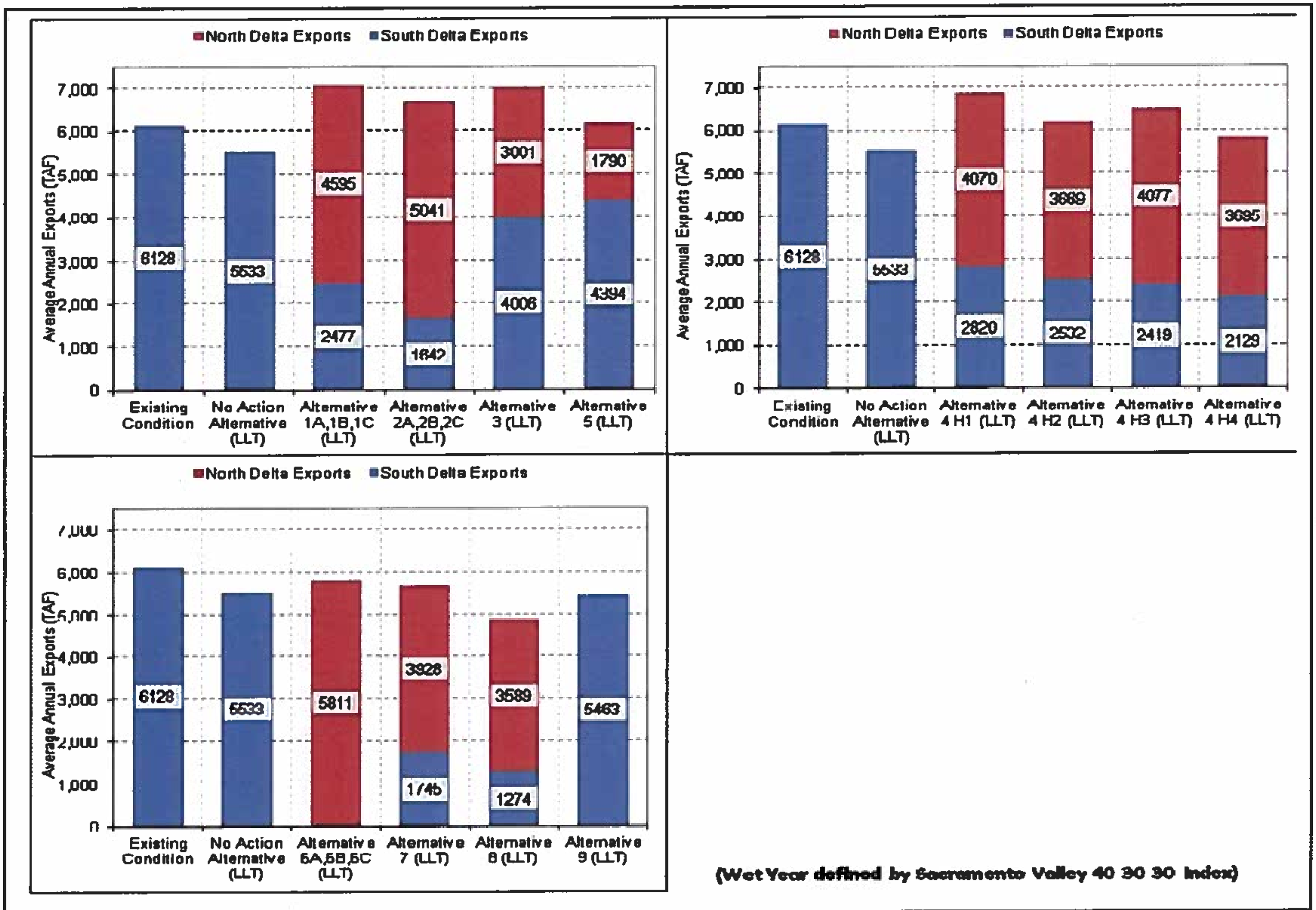


Figure 5-18
North and South Delta Exports—Wet Year Average

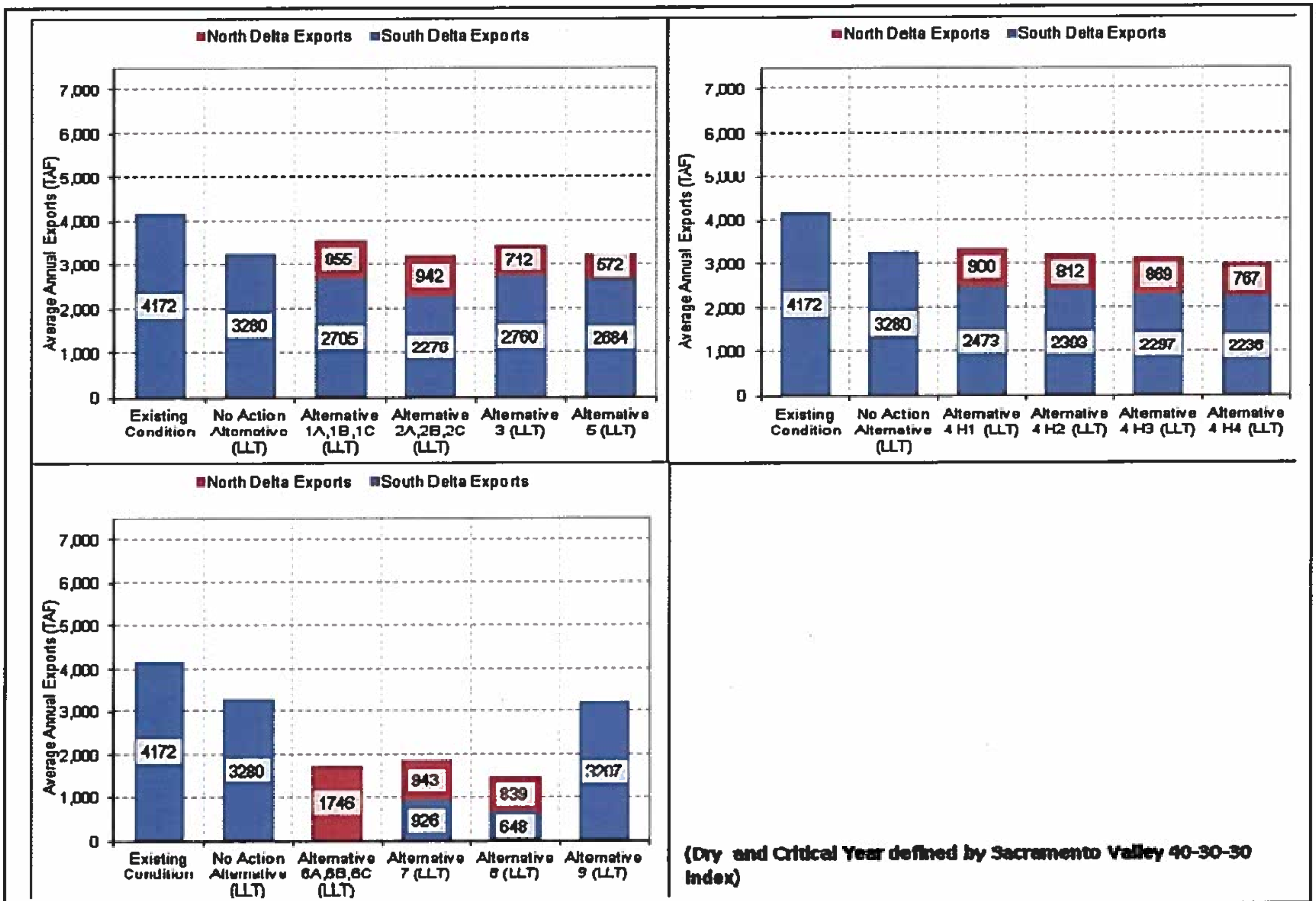
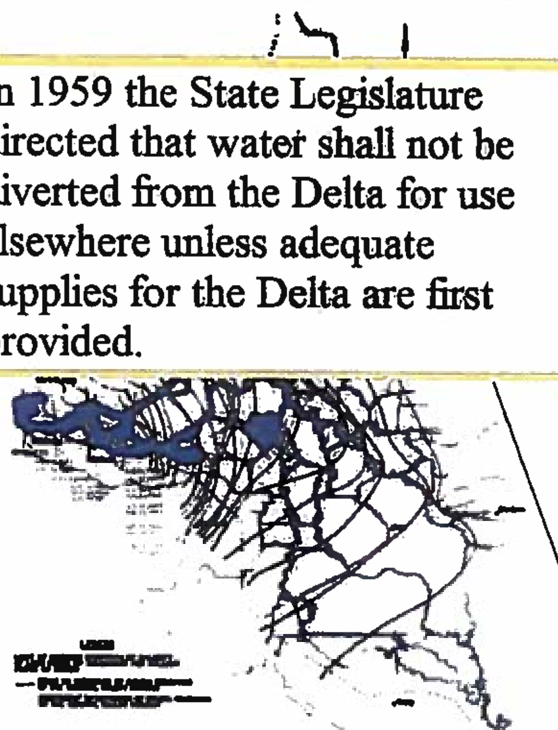


Figure 5-19
North and South Delta Exports—Dry and Critical Year Average

In 1959, when the SWP was authorized, the Legislature enacted the Delta Protection Act. (§§ 12200-12220.) The Legislature recognized the unique water problems in the Delta, particularly "salinity intrusion," which mandates the need for such special legislation "for the protection, conservation, development, control and use of the waters in the Delta for the public good." (§ 12200.) The act prohibits project exports from the Delta of water necessary to provide water to which the Delta users are "entitled" and water which is needed for salinity control and an adequate supply for Delta users.[37] (§§ 12202, 12203, 12204.)

Delta Problems — salinity incursion and water supplies

In 1959 the State Legislature directed that water shall not be diverted from the Delta for use elsewhere unless adequate supplies for the Delta are first provided.

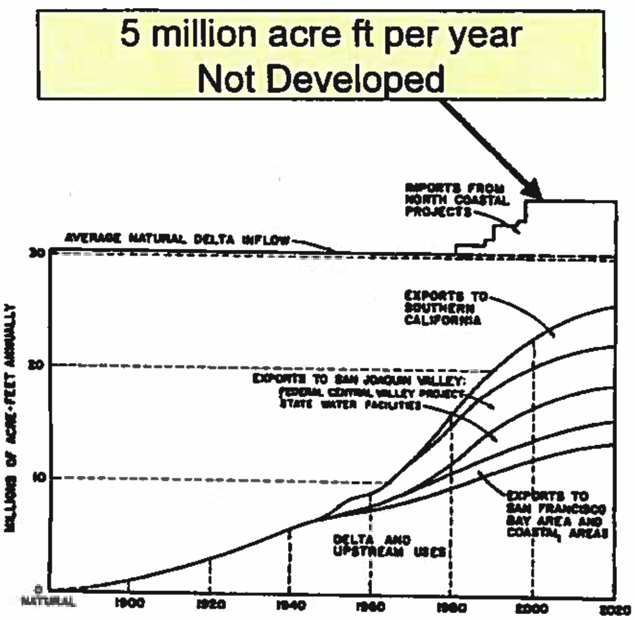


HISTORICAL SALINITY INCURSION
1920-1960

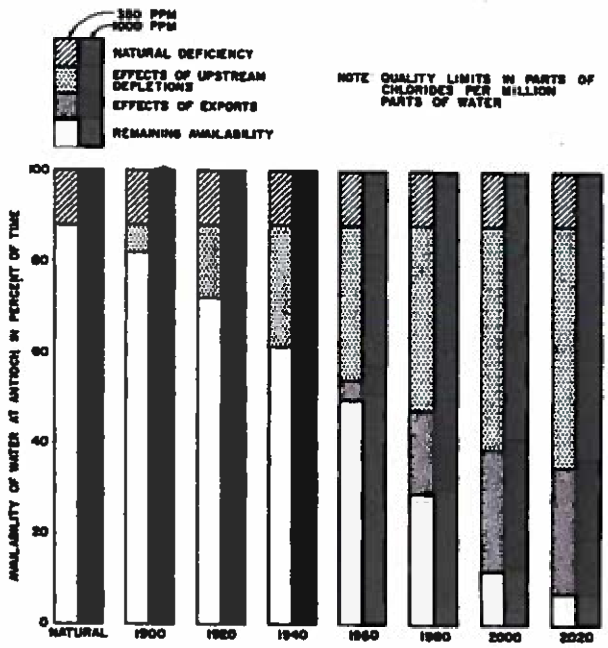
Salinity incursion into the Delta results from the flooding and ebbing of ocean tides through the San Francisco Bay and Delta system during periods when the fresh water outflow from the Delta is insufficient to repel the saline water. The natural fresh water outflow from the Central Valley was historically inadequate to repel salinity during summer months of some years. The first known record of salinity encroachment into the Delta was reported by Cmdr. Ringgold, U. S. Navy, in August 1841, whose party found the water at the site of the present city of Antioch very brackish and unfit for drinking. Since that time, and particularly after the turn of the century, with expanding upstream water use salinity incursion has become an increasingly greater problem in Delta water supplies. The maximum recorded extent of salinity incursion happened in 1931, when ocean salts reached Stockton. Since 1944 extensive incursion has been repulsed much of the time by fresh water releases from Central Valley Project storage in Shasta and Folsom Reservoirs. Without such releases, saline water would have spread through about 90 percent of the Delta channels in 1955 and 1959. Although upstream use might not have reached present levels in the absence of the Central Valley Project, salinity problems would still have been very serious during most years.

Further increase in water use in areas tributary to the Delta will worsen the salinity incursion problem and complicate the already complex water rights situation. To maintain and expand the economy of the Delta, it will be necessary to provide an adequate supply of good quality water and protect the lands from the effects of salinity incursion. In 1959 the State Legislature directed that water shall not be diverted from the Delta for use elsewhere unless adequate supplies for the Delta are first provided.

The natural availability of good quality water in the Delta is directly related to the amount of surplus water which flows to the ocean. The graph to the right indicates the historic and projected availability of water in the San Joaquin River at Antioch containing less than 350 and 1,000 parts chlorides per million parts water, under long-term average runoff and *without* specific releases for salinity control. It may be noted that even under natural conditions, before any significant upstream water developments, there was a deficiency of water supplies within the specified quality limits. It is anticipated that, without salinity control releases, upstream depletions by the year 2020 will have reduced the availability of water containing less than 1,000 ppm chlorides by about 60 percent, and that exports will have caused an additional 30 percent reduction.



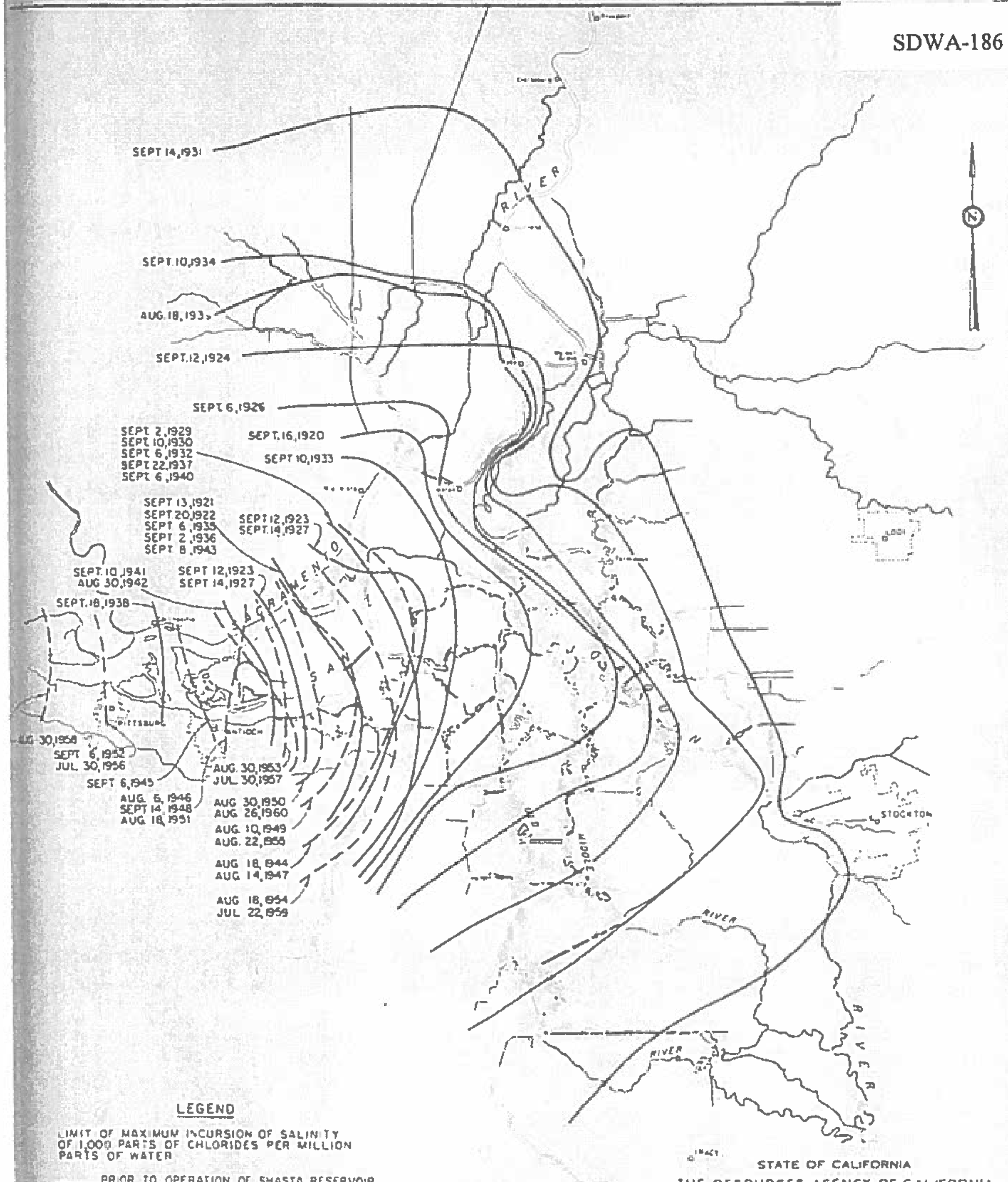
USE OF DELTA WATER SUPPLIES



DELTA WATER QUALITY WITHOUT SALINITY CONTROL

The magnitude of the past and anticipated future uses of water in areas tributary to the Delta, except the Tulare Lake Basin, is indicated in the diagram to the left. It may be noted that, while the present upstream use accounts for reduction of natural inflow to the Delta by almost 25 percent, upstream development during the next 60 years will deplete the inflow by an additional 20 percent. By that date about 22 percent of the natural water supply reaching the Delta will be exported to areas of deficiency by local, state, and federal projects. In addition, economical development of water supplies will necessitate importation of about 5,000,000 acre-feet of water seasonally to the Delta from north coastal streams for transfer to areas of deficiency.

SDWA-186



LEGEND

LIMIT OF MAXIMUM INCURSION OF SALINITY OF 1,000 PARTS OF CHLORIDES PER MILLION PARTS OF WATER

——— PRIOR TO OPERATION OF SHASTA RESERVOIR OF THE CENTRAL VALLEY PROJECT

– – – SUBSEQUENT TO OPERATION OF SHASTA RESERVOIR OF THE CENTRAL VALLEY PROJECT

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DELTA BRANCH

HISTORICAL SALINITY INCURSION SACRAMENTO-SAN JOAQUIN DELTA

FEBRUARY 1962

SCALE OF MILES

2 0 2 4

Figure 3.6: Historical Salinity (Modeled and Observed) at Jersey Point

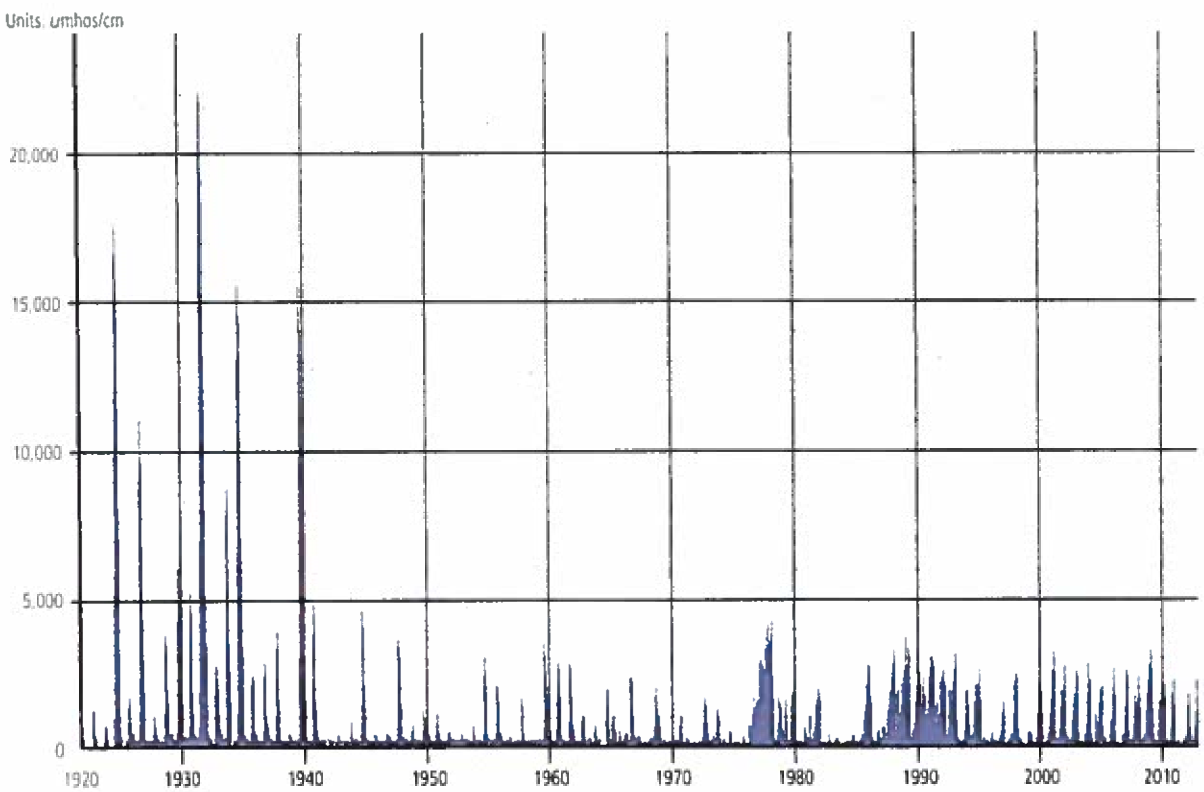


Table EC-15A. Period average change in EC levels for Alternative 4-H1 LLT relative to existing conditions and the No Action Alternative LLT.

Electrical Conductivity			OCT		NOV		DEC		JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		Annual Avg. Change	
Alt 4 Scn H1	Location	Period *	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT
Western Delta	Sac. R. at Emmaton	ALL	-424	51	-206	119	57	-25	-65	-131	12	-64	60	3	91	34	197	103	314	173	432	383	622	455	541	422	138	127
			(-10%)	(3%)	(-10%)	(7%)	(5%)	(-2%)	(-11%)	(-19%)	(3%)	(-13%)	(22%)	(1%)	[illegible]	(10%)	[illegible]	(18%)	[illegible]	(18%)	[illegible]	[illegible]	[illegible]	(30%)	(25%)	(19%)	(13%)	(12%)
		DROUGHT	-784	-257	-321	-44	-64	-254	94	-125	195	-26	87	21	124	56	471	233	676	282	1083	676	774	441	10	-667	195	45
			(-27%)	(-11%)	(-11%)	(-2%)	(-3%)	(-12%)	(11%)	(-12%)	[illegible]	(-3%)	(27%)	(5%)	[illegible]	(15%)	[illegible]	[illegible]	[illegible]	(20%)	[illegible]	[illegible]	[illegible]	(21%)	(0%)	(-18%)	(13%)	(3%)
	SJR at Jersey Point	ALL	-684	4	-892	-249	-388	-155	-220	-205	-58	-94	24	-10	39	11	53	6	140	52	-248	-3	17	185	83	234	-178	-19
			(-33%)	(0%)	(-40%)	(-16%)	(-23%)	(-11%)	(-26%)	(-24%)	(-13%)	(-19%)	(8%)	(-3%)	(14%)	(4%)	(15%)	(1%)	[illegible]	(8%)	(-12%)	(-0%)	(1%)	(14%)	(4%)	(12%)	(-16%)	(-2%)
		DROUGHT	-780	-168	-851	-321	-542	-204	-243	-261	26	-104	47	6	50	18	151	19	329	68	-414	-118	26	257	-129	-482	-194	-106
			(-34%)	(-10%)	(-33%)	(-16%)	(-25%)	(-11%)	(-22%)	(-23%)	(5%)	(-15%)	(15%)	(2%)	(18%)	(8%)	[illegible]	(4%)	[illegible]	(7%)	(-18%)	(-6%)	(1%)	(15%)	(-6%)	(-17%)	(-14%)	(-8%)
Interior Delta	S Fork Moke. R Term.	ALL	8	8	9	9	4	5	4	9	8	10	13	15	12	13	9	10	14	15	10	10	11	10	9	8	9	10
			(4%)	(5%)	(5%)	(5%)	(2%)	(3%)	(2%)	(4%)	(2%)	(4%)	(6%)	(7%)	(6%)	(7%)	(5%)	(5%)	(7%)	(8%)	(5%)	(5%)	(6%)	(5%)	(5%)	(5%)	(5%)	(5%)
		DROUGHT	7	6	6	8	4	5	1	5	-2	4	7	13	5	8	8	10	19	20	16	16	10	10	8	8	8	10
			(4%)	(4%)	(4%)	(4%)	(2%)	(2%)	(0%)	(2%)	(-1%)	(1%)	(3%)	(5%)	(2%)	(4%)	(4%)	(5%)	(10%)	(10%)	(8%)	(8%)	(6%)	(5%)	(4%)	(4%)	(4%)	(5%)
	SJR at San And Landing	ALL	51	119	-95	23	-32	20	-33	-17	5	-3	19	12	24	20	31	21	71	51	55	82	123	151	230	201	37	57
			(10%)	(27%)	(-15%)	(5%)	(-5%)	(4%)	(-6%)	(-4%)	(2%)	(-1%)	(8%)	(5%)	(10%)	(9%)	(12%)	(8%)	[illegible]	(19%)	(14%)	(23%)	[illegible]	[illegible]	[illegible]	[illegible]	(9%)	(15%)
		DROUGHT	63	90	-42	35	-5	41	-40	2	47	9	30	21	24	21	51	27	136	74	75	120	163	208	206	78	59	60
			(10%)	(15%)	(-6%)	(5%)	(-1%)	(8%)	(-7%)	(0%)	(14%)	(2%)	(12%)	(8%)	(10%)	(9%)	(21%)	(10%)	[illegible]	(23%)	(14%)	(25%)	[illegible]	[illegible]	[illegible]	(10%)	(13%)	(13%)
Southern Delta	SJR at Vernalis	ALL	4	0	-35	0	-43	5	-82	1	-10	0	-28	0	-10	0	-5	0	57	0	38	0	6	1	-16	-1	-10	1
			(1%)	(0%)	(-6%)	(0%)	(-6%)	(1%)	(-11%)	(0%)	(-2%)	(0%)	(-4%)	(-0%)	(-2%)	(0%)	(-1%)	(0%)	(11%)	(0%)	(7%)	(0%)	(1%)	(0%)	(-3%)	(-0%)	(-2%)	(0%)
		DROUGHT	-6	0	-41	0	-53	0	-66	0	-9	0	-19	0	-4	0	-9	0	-9	0	-5	0	-7	0	-19	-3	-21	0
			(-1%)	(0%)	(-6%)	(-0%)	(-6%)	(-0%)	(-7%)	(-0%)	(-1%)	(-0%)	(-2%)	(0%)	(-1%)	(0%)	(-2%)	(0%)	(-1%)	(0%)	(-1%)	(0%)	(-1%)	(0%)	(-3%)	(-1%)	(-3%)	(-0%)
	SJR at Brandt Bridge	ALL	2	0	-33	0	-43	7	-83	-4	-14	0	-28	-1	-12	-5	-5	-1	55	1	35	13	11	9	-14	-1	-11	2
			(0%)	(0%)	(-6%)	(0%)	(-6%)	(1%)	(-11%)	(-1%)	(-2%)	(0%)	(-4%)	(-0%)	(-3%)	(-1%)	(-1%)	(-0%)	(10%)	(0%)	(6%)	(2%)	(2%)	(2%)	(-3%)	(-0%)	(-2%)	(0%)
		DROUGHT	-7	0	-39	0	-53	4	-67	-3	-13	2	-19	-2	-7	-11	-9	-2	-8	0	-16	44	-7	33	-17	-3	-22	5
			(-1%)	(-0%)	(-6%)	(0%)	(-6%)	(0%)	(-7%)	(-0%)	(-1%)	(0%)	(-2%)	(-0%)	(-1%)	(-2%)	(-2%)	(-0%)	(-1%)	(-0%)	(-2%)	(7%)	(-1%)	(5%)	(-3%)	(-0%)	(-3%)	(1%)
	Old River at Middle River	ALL	7	6	-32	1	-43	5	-73	7	-11	2	-25	2	-3	6	-3	2	54	0	39	3	11	1	-14	-1	-8	3
			(1%)	(1%)	(-6%)	(0%)	(-6%)	(1%)	(-10%)	(1%)	(-2%)	(0%)	(-4%)	(0%)	(-1%)	(1%)	(-1%)	(0%)	(10%)	(0%)	(7%)	(0%)	(2%)	(0%)	(-3%)	(-0%)	(-1%)	(0%)
		DROUGHT	-3	4	-38	1	-54	0	-58	7	-11	2	-14	4	10	10	-5	3	-8	0	-4	8	-6	2	-18	-3	-17	3
			(-0%)	(1%)	(-6%)	(0%)	(-6%)	(0%)	(-6%)	(1%)	(-1%)	(0%)	(-2%)	(0%)	(2%)	(2%)	(-1%)	(1%)	(-1%)	(0%)	(-1%)	(1%)	(-1%)	(0%)	(-3%)	(-0%)	(-2%)	(0%)
	Old River at Tracy Bridge	ALL	16	23	-20	7	-46	3	-55	25	-6	12	-17	10	21	31	3	9	41	-7	33	2	5	11	-13	6	-3	11
			(3%)	(4%)	(-4%)	(1%)	(-6%)	(0%)	(-7%)	(4%)	(-1%)	(2%)	(-3%)	(2%)	(4%)	(7%)	(1%)	(2%)	(8%)	(-1%)	(6%)	(0%)	(1%)	(2%)	(-2%)	(1%)	(-1%)	(2%)
		DROUGHT	10	18	-25	13	-58	-1	-49	15	-15	3	-1	16	56	56	4	12	-33	-3	-36	-2	-36	17	-17	18	-17	13
			(2%)	(3%)	(-4%)	(2%)	(-7%)	(-0%)	(-5%)	(2%)	(-2%)	(0%)	(-0%)	(2%)	(8%)	(8%)	(1%)	(2%)	(-6%)	(-1%)	(-5%)	(-0%)	(-5%)	(3%)	(-3%)	(3%)	(-2%)	(2%)
SJR	SJR at Prisoners Point	ALL	-22	39	-154	-28	-113	-28	-51	-12	24	38	50	61	47	67	37	46	57	58	-12	33	13	75	74	90	-4	37
			(-4%)	(9%)	(-26%)	(-6%)	(-18%)	(-5%)	(-10%)	(-3%)	(6%)	(10%)	(15%)	(19%)	(14%)	(21%)	(12%)	(15%)	(20%)	(20%)	(-3%)	(8%)	(3%)	(19%)	(14%)	(18%)	(-1%)	(9%)
		DROUGHT	-23	4	-128	-34	-111	-21	-96	-20	38	39	86	104	73	94	69	66	96	55	-55	8	-10	94	73	35	1	35
			(-4%)	(1%)	(-20%)	(-6%)	(-15%)	(-3%)	(-16%)	(-4%)	(9%)	(9%)	(22%)	(28%)	(20%)	(28%)	(22%)	(21%)	[illegible]	(18%)	(-10%)	(2%)	(-2%)	(19%)	(12%)	(5%)	(0%)	(7%)
Export Area	Banks PP	ALL	-53	-13	-173	-53	-198	-104	-230	-179	-158	-148	-190	-183	-153	-144	-40	-37	-50	-69	-78	-56	-113	-41	-46	-8	-124	-87
			(-9%)	(-2%)	(-27%)	(-10%)	(-29%)	(-18%)	(-35%)	(-29%)	(-29%)	(-26%)	(-40%)	(-39%)	(-33%)	(-32%)	(-9%)	(-9%)	(-13%)	(-17%)	(-18%)	(-14%)	(-21%)	(-9%)	(-8%)	(-2%)	(-23%)	(-18%)
		DROUGHT	-6	8	-126	-40	-200	-108	-285	-220	-201	-180	-287	-275	-220	-212	-78	-78	48	8	-109	-71	-159	-24	16	51	-134	-95
			(-1%)	(1%)	(-18%)	(-6%)	(-25%)	(-15%)	(-37%)	(-31%)	(-31%)	(-28%)	(-45%)	(-44%)	(-35%)	(-34%)	(-14%)	(-14%)	(11%)	(2%)	(-21%)	(-14%)	(-22%)	(-4%)	(3%)	(8%)	(-21%)	(-16%)
	Jones PP	ALL	-89	-63	-169	-65	-128	-47	-190	-131	-153	-147	-173	-165	-100	-96	-97	-93	-85	-132	-53	-58	-37	13	-103	-75	-115	-88
			(-16%)	(-12%)	(-27%)	(-12%)	(-18%)	(-6%)	(-27%)	(-20%)	(-25%)	(-24%)	(-29%)	(-28%)	(-21%)	(-20%)	(-22%)	(-21%)	(-22%)	(-30%)	(-11%)	(-12%)	(-7%)	(3%)	(-19%)	(-14%)	(-21%)	(-17%)
		DROUGHT	-80	-90	-129	-48	-124	-50	-208	-125	-188	-174	-214	-206	-107	-111	-165	-159	-49	-88	-128	-97	-73	37	27	45	-120	-89
			(-13%)	(-14%)	(-18%)	(-8%)	(-15%)	(-7%)	(-24%)	(-18%)	(-22%)	(-21%)	(-25%)	(-24%)	(-16%)	(-17%)	(-29%)	(-28%)	(-12%)	(-20%)	(-23%)	(-19%)	(-11%)	(8%)	(4%)	(7%)	(-17%)	(-14%)

* ALL: Water years 1976-1991 represent the 16-year period modeled using DSM2. DROUGHT: Represents a 5 consecutive year (water years 1987-1991) drought period consisting of dry and critical water year types (as defined by the Sacramento Valley 40-30-30 water year hydrologic classification index).

SWRCB-102
Appendix 8H
Tables EC 15 A, B & C

Table EC-15B. Period average change in EC levels for Alternative 4-H2 LLT relative to existing conditions and the No Action Alternative LLT.

Electrical Conductivity			OCT		NOV		DEC		JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		Annual Avg. Change	
Alt 4 LLT Scn H2	Location	Period ᵃ	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT	Ex. Cond.	No Act LLT
Western Delta	Sac. R. at Emmaton	ALL	-450	25	-199	125	165	103	-87	-153	-1	-78	52	-4	82	25	175	82	319	178	518	470	654	487	584	465	153	144
			(-21%)	(1%)	(-8%)	(7%)	(15%)	(8%)	(-14%)	(-23%)	(-0%)	(-10%)	(19%)	(-1%)	(30%)	(7%)	(37%)	(14%)	(39%)	(19%)	[illegible]	[illegible]	[illegible]	(32%)	(27%)	(21%)	(14%)	(13%)
		DROUGHT	-1092	-565	-493	-217	373	183	-7	-227	141	-80	91	28	123	55	458	220	691	297	1108*	901	620	487	-46	-724	181	30
			(-37%)	(-24%)	(-17%)	(-8%)	(20%)	(8%)	(-1%)	(-21%)	(26%)	(-10%)	(29%)	(7%)	[illegible]	(15%)	[illegible]	(27%)	[illegible]	(21%)	[illegible]	[illegible]	[illegible]	(24%)	(-2%)	(-20%)	(12%)	(2%)
	SJR at Jersey Point	ALL	-689	-1	-876	-233	-410	-177	-238	-223	-87	-103	22	-12	37	9	50	3	124	37	-295	-51	-4	164	49	200	-182	-32
			(-36%)	(-0%)	(-40%)	(-15%)	(-25%)	(-12%)	(-26%)	(-26%)	(-15%)	(-21%)	(7%)	(-4%)	(14%)	(3%)	(14%)	(1%)	(22%)	(6%)	(-21%)	(-4%)	(-0%)	(12%)	(2%)	(10%)	(-17%)	(-3%)
		DROUGHT	-922	-310	-933	-403	-450	-112	-230	-248	-10	-140	48	7	51	19	145	13	305	43	-348	-52	41	270	-145	-498	-204	-117
			(-40%)	(-18%)	(-39%)	(-20%)	(-20%)	(-8%)	(-21%)	(-22%)	(-2%)	(-21%)	(15%)	(2%)	(18%)	(6%)	[illegible]	(2%)	[illegible]	(5%)	(-16%)	(-3%)	(2%)	(16%)	(-6%)	(-18%)	(-14%)	(-9%)
Interior Delta	S Fork Moke R. Term	ALL	8	9	9	9	6	7	5	10	6	11	13	15	12	13	9	10	15	16	12	13	11	10	9	9	10	11
			(4%)	(5%)	(5%)	(4%)	(3%)	(3%)	(2%)	(4%)	(3%)	(4%)	(6%)	(7%)	(6%)	(6%)	(5%)	(5%)	(8%)	(9%)	(6%)	(7%)	(6%)	(5%)	(5%)	(5%)	(5%)	(5%)
		DROUGHT	7	7	9	9	6	7	1	5	-2	3	9	14	7	10	9	11	20	21	15	15	11	10	7	8	8	10
			(4%)	(4%)	(4%)	(4%)	(3%)	(4%)	(0%)	(2%)	(-1%)	(1%)	(4%)	(6%)	(3%)	(5%)	(5%)	(6%)	(10%)	(11%)	(8%)	(8%)	(6%)	(5%)	(4%)	(4%)	(4%)	(5%)
	SJR at San Andreas Landing	ALL	56	124	-91	27	-29	24	-38	-22	5	-3	21	14	28	24	34	24	74	53	41	68	107	135	218	188	35	55
			(11%)	(28%)	(-15%)	(5%)	(-5%)	(4%)	(-8%)	(-5%)	(2%)	(-1%)	(9%)	(6%)	(12%)	(10%)	(14%)	(9%)	(30%)	(20%)	(11%)	(19%)	(25%)	(34%)	[illegible]	[illegible]	(9%)	(15%)
		DROUGHT	22	49	-78	1	28	72	-24	18	40	1	34	28	41	38	65	41	136	73	88	130	185	229	190	60	80	62
			(4%)	(8%)	(-11%)	(0%)	(4%)	(11%)	(-4%)	(4%)	(12%)	(0%)	(14%)	(10%)	(17%)	(16%)	(20%)	(16%)	[illegible]	(23%)	(16%)	(27%)	(33%)	[illegible]	(30%)	(8%)	(13%)	(13%)
Southern Delta	SJR at Vernalis	ALL	3	0	-35	0	-48	0	-85	-2	-11	0	-28	0	-10	0	-5	0	57	1	38	1	9	1	-16	-1	-11	0
			(1%)	(0%)	(-6%)	(-0%)	(-6%)	(0%)	(-11%)	(-0%)	(-2%)	(-0%)	(-4%)	(-0%)	(-2%)	(-0%)	(-1%)	(0%)	(11%)	(0%)	(7%)	(0%)	(2%)	(0%)	(-3%)	(-0%)	(-2%)	(-0%)
		DROUGHT	-6	0	-41	0	-53	0	-66	0	-9	0	-19	0	-4	0	-9	0	-7	1	-3	2	-5	2	-19	-4	-20	0
			(-1%)	(0%)	(-6%)	(0%)	(-6%)	(0%)	(-7%)	(0%)	(-1%)	(-0%)	(-2%)	(-0%)	(-1%)	(-0%)	(-2%)	(0%)	(-1%)	(0%)	(-1%)	(0%)	(-1%)	(0%)	(-3%)	(-1%)	(-3%)	(0%)
	SJR at Brandt Bridge	ALL	1	0	-33	0	-47	4	-86	-7	-14	0	-28	-1	-12	-5	-6	-1	55	1	36	14	12	10	-14	-1	-11	1
			(0%)	(-0%)	(-6%)	(0%)	(-6%)	(0%)	(-11%)	(-1%)	(-2%)	(0%)	(-4%)	(-0%)	(-3%)	(-1%)	(-1%)	(-0%)	(10%)	(0%)	(6%)	(2%)	(2%)	(2%)	(-3%)	(-0%)	(-2%)	(0%)
		DROUGHT	-7	0	-39	0	-51	5	-67	-3	-13	2	-19	-2	-7	-12	-9	-2	-7	1	-12	47	-5	34	-17	-3	-21	6
			(-1%)	(0%)	(-6%)	(0%)	(-6%)	(1%)	(-7%)	(-0%)	(-1%)	(0%)	(-2%)	(-0%)	(-1%)	(-2%)	(-2%)	(-0%)	(-1%)	(0%)	(-2%)	(8%)	(-1%)	(6%)	(-3%)	(-0%)	(-3%)	(1%)
	Old River at Middle River	ALL	6	5	-32	0	-48	0	-77	4	-12	2	-25	2	-3	6	-3	2	54	0	39	3	11	2	-15	-1	-9	2
			(1%)	(1%)	(-6%)	(0%)	(-6%)	(0%)	(-10%)	(1%)	(-2%)	(0%)	(-4%)	(0%)	(-1%)	(1%)	(-1%)	(0%)	(10%)	(0%)	(7%)	(0%)	(2%)	(0%)	(-3%)	(-0%)	(-1%)	(0%)
		DROUGHT	-3	4	-38	1	-54	0	-58	7	-11	2	-14	4	11	11	-5	3	-7	1	-2	9	-4	4	-18	-3	-17	4
			(-0%)	(1%)	(-6%)	(0%)	(-6%)	(0%)	(-6%)	(1%)	(-1%)	(0%)	(-1%)	(0%)	(2%)	(2%)	(-1%)	(1%)	(-1%)	(0%)	(-0%)	(1%)	(-1%)	(1%)	(-3%)	(-0%)	(-2%)	(1%)
	Old River at Tracy Bridge	ALL	15	22	-20	7	-50	-1	-59	21	-7	11	-17	11	25	35	3	9	44	-3	34	4	2	8	-17	4	-4	10
			(3%)	(4%)	(-4%)	(1%)	(-7%)	(-0%)	(-8%)	(3%)	(-1%)	(2%)	(-2%)	(2%)	(5%)	(8%)	(1%)	(2%)	(9%)	(-1%)	(6%)	(1%)	(0%)	(1%)	(-3%)	(1%)	(-1%)	(2%)
		DROUGHT	7	15	-28	10	-56	-1	-49	16	-15	2	0	17	69	69	5	13	-20	10	-30	3	-44	9	-30	5	-16	14
			(1%)	(2%)	(-4%)	(2%)	(-7%)	(-0%)	(-6%)	(2%)	(-2%)	(0%)	(-0%)	(2%)	(11%)	(11%)	(1%)	(2%)	(-3%)	(2%)	(-5%)	(0%)	(-6%)	(1%)	(-4%)	(1%)	(-2%)	(2%)
SJR	SJR at Prisoners Point	ALL	-16	45	-151	-25	-124	-38	-81	-22	31	45	61	72	64	84	47	55	67	68	-9	36	-4	58	60	78	-3	38
			(-3%)	(10%)	(-25%)	(-5%)	(-20%)	(-7%)	(-12%)	(-5%)	(8%)	(12%)	(18%)	(22%)	(19%)	(27%)	(15%)	(18%)	(23%)	(23%)	(-2%)	(10%)	(-1%)	(15%)	(12%)	(15%)	(-1%)	(9%)
		DROUGHT	-36	-9	-139	-45	-129	-40	-84	-8	43	47	105	123	123	144	97	95	105	63	-49	14	11	115	70	33	10	44
			(-6%)	(-2%)	(-21%)	(-6%)	(-18%)	(-6%)	(-14%)	(-2%)	(10%)	(11%)	(27%)	(33%)	(34%)	[illegible]	(32%)	(30%)	[illegible]	(20%)	(-9%)	(3%)	(2%)	(23%)	(12%)	(5%)	(2%)	(8%)
Export Area	Banks PP	ALL	-40	0	-170	-50	-208	-112	-232	-181	-158	-149	-142	-135	-176	-167	-80	-77	-78	-98	-58	-39	-99	-28	-44	-8	-122	-85
			(-7%)	(0%)	(-27%)	(-10%)	(-30%)	(-19%)	(-35%)	(-30%)	(-29%)	(-28%)	(-30%)	(-29%)	(-39%)	(-37%)	(-18%)	(-18%)	(-20%)	(-24%)	(-13%)	(-8%)	(-19%)	(-8%)	(-8%)	(-1%)	(-23%)	(-17%)
		DROUGHT	-38	-23	-146	-59	-277	-185	-222	-158	-179	-159	-224	-212	-303	-294	-208	-208	-38	-76	-105	-67	-105	30	-28	7	-158	-117
			(-8%)	(-4%)	(-21%)	(-10%)	(-34%)	(-20%)	(-29%)	(-22%)	(-27%)	(-25%)	(-35%)	(-34%)	(-40%)	(-47%)	(-38%)	(-39%)	(-9%)	(-16%)	(-20%)	(-14%)	(-15%)	(5%)	(-4%)	(1%)	(-24%)	(-19%)
	Jones PP	ALL	-108	-83	-188	-84	-190	-109	-213	-154	-209	-203	-228	-220	-131	-127	-72	-68	-38	-85	-70	-75	-68	-17	-101	-73	-135	-108
			(-19%)	(-16%)	(-30%)	(-16%)	(-27%)	(-18%)	(-30%)	(-24%)	(-34%)	(-33%)	(-38%)	(-38%)	(-27%)	(-27%)	(-16%)	(-16%)	(-10%)	(-19%)	(-15%)	(-16%)	(-13%)	(-4%)	(-18%)	(-14%)	(-24%)	(-20%)
		DROUGHT	-132	-141	-166	-85	-159	-86	-259	-179	-284	-270	-340	-332	-205	-209	-102	-97	12	-28	-128	-94	-92	18	-40	-22	-158	-127
			(-20%)	(-22%)	(-24%)	(-14%)	(-20%)	(-12%)	(-31%)	(-23%)	(-34%)	(-33%)	(-40%)	(-39%)	(-32%)	(-32%)	(-16%)	(-17%)	(3%)	(-6%)	(-27%)	(-18%)	(-13%)	(3%)	(-6%)	(-4%)	(-23%)	(-18%)

ᵃ ALL: Water years 1976-1991 represent the 16-year period modeled using DSM2. DROUGHT: Represents a 5 consecutive year (water years 1987-1991) drought period consisting of dry and critical water year types (as defined by the Sacramento Valley 40-30-30 water year hydrologic classification index).

Table EC-15C. Period average change in EC levels for Alternative 4-H3 LLT relative to existing conditions and the No Action Alternative LLT.

Electrical Conductivity			OCT		NOV		DEC		JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		Annual Avg. Change	
Alt 4 Scn H3	Location	Period *	Ex. Cond.	No Act. LLT	Ex. Cond.	No Act. LLT	Ex. Cond.	No Act. LLT	Ex. Cond.	No Act. LLT	Ex. Cond.	No Act. LLT	Ex. Cond.	No Act. LLT	Ex. Cond.	No Act. LLT	Ex. Cond.	No Act. LLT	Ex. Cond.	No Act. LLT	Ex. Cond.	No Act. LLT	Ex. Cond.	No Act. LLT	Ex. Cond.	No Act. LLT	Ex. Cond.	No Act. LLT
Western Delta	Sac. R. at Emmaton	ALL	-813	-338	-532	-207	-183	-244	-122	-189	6	-68	68	12	94	38	194	101	319	178	456	407	667	500	-157	-278	2	-7
			[illegible]	(-20%)	(-25%)	(-12%)	(-13%)	(-18%)	(-20%)	[illegible]	(2%)	(-14%)	[illegible]	(4%)	[illegible]	(11%)	[illegible]	(18%)	[illegible]	(19%)	[illegible]	[illegible]	[illegible]	[illegible]	(-7%)	(-12%)	(0%)	(-1%)
		DROUGHT	-1098	-571	-687	-411	-290	-480	-111	-330	129	-92	94	28	131	62	485	247	708	315	1070	883	841	508	49	-628	110	-41
			[illegible]	(-24%)	(-24%)	(-10%)	(-15%)	(-23%)	(-13%)	[illegible]	[illegible]	(-12%)	[illegible]	(7%)	[illegible]	(17%)	[illegible]	(30%)	[illegible]	(27%)	[illegible]	[illegible]	[illegible]	(25%)	(2%)	(-17%)	(8%)	(-3%)
	SJR at Jersey Point	ALL	-994	-306	-1101	-458	-682	-446	-328	-313	-82	-118	24	-10	38	10	55	8	139	52	-251	-6	10	179	-476	-325	-304	-145
			[illegible]	(-24%)	[illegible]	(-29%)	(-41%)	(-31%)	[illegible]	(-37%)	(-18%)	(-24%)	(8%)	(-3%)	(14%)	(3%)	(15%)	(2%)	[illegible]	(8%)	(-18%)	(-1%)	(1%)	(13%)	(-23%)	(-17%)	(-22%)	(-15%)
		DROUGHT	-1022	-410	-1073	-543	-805	-467	-399	-417	-52	-182	42	1	47	15	160	28	343	82	-420	-125	8	237	-76	-429	-271	-184
			(-44%)	(-24%)	(-42%)	(-27%)	(-37%)	(-25%)	[illegible]	(-37%)	(-10%)	(-27%)	(13%)	(0%)	(17%)	(5%)	[illegible]	(5%)	[illegible]	(9%)	(-19%)	(-7%)	(0%)	(14%)	(-3%)	(-15%)	(-18%)	(-14%)
Interior Delta	S. Fork Moke. R. Term.	ALL	9	9	10	9	5	6	5	10	6	10	13	15	13	14	9	10	14	15	10	11	11	10	8	7	9	11
			(5%)	(5%)	(5%)	(5%)	(2%)	(3%)	(2%)	(4%)	(2%)	(4%)	(6%)	(7%)	(6%)	(7%)	(5%)	(5%)	(7%)	(8%)	(5%)	(6%)	(6%)	(5%)	(4%)	(4%)	(5%)	(5%)
		DROUGHT	8	8	8	8	3	4	1	5	-2	3	9	14	6	9	6	10	19	20	16	16	11	10	8	9	8	10
			(4%)	(4%)	(4%)	(4%)	(2%)	(2%)	(0%)	(2%)	(-1%)	(1%)	(4%)	(6%)	(3%)	(4%)	(4%)	(5%)	(10%)	(10%)	(8%)	(8%)	(6%)	(6%)	(4%)	(5%)	(4%)	(5%)
	SJR at San And. Landing	ALL	-39	29	-139	-20	-120	-67	-83	-67	-8	-16	18	11	25	22	32	22	71	51	55	82	123	152	85	55	2	21
			(-8%)	(6%)	(-22%)	(-4%)	(-20%)	(-12%)	(-20%)	(-16%)	(-3%)	(-5%)	(8%)	(4%)	(11%)	(9%)	(13%)	(9%)	[illegible]	(19%)	(14%)	(23%)	[illegible]	[illegible]	(16%)	(10%)	(0%)	(6%)
		DROUGHT	-26	0	-105	-28	-103	-57	-99	-57	14	-24	26	18	27	25	56	32	141	78	73	118	163	207	219	89	32	33
			(-4%)	(0%)	(-15%)	(-4%)	(-14%)	(-8%)	(-18%)	(-11%)	(4%)	(-7%)	(11%)	(7%)	(11%)	(10%)	(23%)	(12%)	[illegible]	(25%)	(14%)	(24%)	(29%)	[illegible]	[illegible]	(12%)	(7%)	(7%)
Southern Delta	SJR at Vernalis	ALL	3	0	-35	0	-48	0	-62	1	-10	0	-28	0	-10	0	-5	0	56	0	38	0	7	0	-16	-1	-11	0
			(1%)	(0%)	(-6%)	(0%)	(-6%)	(0%)	(-11%)	(0%)	(-2%)	(0%)	(-4%)	(0%)	(-2%)	(0%)	(-1%)	(0%)	(11%)	(0%)	(7%)	(0%)	(1%)	(0%)	(-3%)	(-0%)	(-2%)	(0%)
		DROUGHT	-6	0	-41	0	-53	0	-66	0	-9	0	-19	0	-4	0	-9	0	-9	0	-5	0	-7	0	-17	-2	-21	0
			(-1%)	(0%)	(-6%)	(-0%)	(-6%)	(-0%)	(-7%)	(-0%)	(-1%)	(-0%)	(-2%)	(0%)	(-1%)	(0%)	(-2%)	(0%)	(-1%)	(0%)	(-1%)	(0%)	(-1%)	(0%)	(-3%)	(-0%)	(-3%)	(-0%)
	SJR at Brandt Bridge	ALL	1	0	-33	0	-47	3	-83	-4	-14	0	-28	-1	-12	-5	-6	-1	55	0	36	13	11	9	-14	0	-11	1
			(0%)	(0%)	(-6%)	(0%)	(-6%)	(0%)	(-11%)	(-1%)	(-2%)	(0%)	(-4%)	(-0%)	(-3%)	(-1%)	(-1%)	(-0%)	(10%)	(0%)	(6%)	(2%)	(2%)	(2%)	(-3%)	(-0%)	(-2%)	(0%)
		DROUGHT	-7	0	-39	0	-53	3	-67	-3	-13	2	-19	-2	-7	-12	-9	-2	-8	0	-14	45	-7	33	-16	-1	-22	5
			(-1%)	(-0%)	(-6%)	(0%)	(-6%)	(0%)	(-7%)	(-0%)	(-1%)	(0%)	(-2%)	(-0%)	(-1%)	(-2%)	(-2%)	(-0%)	(-1%)	(-0%)	(-2%)	(7%)	(-1%)	(5%)	(-2%)	(-0%)	(-3%)	(1%)
	Old River at Middle River	ALL	6	5	-32	1	-48	0	-74	7	-11	2	-25	2	-3	6	-3	2	54	0	39	3	10	1	-14	0	-8	2
			(1%)	(1%)	(-6%)	(0%)	(-6%)	(0%)	(-10%)	(1%)	(-2%)	(0%)	(-4%)	(0%)	(-1%)	(1%)	(-1%)	(0%)	(10%)	(-0%)	(7%)	(0%)	(2%)	(0%)	(-3%)	(-0%)	(-1%)	(0%)
		DROUGHT	-3	4	-38	1	-54	0	-58	7	-11	2	-14	4	11	11	-5	3	-8	0	-4	6	-6	2	-16	-1	-17	3
			(-1%)	(1%)	(-6%)	(0%)	(-6%)	(0%)	(-6%)	(1%)	(-1%)	(0%)	(-2%)	(0%)	(2%)	(2%)	(-1%)	(1%)	(-1%)	(0%)	(-1%)	(1%)	(-1%)	(0%)	(-3%)	(-0%)	(-2%)	(0%)
	Old River at Tracy Bridge	ALL	4	11	-23	5	-50	-1	-55	24	-6	12	-17	10	24	35	3	9	41	-6	33	2	7	13	-11	9	-4	10
			(1%)	(2%)	(-4%)	(1%)	(-7%)	(-0%)	(-7%)	(3%)	(-1%)	(2%)	(-3%)	(2%)	(5%)	(7%)	(1%)	(2%)	(8%)	(-1%)	(6%)	(0%)	(1%)	(2%)	(-2%)	(2%)	(-1%)	(2%)
		DROUGHT	3	11	-26	12	-55	0	-49	15	-14	3	-1	16	67	67	4	12	-29	0	-34	-1	-29	24	-16	19	-15	15
			(1%)	(2%)	(-4%)	(2%)	(-7%)	(-0%)	(-5%)	(2%)	(-2%)	(0%)	(-0%)	(2%)	(10%)	(10%)	(1%)	(2%)	(-5%)	(0%)	(-6%)	(-0%)	(-4%)	(4%)	(-2%)	(3%)	(-2%)	(2%)
SJR	SJR at Prisoners Point	ALL	-53	6	-149	-23	-181	-95	-104	-65	17	31	49	60	53	73	40	48	57	57	-12	32	9	72	14	30	-22	19
			(-11%)	(2%)	(-25%)	(-5%)	(-29%)	(-18%)	(-20%)	(-14%)	(4%)	(8%)	(15%)	(18%)	(16%)	(23%)	(13%)	(16%)	(20%)	(20%)	(-3%)	(9%)	(2%)	(18%)	(3%)	(6%)	(-5%)	(5%)
		DROUGHT	-49	-22	-143	-49	-193	-104	-148	-73	19	22	89	107	90	111	78	78	100	50	-52	11	-18	87	81	43	-12	22
			(-8%)	(-4%)	(-22%)	(-9%)	(-20%)	(-16%)	(-24%)	(-14%)	(4%)	(5%)	(23%)	(29%)	(25%)	(30%)	(25%)	(24%)	[illegible]	(10%)	(-9%)	(2%)	(-3%)	(17%)	(13%)	(7%)	(-2%)	(5%)
Export Area	Banks PP	ALL	-88	-47	-225	-105	-247	-153	-293	-242	-160	-151	-167	-160	-177	-168	-48	-45	-42	-61	-56	-38	-116	-43	-90	-51	-140	-103
			(-16%)	(-9%)	(-36%)	(-20%)	(-35%)	(-28%)	(-44%)	(-40%)	(-30%)	(-29%)	[illegible]	(-34%)	(-38%)	(-37%)	(-11%)	(-11%)	(-11%)	(-15%)	(-13%)	(-9%)	(-22%)	(-10%)	(-16%)	(-10%)	[illegible]	(-21%)
		DROUGHT	-29	-14	-194	-107	-309	-217	-425	-360	-189	-168	-306	-294	-282	-273	-70	-70	58	19	-66	-28	-201	-66	38	72	-154	-115
			(-4%)	(-2%)	(-27%)	(-17%)	[illegible]	(-30%)	(-55%)	(-51%)	(-29%)	(-28%)	(-48%)	(-47%)	(-45%)	(-44%)	(-13%)	(-13%)	(14%)	(4%)	(-12%)	(-6%)	(-38%)	(-11%)	(6%)	(12%)	(-24%)	(-19%)
	Jones PP	ALL	-133	-107	-220	-117	-184	-83	-228	-169	-194	-189	-219	-211	-108	-104	-91	-88	-80	-126	-57	-62	-30	21	-103	-75	-135	-109
			(-24%)	(-20%)	(-36%)	(-22%)	(-23%)	(-13%)	(-32%)	(-26%)	(-31%)	(-31%)	(-37%)	(-36%)	(-20%)	(-22%)	(-21%)	(-20%)	(-20%)	(-20%)	(-12%)	(-13%)	(-6%)	(4%)	(-16%)	(-14%)	(-24%)	(-21%)
		DROUGHT	-93	-103	-174	-93	-147	-73	-387	-306	-293	-279	-268	-259	-137	-141	-154	-149	-39	-79	-137	-108	-74	37	31	49	-146	-115
			(-16%)	(-16%)	(-25%)	(-15%)	(-18%)	(-10%)	(-46%)	(-40%)	(-35%)	(-34%)	(-31%)	(-31%)	(-21%)	(-22%)	(-27%)	(-26%)	(-10%)	(-16%)	(-25%)	(-20%)	(-11%)	(6%)	(5%)	(8%)	(-21%)	(-16%)

* ALL: Water years 1976-1991 represent the 16-year period modeled using DSM2. DROUGHT: Represents a 5 consecutive year (water years 1987-1991) drought period consisting of dry and critical water year types (as defined by the Sacramento Valley 40-30-30 water year hydrologic classification index).

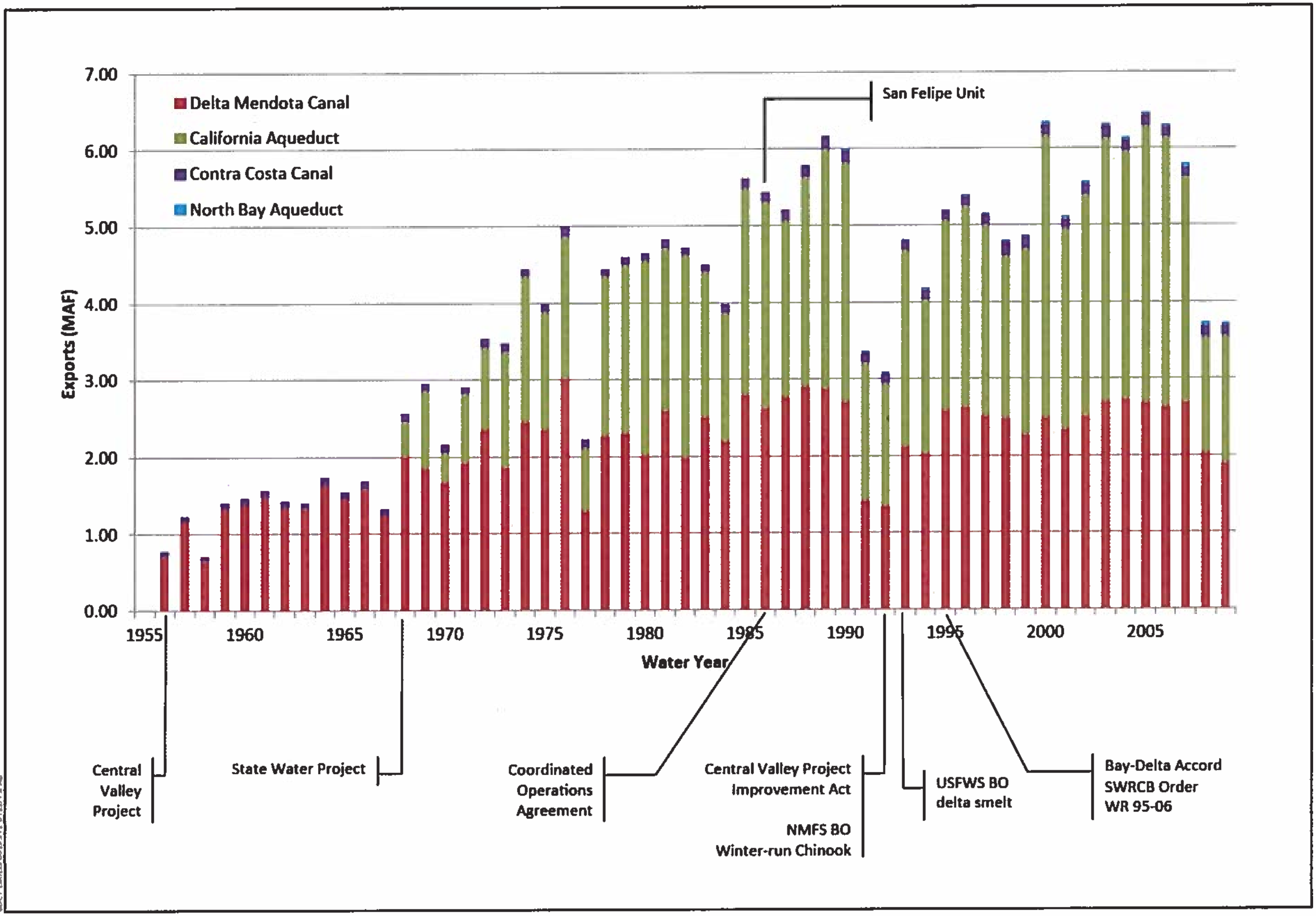
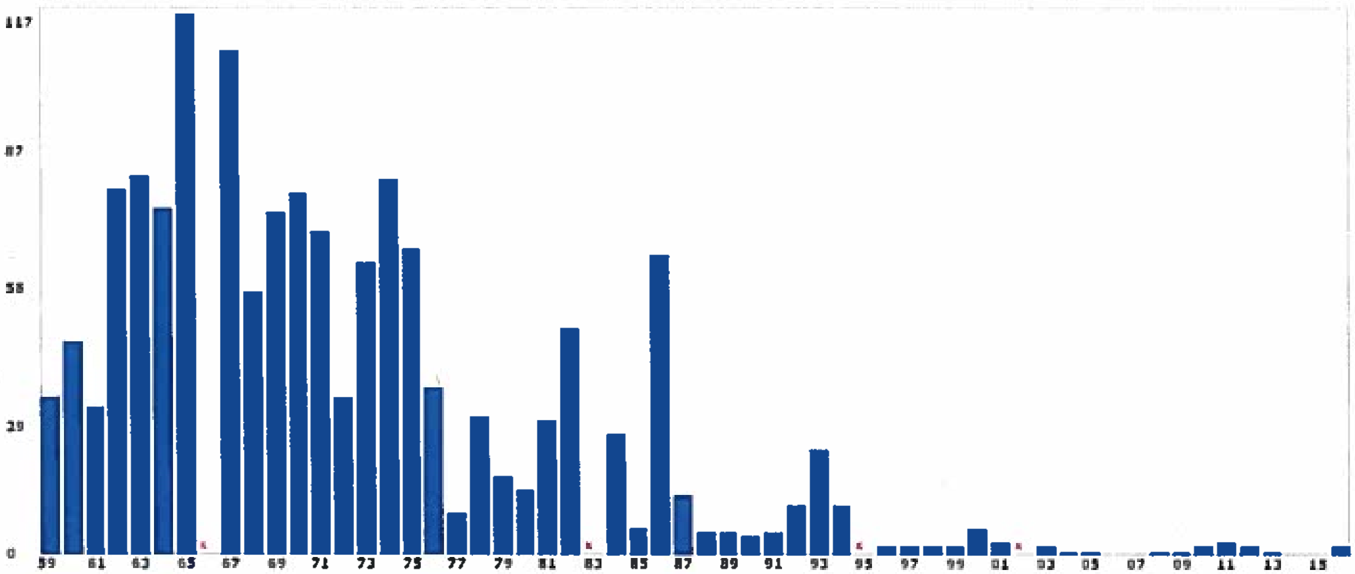


Figure 5-2
Delta Exports 1956–2009

CALIFORNIA DEPARTMENT OF FISH and WILDLIFE

Striped Bass Indices



Striped Bass Indices

YEAR	INDEXDATE	DELTA INDEX	SUISUN BAY INDEX	TOTAL INDEX
1959	12-Jul	30.7	3.0	33.7
1960	16-Jul	32.0	13.6	45.6
1961	21-Jul	25.2	6.4	31.6
1962	26-Jul	46.8	32.1	78.9
1963	3-Aug	38.2	43.5	81.7
1964	1-Aug	54.7	20.7	75.4
1965	31-Jul	49.4	67.8	117.2
1966				
1967	12-Aug	35.1	73.6	108.7
1968	18-Jul	39.6	17.7	57.3
1969	9-Aug	33.6	40.2	73.8
1970	18-Jul	36.6	41.9	78.5
1971	11-Aug	24.6	45.0	69.6
1972	24-Jul	13.4	21.1	34.5
1973	15-Jul	15.6	47.1	62.7

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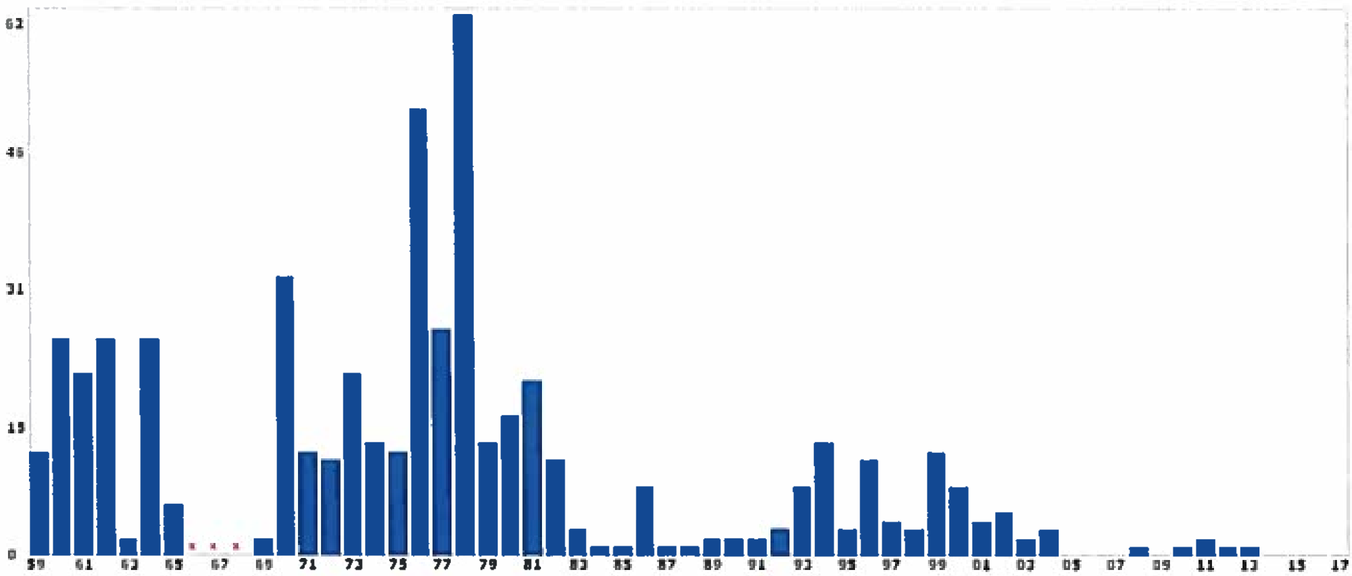
CALIFORNIA DEPARTMENT OF FISH and WILDLIFE

Delta Smelt Indices



Delta Smelt Indices

YEAR	INDEX
1959	12.1
1960	25.4
1961	21.3
1962	24.9
1963	1.8
1964	24.6
1965	6.0
1966	
1967	
1968	
1969	2.5
1970	32.5
1971	12.5
1972	11.1
1973	21.3

SDWA 302

Central Valley Steelhead

Dennis R. McEwan

Abstract

Before extensive habitat modification of the 19th and 20th centuries, steelhead (*Oncorhynchus mykiss*) were broadly distributed throughout the Sacramento and San Joaquin drainages. Historical run size is difficult to estimate given the paucity of data, but may have approached 1 to 2 million adults annually. By the early 1960s run size had declined to about 40,000 adults. Natural spawning populations currently exist in the Sacramento and San Joaquin river systems but at much lower levels. Coastal rainbow trout populations can be polymorphic in their life-history, and progeny of one life-history form can assume a life-history strategy different from that of their parents. A polymorphic population structure may be necessary for the long-term persistence in highly variable environments such as the Central Valley. Despite the substantial introduction of exotic stocks for hatchery production, native Central Valley steelhead may have maintained some degree of genetic integrity. Primary stressors affecting Central Valley steelhead are all related to water development and water management, and the single greatest stressor is the substantial loss of spawning and rearing habitat due to dam construction. Central Valley anadromous fish management and research is primarily focused on chinook salmon (*Oncorhynchus tshawytscha*) and has lead to less emphasis on steelhead monitoring and restoration. Much of the information on historical abundance and stock characteristics that exists for Central Valley steelhead is derived from an intensive DFG research program in the 1950s. Since this time there has been relatively little research directed at steelhead in the Central Valley, and efforts to restore Central Valley steelhead have been greatly hampered by lack of information. The National Marine Fisheries Service cited the ongoing conservation efforts of the Central Valley Project Improvement Act (CVPIA) and CALFED as justification for listing Central Valley steelhead as a threatened species under the Endangered Species Act, rather than endangered as proposed. Restoration actions identified in these programs are largely directed at chinook salmon recovery with comparatively little emphasis on specific actions needed to recover steelhead, or have not yet been implemented. The structure of rainbow trout populations has important management implications that can only be addressed through an integrated management strategy that treats all life-history forms occupying a stream as a single population. However, management

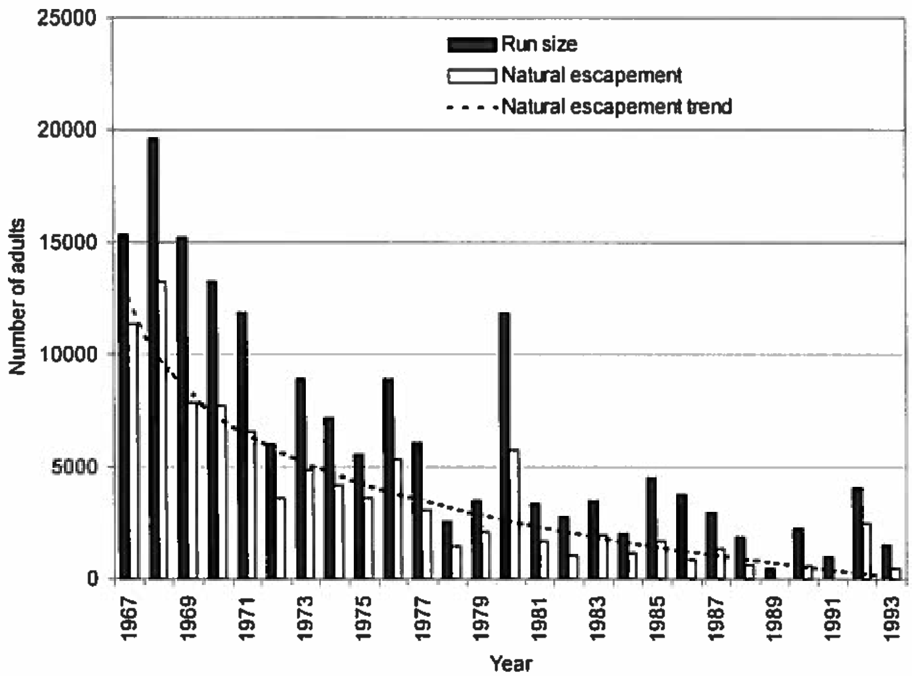


Figure 8 Steelhead population trends in the upper Sacramento River from 1967 to 1993. Run size is the adjusted steelhead counts at Red Bluff Diversion Dam and includes hatchery and natural spawners. Natural escapement was calculated by applying an estimated harvest rate of 16% (DFG unpublished data) to run size, then subtracting Coleman National Fish Hatchery escapement.

Factors Affecting the Decline of Central Valley Steelhead

Stressors affecting abundance, persistence, and recovery have been identified for anadromous fishes in the Sacramento and San Joaquin River systems and these apply reasonably well to Central Valley steelhead. Stressors affecting Central Valley anadromous fishes include water diversions and water management; entrainment; dams and other structures; bank protection; dredging and sediment disposal; gravel mining; invasive aquatic organisms; fishery management practices; and contaminants (Upper Sacramento River FRHAC 1989; Reynolds and others 1990, 1993; CALFED 2000; CMARP Steering Committee 1999). Stressors affecting steelhead on the west coast generally include the stressors listed above plus logging, agriculture, urbanization, disease, predation, and natural factors (NMFS 1996b; NMFS 1997b). McEwan and Jackson

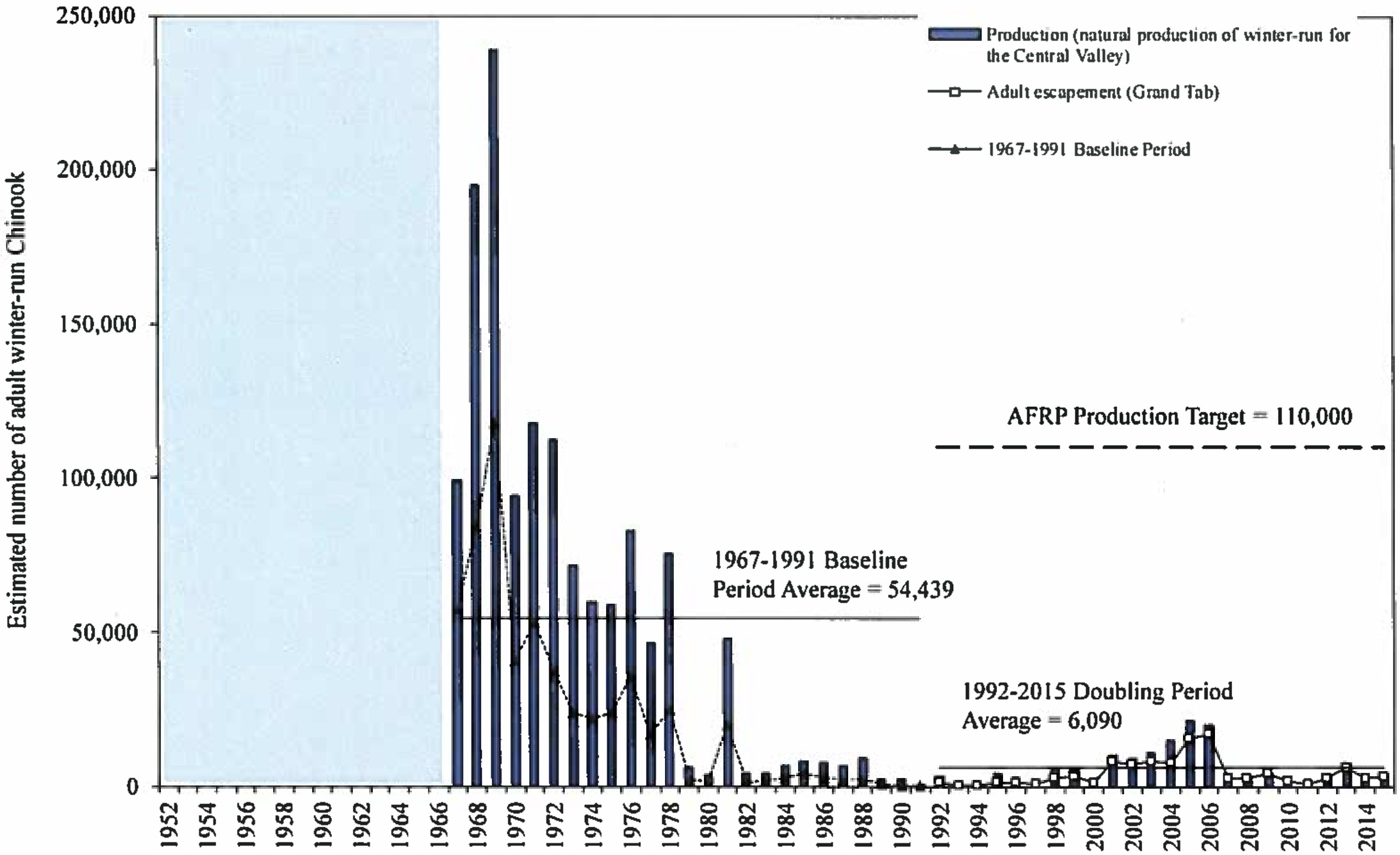


Figure 4. Estimated yearly adult natural production, and in river adult escapements of winter-run Chinook salmon in the Central Valley rivers and streams. ▭ = data was not available for 1952-1966. 1992-2015 numbers are from CDFG Grand Tab (Apr 11, 2016). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

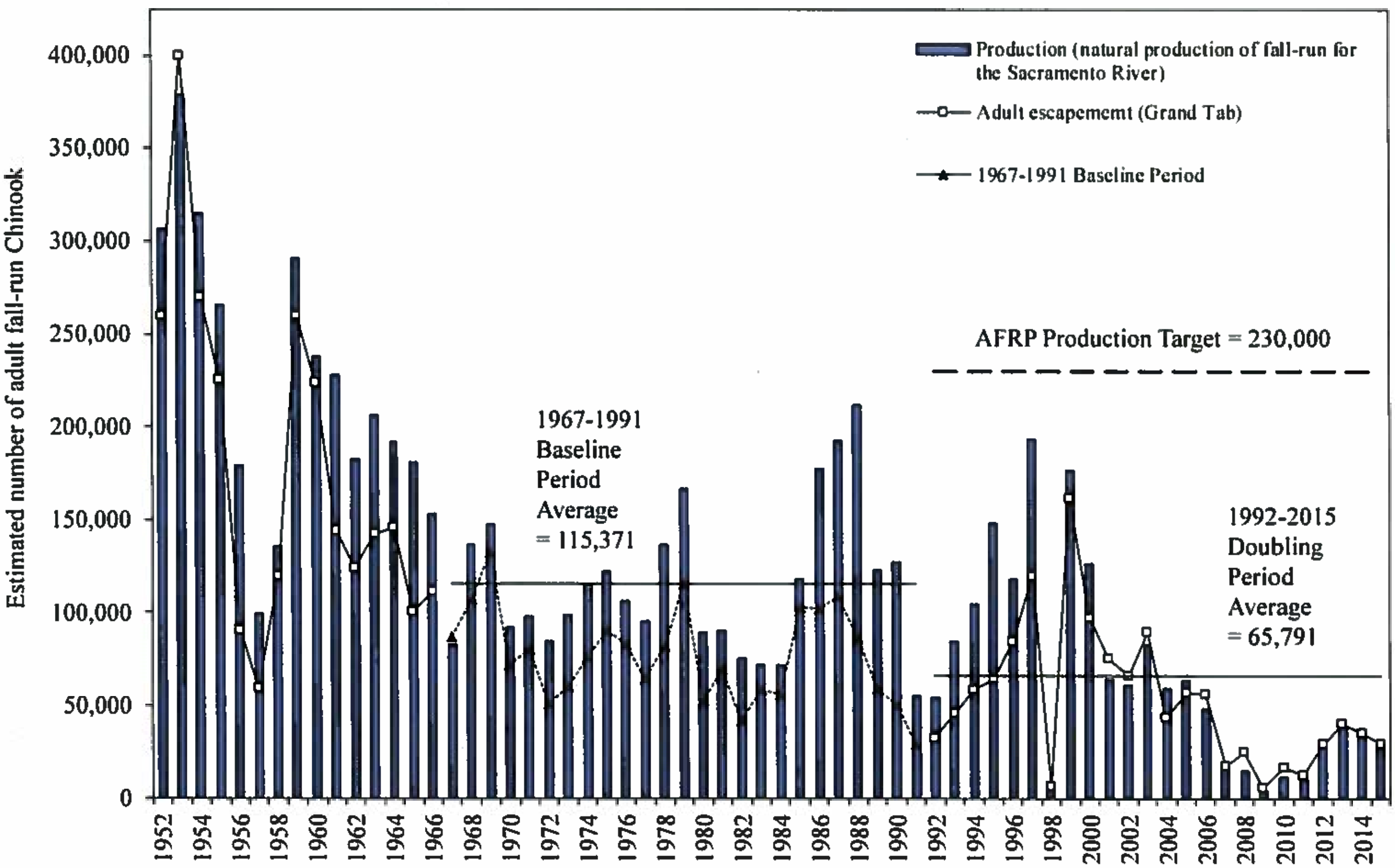
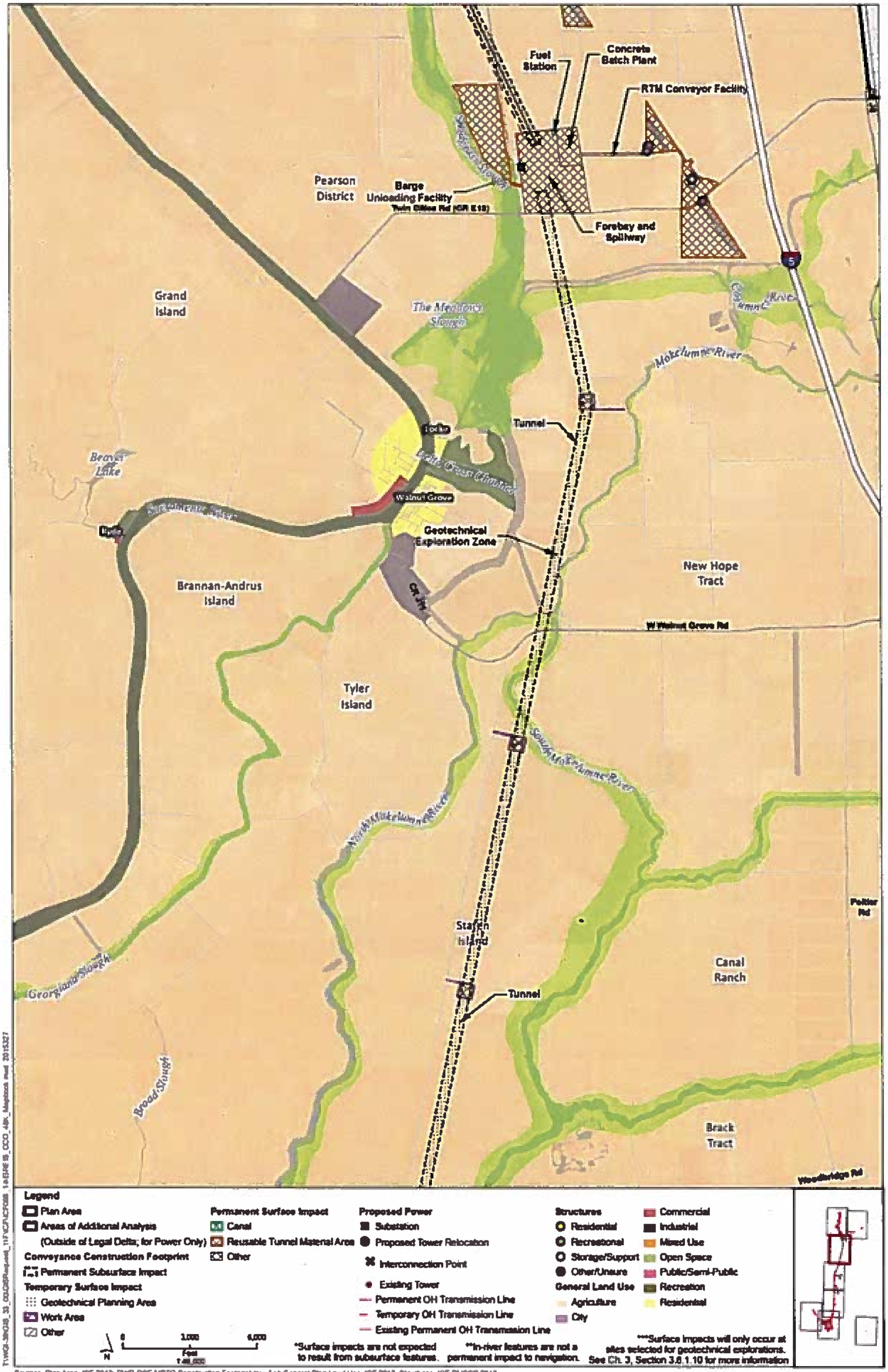
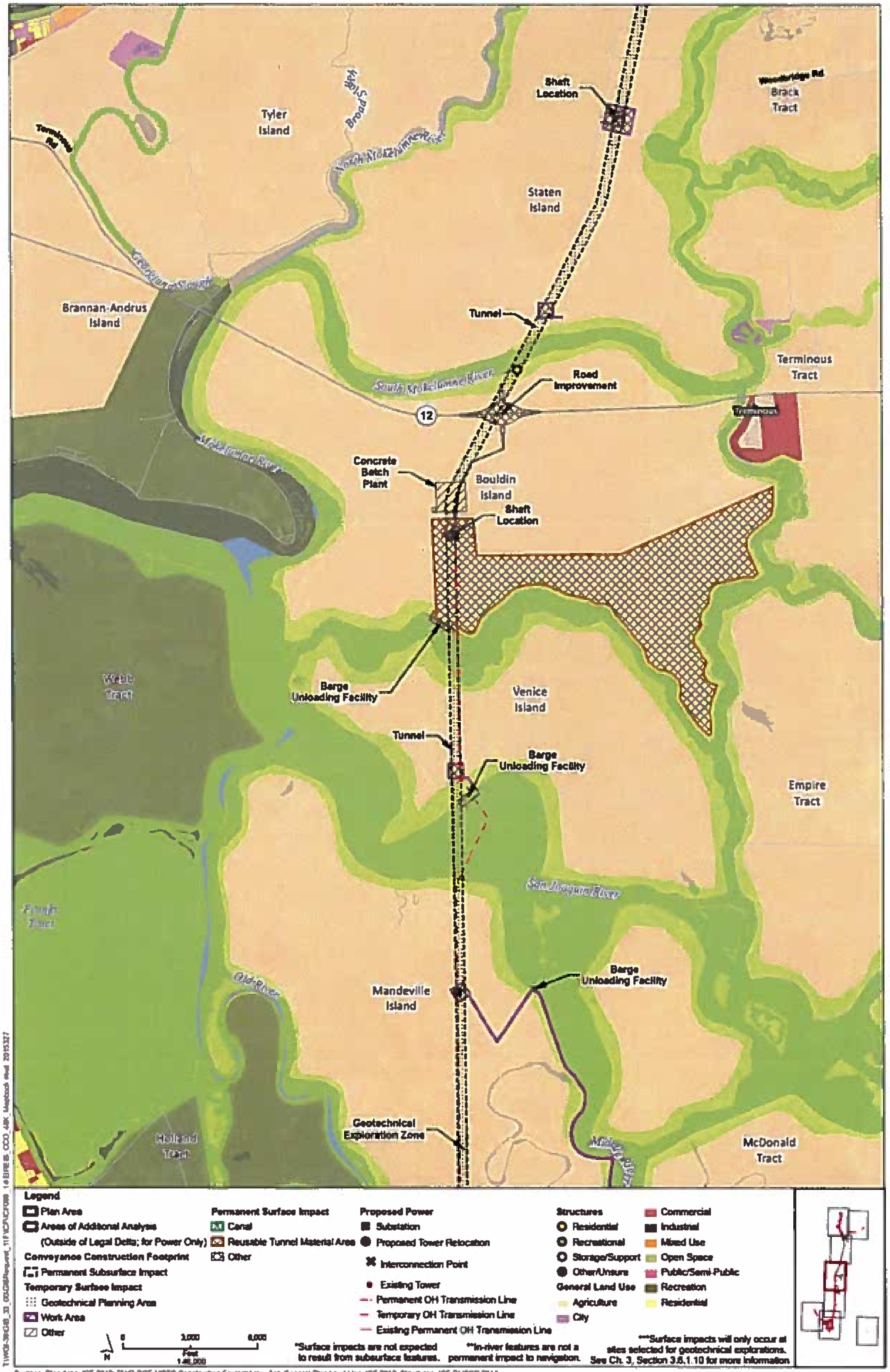


Figure 6. Estimated yearly adult natural production, and in-river adult escapements for the entire mainstem Sacramento River fall-run Chinook salmon. 1952-1966 and 1992-2015 numbers are from CDFG Grand Tab (Apr 11, 2016). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).



Sources: Plan Area, ICF 2012; DWR DCE MPTO Construction Footprint (rev 5a); General Plan Land Use, ICF 2012, Structures, ICF-DHCCP 2013

Figure M13-4: Sheet 3 of 8
General Plan Land Use Designations — Modified Pipeline/Tunnel Alignment (Alternative 4)

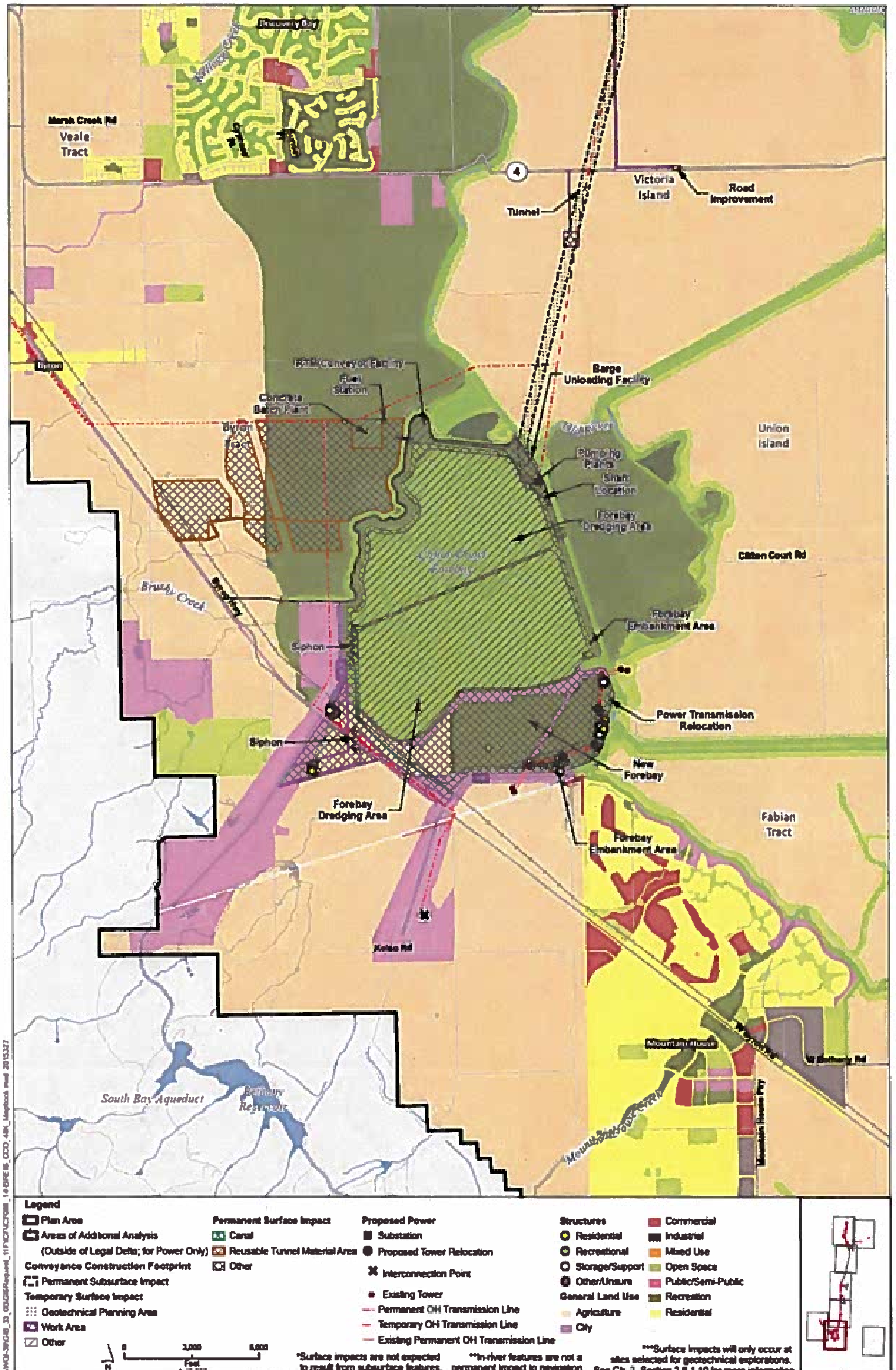


Sources: Plan Area, ICF 2012; DWR DCE MPTO Construction Footprint (rev 5a); General Plan Land Use, ICF 2012; Structures, ICF-DHCCP 2013

Figure M13-4: Sheet 4 of 8
General Plan Land Use Designations — Modified Pipeline/Tunnel Alignment (Alternative 4)

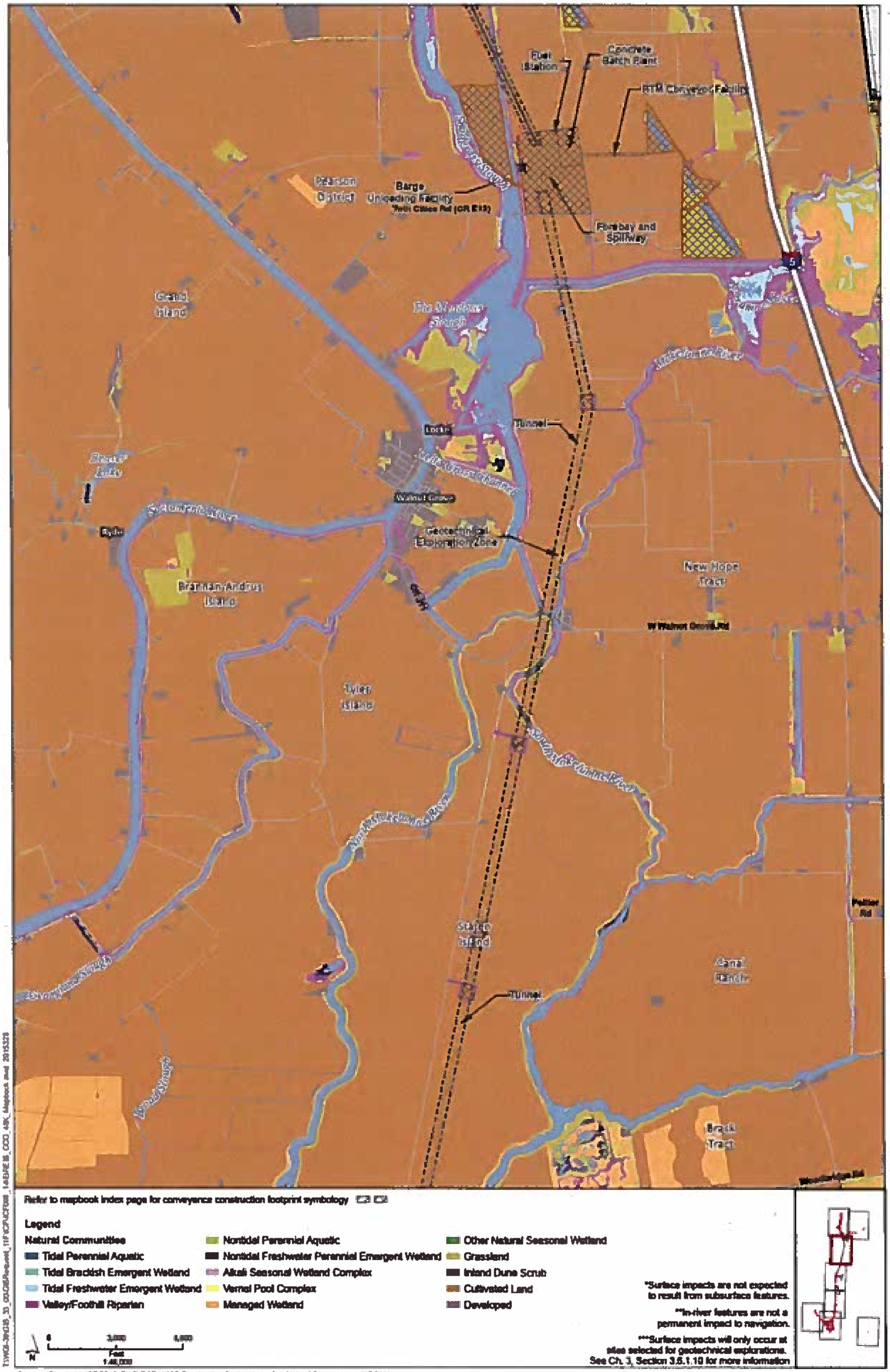
Sources: Plan Area, ICF 2012; DWR DCE MPTO Construction Footprint (rev 5a), General Plan Land Use, ICF 2012, Structures, ICF-DHCCP 2013

Figure M13-4: Sheet 5 of 8
General Plan Land Use Designations — Modified Pipeline/Tunnel Alignment (Alternative 4)



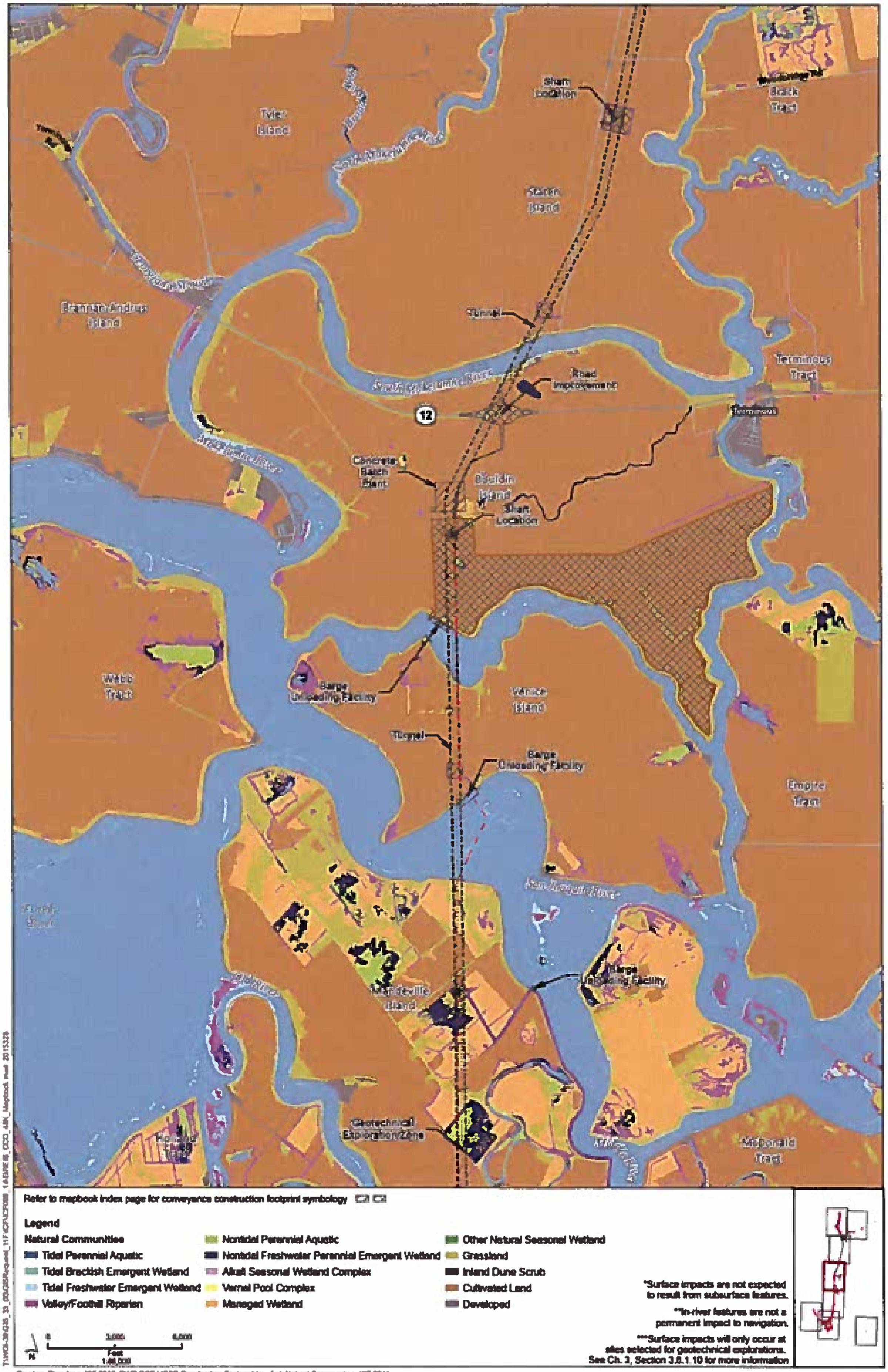
Sources: Plan Area, ICF 2012; DWR DCE MPTO Construction Footprint (rev 5a); General Plan Land Use, ICF 2012. Structures, ICF-DHCCP 2013

Figure M13-4: Sheet 6 of 8
General Plan Land Use Designations — Modified Pipeline/Tunnel Alignment (Alternative 4)



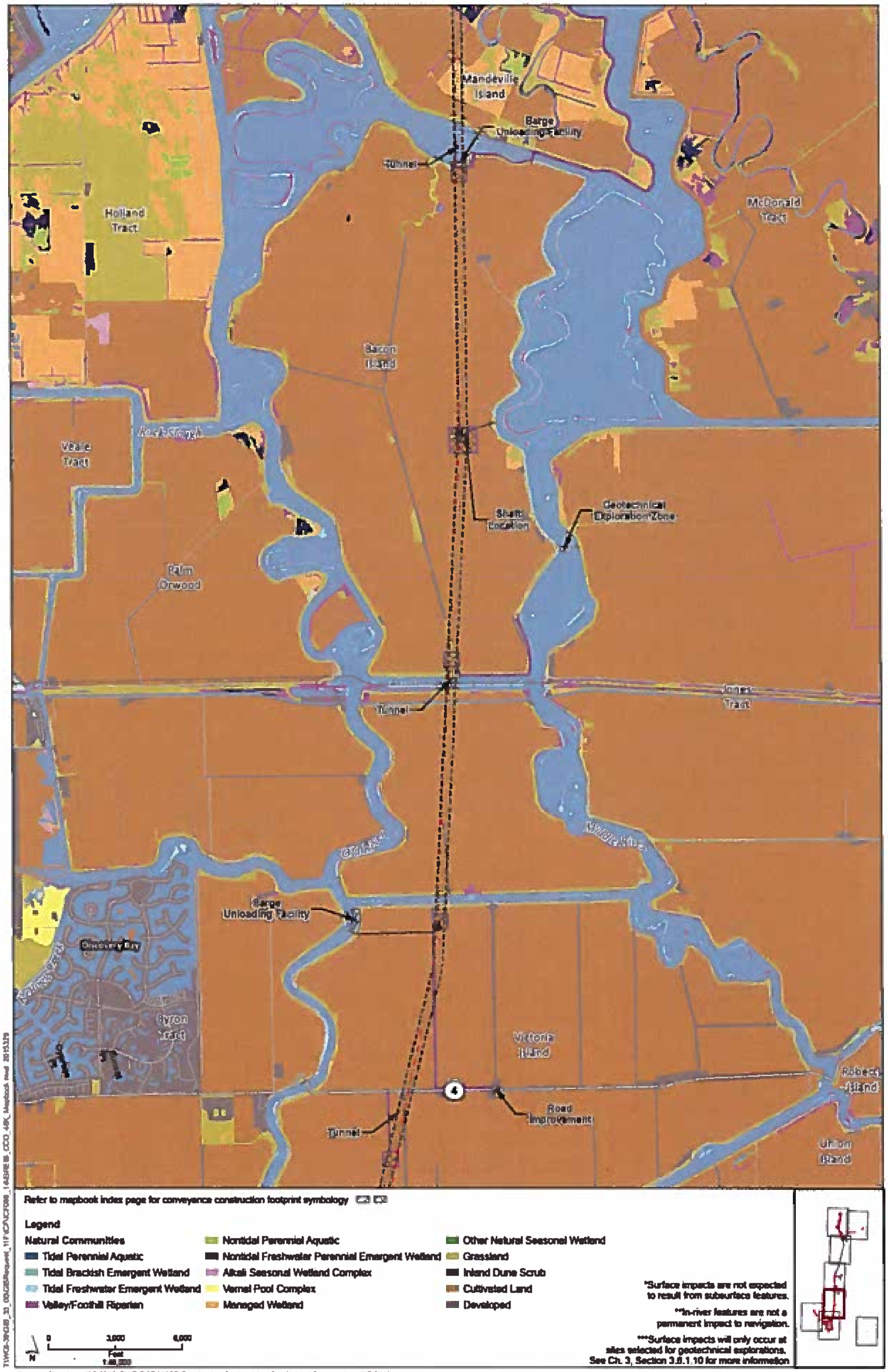
Sources: Plan Area, ICF 2012; DWR DCE MPTO Construction Footprint (rev 5a); Natural Communities, ICF 2011

Figure M12-4: Sheet 3 of 8
Distribution of Natural Communities — Modified Pipeline/Tunnel Alignment (Alternative 4)



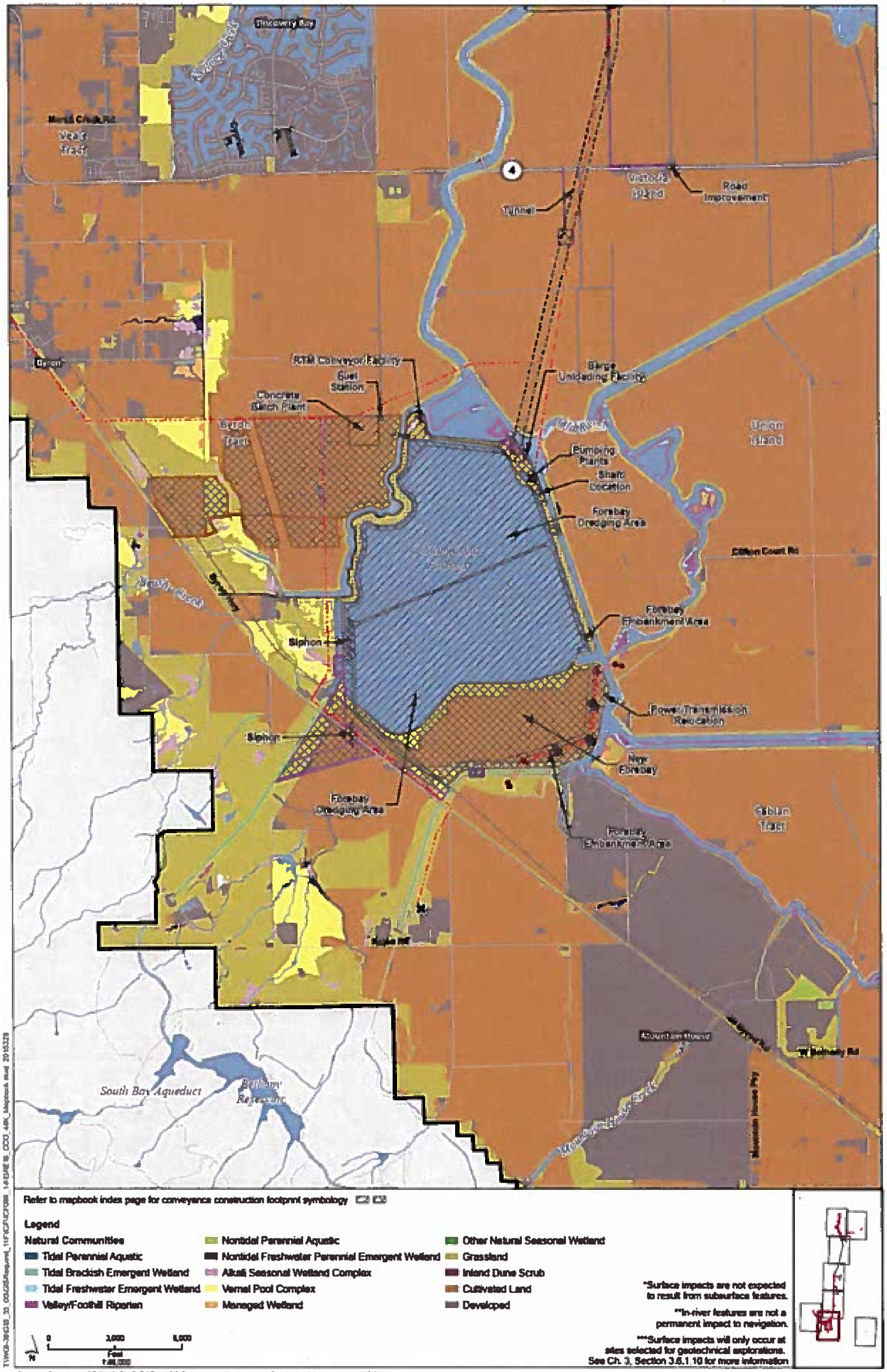
Sources: Plan Area, ICF 2012; DWR DCE MPTO Construction Footprint (rev 5a); Natural Communities, ICF 2011

Figure M12-4: Sheet 4 of 8
Distribution of Natural Communities — Modified Pipeline/Tunnel Alignment (Alternative 4)



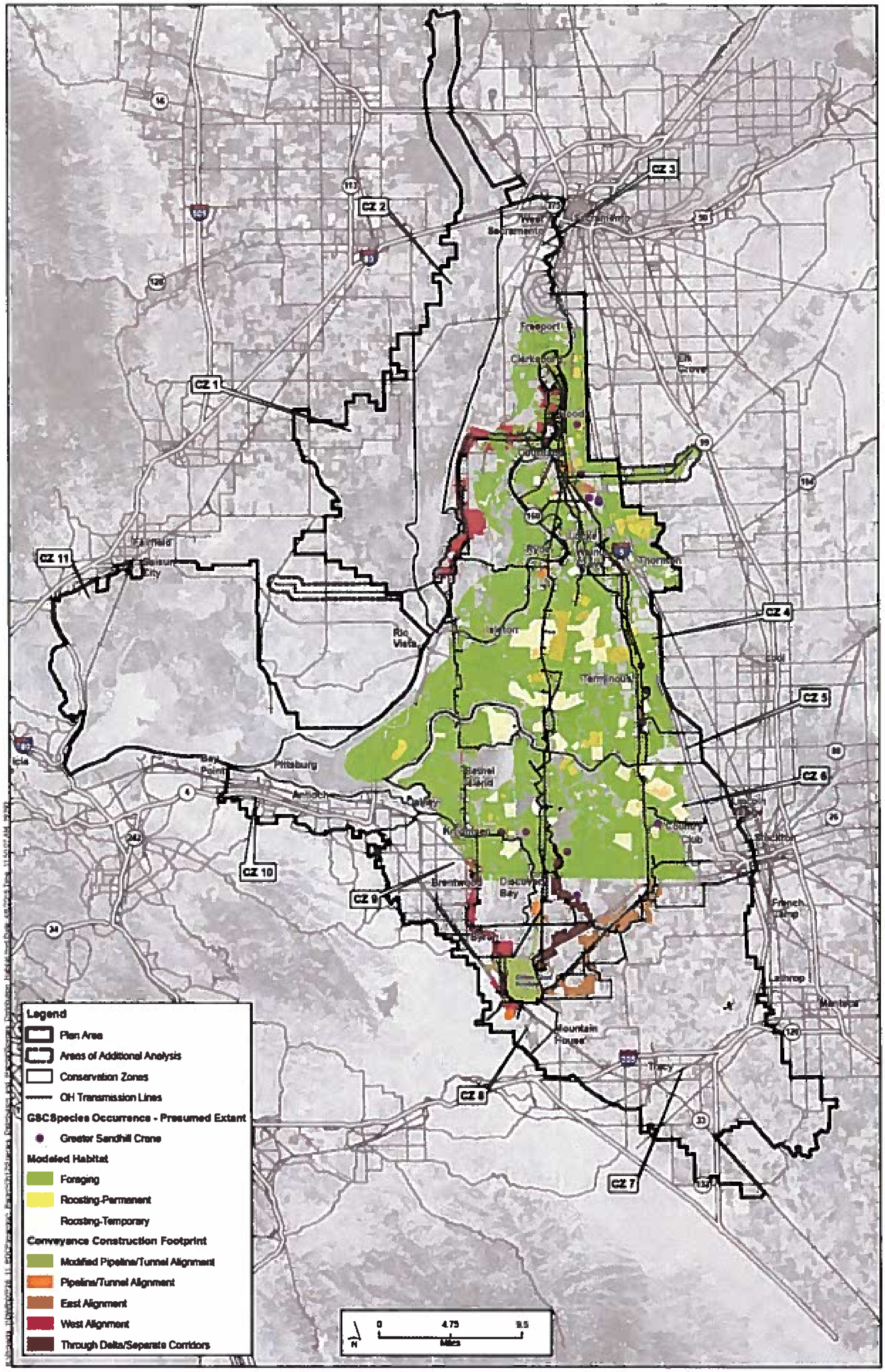
Sources: Plan Area, ICF 2012; DWR DCE MPTO Construction Footprint (rev 5a); Natural Communities, ICF 2011

Figure M12-4: Sheet 5 of 8
Distribution of Natural Communities — Modified Pipeline/Tunnel Alignment (Alternative 4)



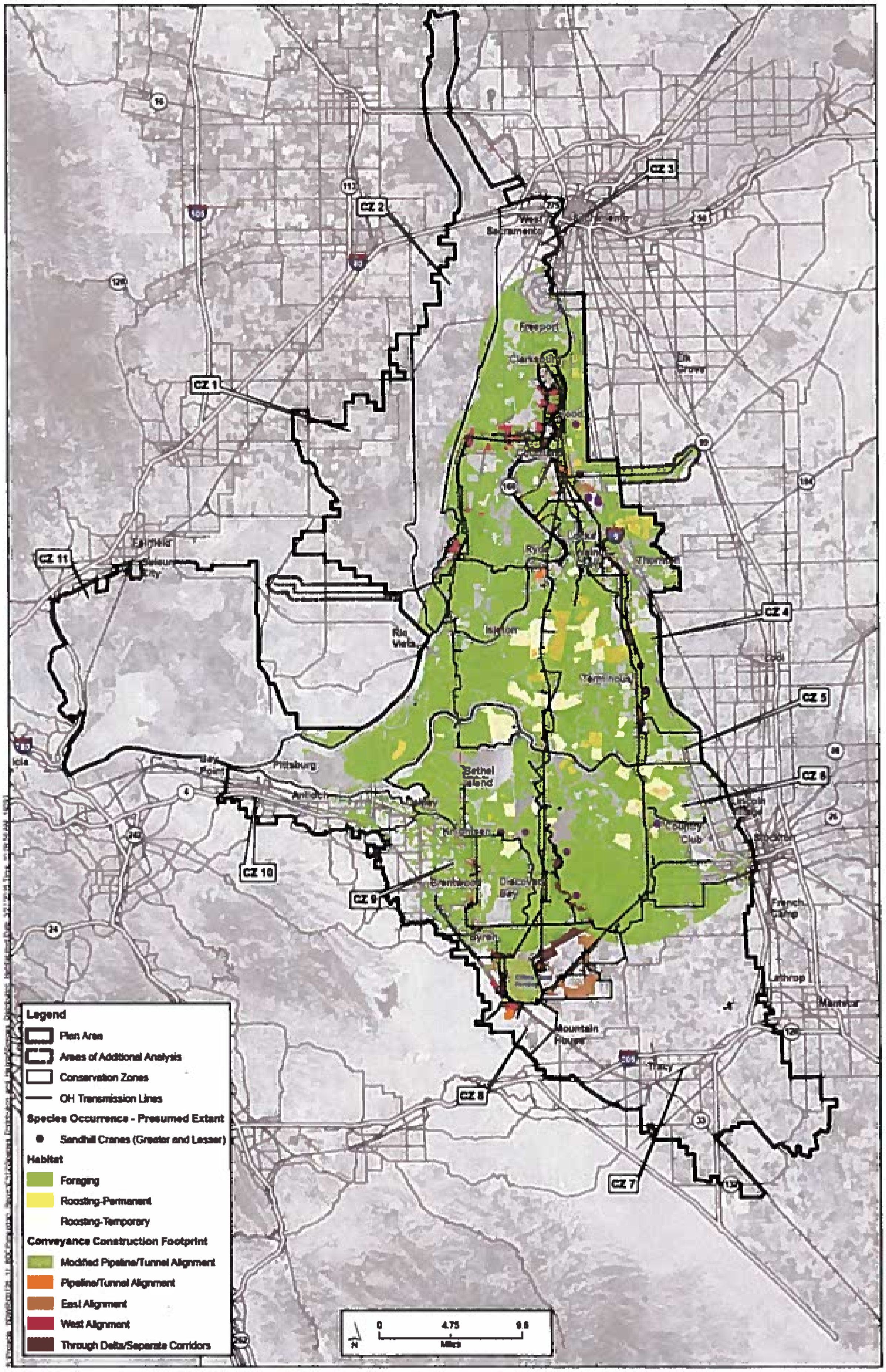
Sources: Plan Area, ICF 2012; DWR DCE MPTO Construction Footprint (rev 5a); Natural Communities, ICF 2011

Figure M12-4: Sheet 6 of 8
Distribution of Natural Communities — Modified Pipeline/Tunnel Alignment (Alternative 4)



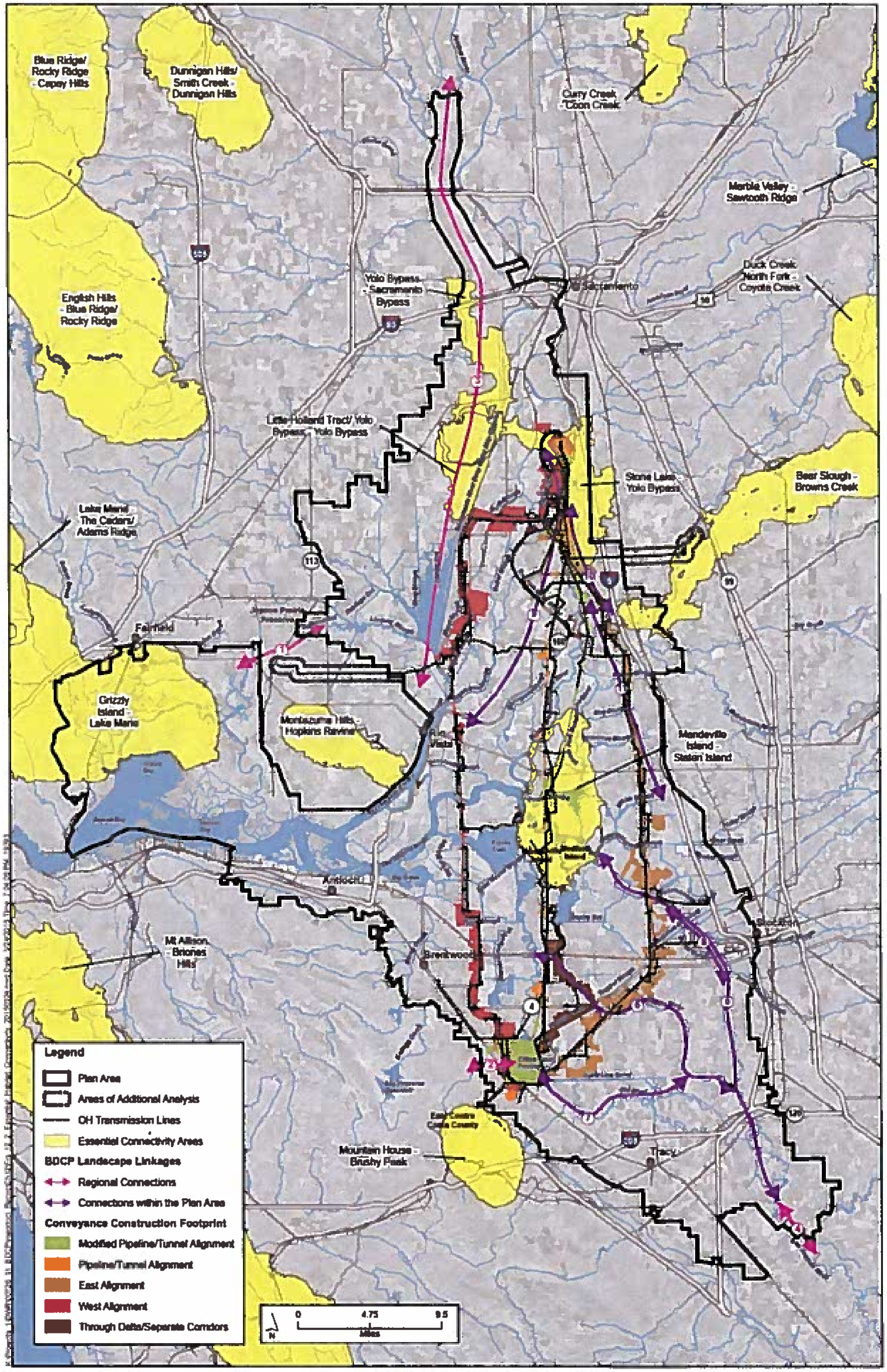
Sources: Plan Area, ICF 2012, Constructability (Rev 10b), DHCCP DWR 2012, Constructability (Rev 3b), DHCCP DWR 2012; Constructability (Rev 5a), DHCCP DWR 2013, Species Occurrences, DHCCP DWR 2011; Modeled Habitat, ICF 2013, Conservation Zones, SAIC 2012

Figure 12-21
Greater Sandhill Crane Distribution and Habitat in Study Area Vicinity



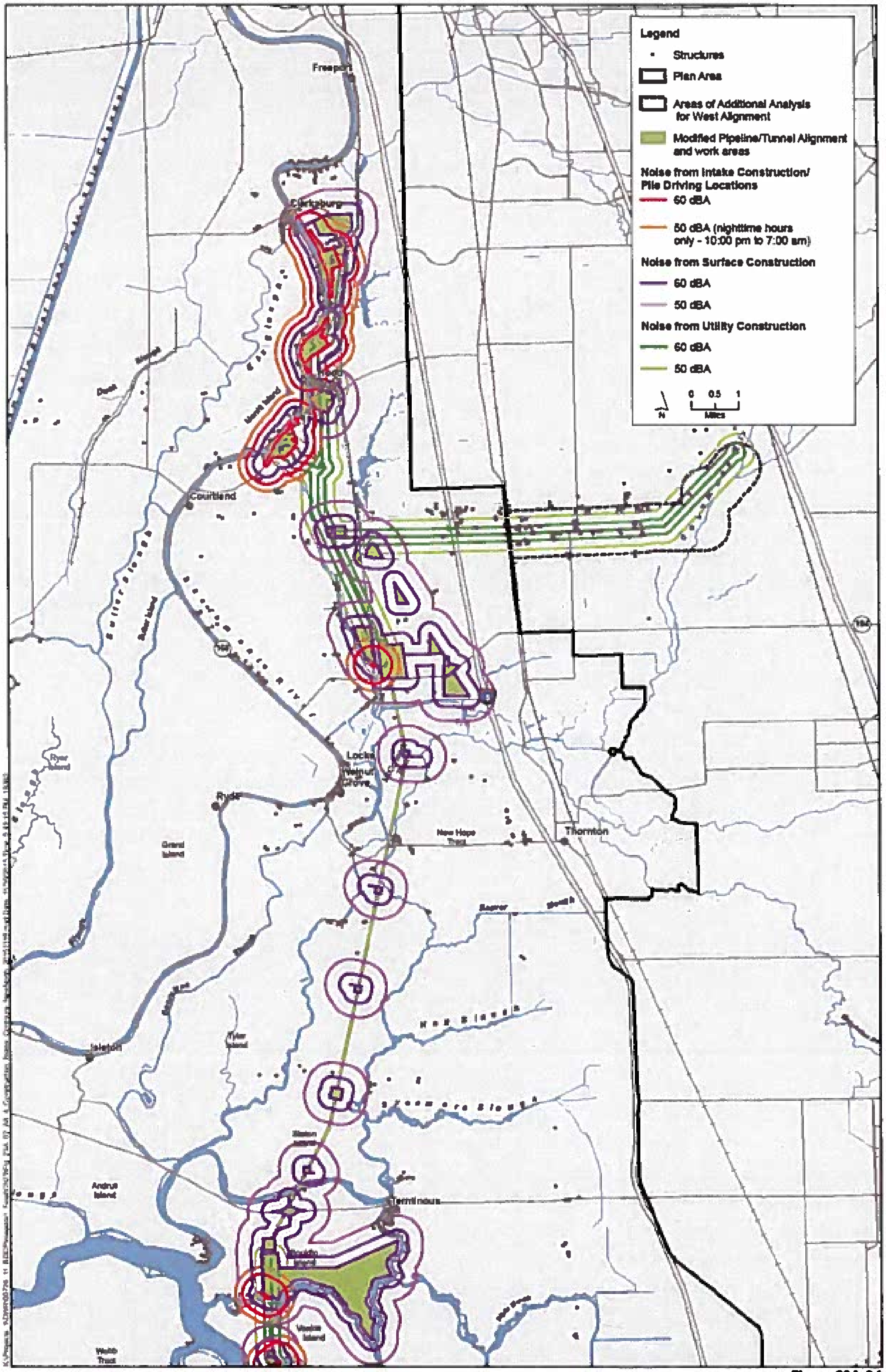
Sources: Plan Area, ICF 2012, Constructability (Rev 10b), DHCCP DWR 2012; Constructability (Rev 3b) DHCCP DWR 2012; Constructability (Rev 5a), DHCCP DWR 2015, Species Occurrences, DHCCP DWR 2011; Habitat, ICF 2013; Conservation Zones, SAIC 2012.

Figure 12-22
Lesser Sandhill Crane Distribution and Habitat in Study Area Vicinity



Sources: Plan Area, ICF 2012; Areas of Additional Analysis, ICF 2012; Constructability (Rev 2b), DHCCP DWR 2013; Constructability (Rev 10b), DHCCP DWR 2012; Constructability (Rev 5a), DHCCP DWR 2015; Conservation Zones, SAIC 2012; Essential Connectivity Areas, Caltrans and CDFG 2010

Figure 12-2
Essential Habitat Connectivity



Sources: Plan Area, ICF 2012; Constructability (Rev 10b), DHCCP DWR 2012; Constructability (Rev 3b), DHCCP DWR 2012; Constructability (Rev 5b), DHCCP DWR 2015

Figure 23A-04
Alternative 4 - Modified Pipeline/Tunnel Option
Construction Noise Contours (North)

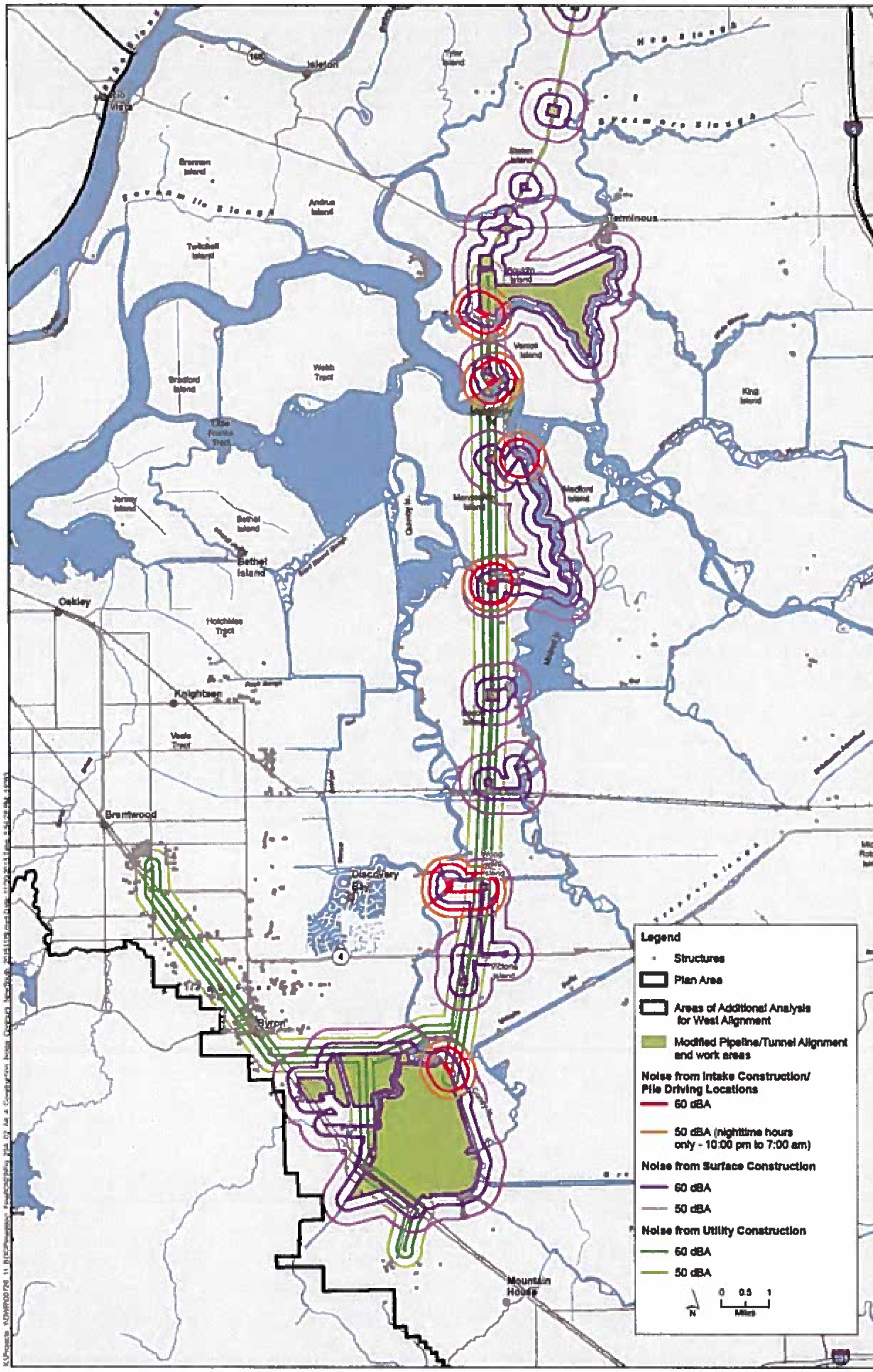
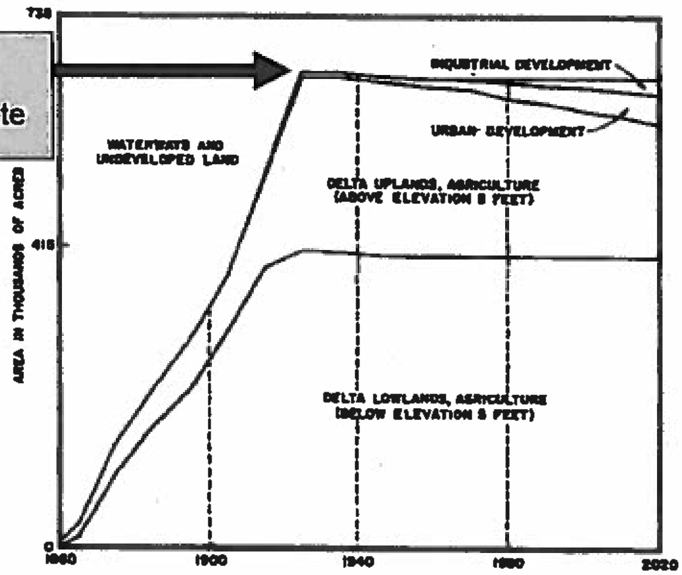


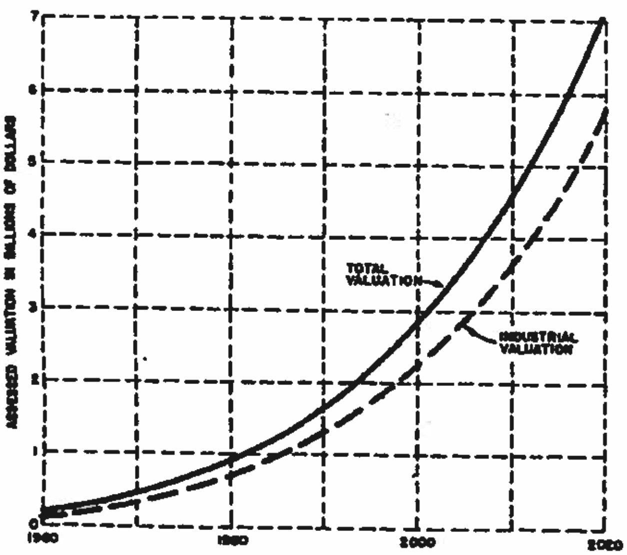
Figure 23A-04
Alternative 4 - Modified Pipeline/Tunnel Option
Construction Noise Contours (South)

Several towns and cities are located in the upland areas and an industrial complex is expanding in th
Delta. Early industrial development cent
kindred products, steel production, fibrebo
building activity. Large water-using ind
paper products, and chemicals, have deve
area where water, rail, and highway transportation, coupled with water supplies, has stimulated growth. The manufacturing employment in this area was about 10,000 people in 1960.

1925 Delta Reclamation Complete



TRENDS IN LAND USE

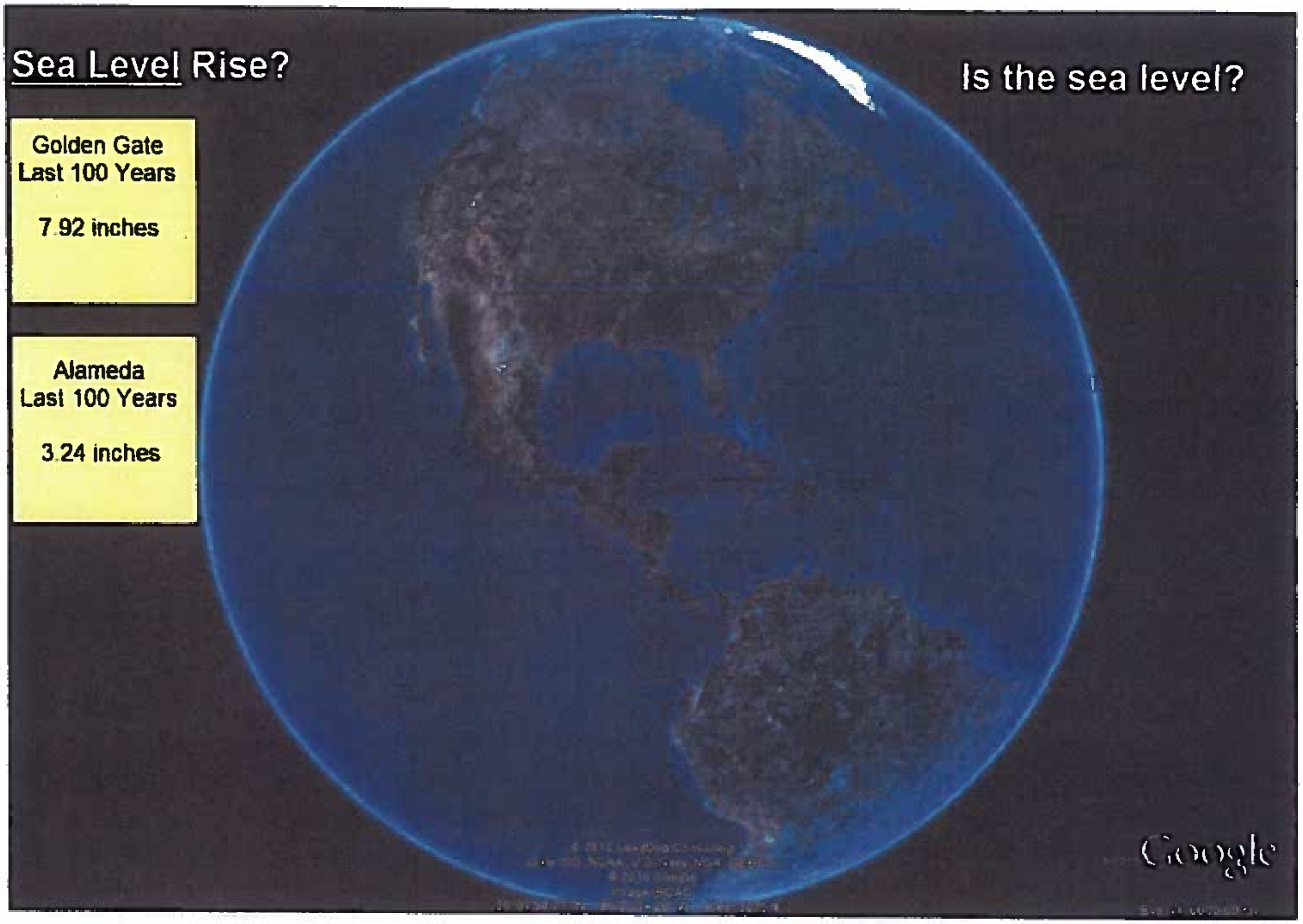


PROJECTED ASSESSED VALUATIONS WITHIN THE WESTERN DELTA STUDY AREA

A deep-draft ship channel serving commercial and military installations terminates at Stockton, and another is being constructed to Sacramento. Water-borne shipments in the Delta amounted to about 6,000,000 tons annually in recent years.

The Delta encompasses one of California's most important high quality natural gas fields. Since 1941 the field has produced about 300,000,000 cubic feet of methane gas for use in the San Francisco Bay area.

With the growing significance of recreation, the Delta has blossomed into a major recreation area at the doorsteps of metropolitan development in the San Francisco Bay area, Sacramento, and Stockton. In 1960, nearly 2,800,000 recreation-days were enjoyed in this boating wonderland.

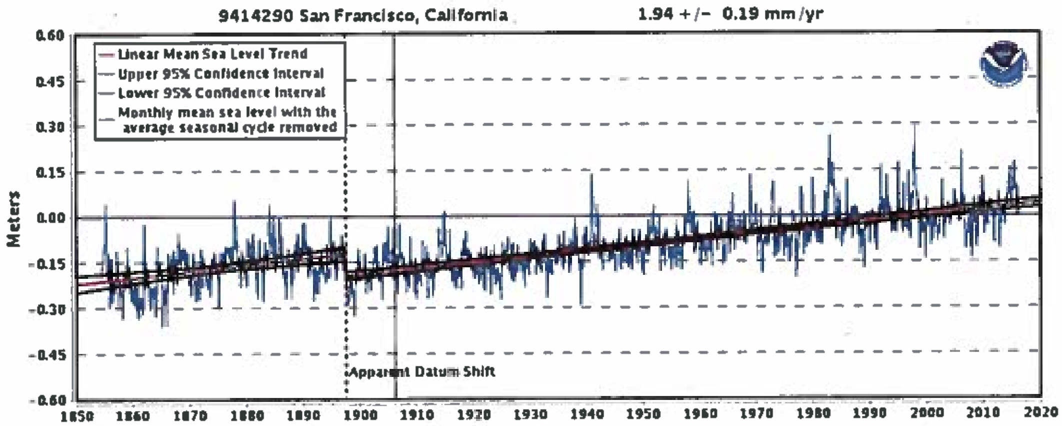

Sea Level Rise?
Golden Gate
Last 100 Years
7.92 inches
Alameda
Last 100 Years
3.24 inches
Is the sea level?
Google

U.S. Trends Map (/sltrends/slmap.htm)

U.S. Regional Trends
Select

Global Regional Trends (/sltrends/globalregiona

Anomalies
Select



EXPORT TO TEXT (DOWNLOADMEANSEALEVELTRENDSTEXT.HTM?STNID=9414290)

| EXPORT TO CSV (DOWNLOADMEANSEALEVELTRENDSCSV.HTM?STNID=9414290) | SAVE IMAGE

Get Adobe Reader (http://tidesandcurrents.noaa.gov/redirect.shtml?url=14)

The mean sea level trend is 1.94 millimeters/year with a 95% confidence interval of +/- 0.19 mm/yr based on monthly mean sea level data from 1897 to 2015 which is equivalent to a change of 0.64 feet in 100 years.
[Metadata: Apparent datum shift]

The plot shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend is also shown, including its 95% confidence interval. The plotted values are relative to the most recent Mean Sea Level datum established by CO-OPS (http://tidesandcurrents.noaa.gov/datum_options.html). The calculated trends for all stations are available as a table in millimeters/year and in feet/century (mslUSTrendsTable.htm) (0.3 meters = 1 foot).

If present, solid vertical lines indicate times of any major earthquakes in the vicinity of the station and dashed vertical lines bracket any periods of questionable data or datum shift.

SDWA-194

Products available at 9414290 San Francisco, California

TIDES/WATER LEVELS **METEOROLOGICAL/OTHER** **OPERATIONAL FORECAST SYSTEMS**

U.S. Trends Map (/sltrends/slrmap.htm)

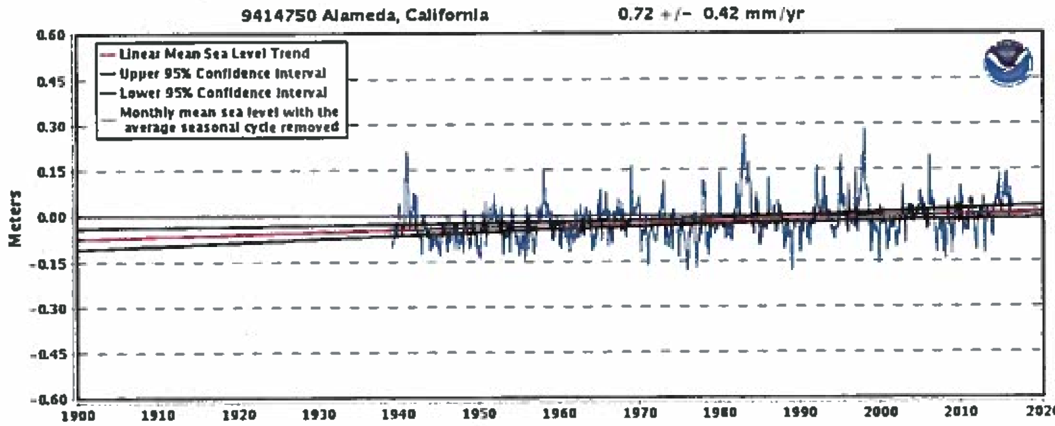
U.S. Regional Trends

Select

Global Regional Trends (/sltrends/globalregiona

Anomalies

Select



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| EXPORT TO CSV (DOWNLOADMEANSEALEVELTRENDSCSV.HTM?STNID=9414750) | SAVE IMAGE

The mean sea level trend is 0.72 millimeters/year with a 95% confidence interval of +/- 0.42 mm/yr based on monthly mean sea level data from 1939 to 2015 which is equivalent to a change of 0.24 feet in 100 years.

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The plot shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend is also shown, including its 95% confidence interval. The plotted values are relative to the most recent Mean Sea Level datum established by CO-OPS (http://tidesandcurrents.noaa.gov/datum_options.html). The calculated trends for all stations are available as a table in millimeters/year and in feet/century (mslUSTrendsTable.htm) (0.3 meters = 1 foot).

If present, solid vertical lines indicate times of any major earthquakes in the vicinity of the station and dashed vertical lines bracket any periods of questionable data or datum shift.

Products available at 9414750 Alameda, California

TIDES/WATER LEVELS	METEOROLOGICAL/OTHER	OPERATIONAL FORECAST SYSTEMS
		This station is not a member of OFS

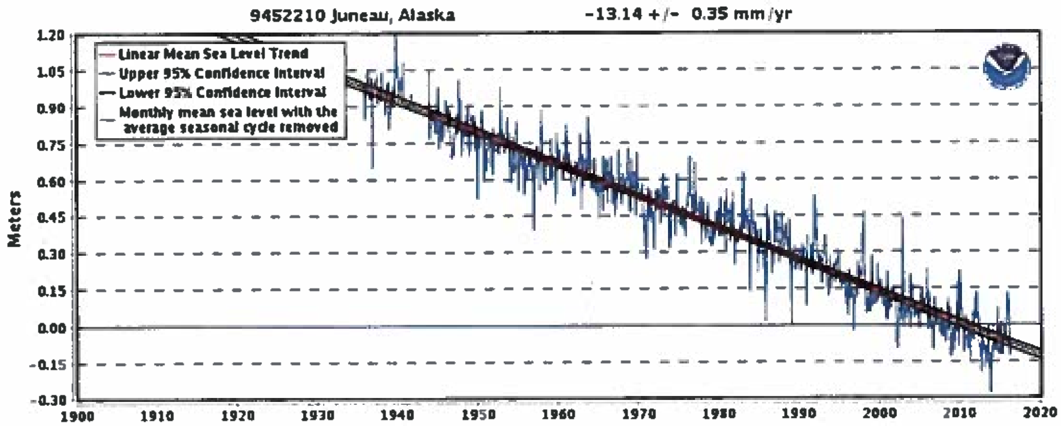
U.S. Regional Trends

Select

Global Regional Trends (/sltrends/globalregiona

Anomalies

Select



Get Adobe Reader (http://tidesandcurrents.noaa.gov/redirect.shtml?url=14)

EXPORT TO TEXT (DOWNLOADMEANSEALEVELTRENDSTEXT.HTM?STNID=9452210) | EXPORT TO CSV (DOWNLOADMEANSEALEVELTRENDSCSV.HTM?STNID=9452210) | SAVE IMAGE

The mean sea level trend is -13.14 millimeters/year with a 95% confidence interval of +/- 0.35 mm/yr based on monthly mean sea level data from 1936 to 2015 which is equivalent to a change of -4.31 feet in 100 years.

The plot shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend is also shown, including its 95% confidence interval. The plotted values are relative to the most recent Mean Sea Level datum established by CO-OPS (http://tidesandcurrents.noaa.gov/datum_options.html). The calculated trends for all stations are available as a table in millimeters/year and in feet/century (mslUSTrendsTable.htm) (0.3 meters = 1 foot).

If present, solid vertical lines indicate times of any major earthquakes in the vicinity of the station and dashed vertical lines bracket any periods of questionable data or datum shift.

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TIDES/WATER LEVELS

METEOROLOGICAL/OTHER

OPERATIONAL FORECAST SYSTEMS

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SEA LEVEL TRENDS

Mean Sea Level Trend

Interannual Variation

Average Seasonal Cycle (seasonal.htm?stnid=060-041)

Variation Of 50-Year MSL Trends

Previous MSL Trends

Home/Map (/sltrends/sltrends.html)

U.S. Stations (/sltrends/sltrends_us.htm)

Global Stations (/sltrends/sltrends_glot

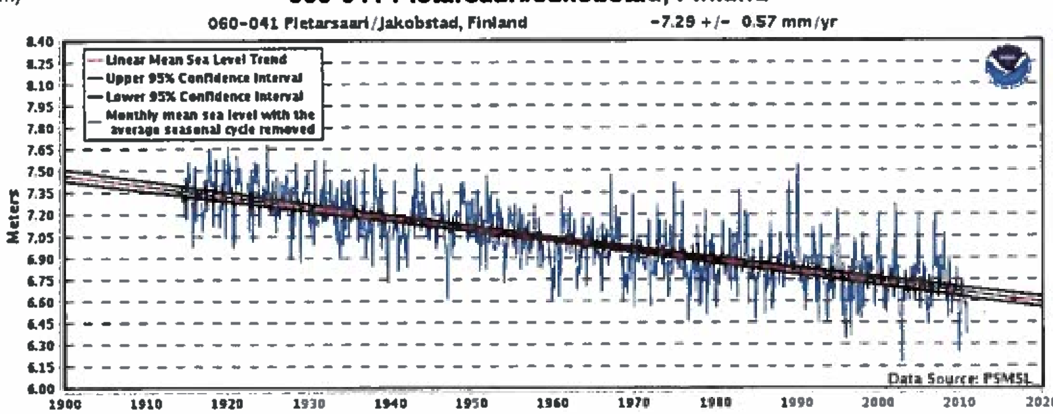
Data Tables

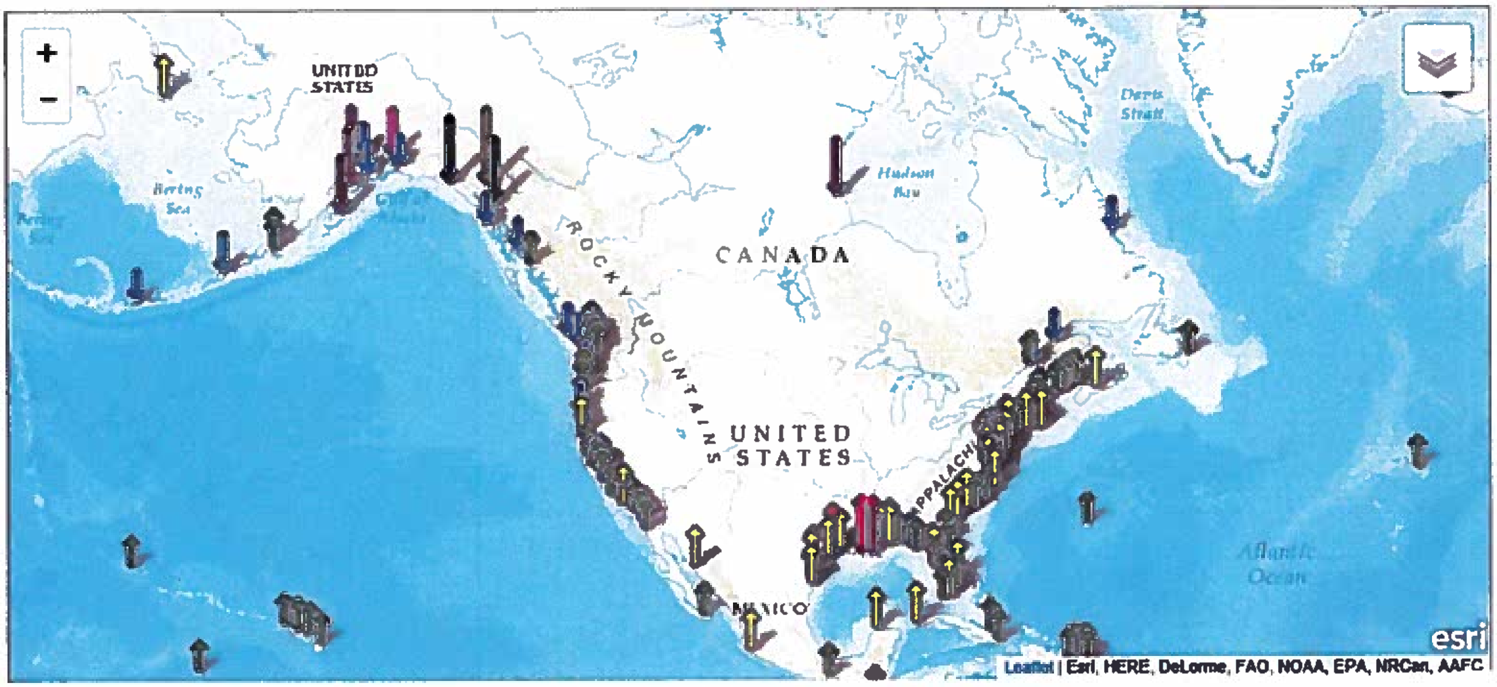
Select

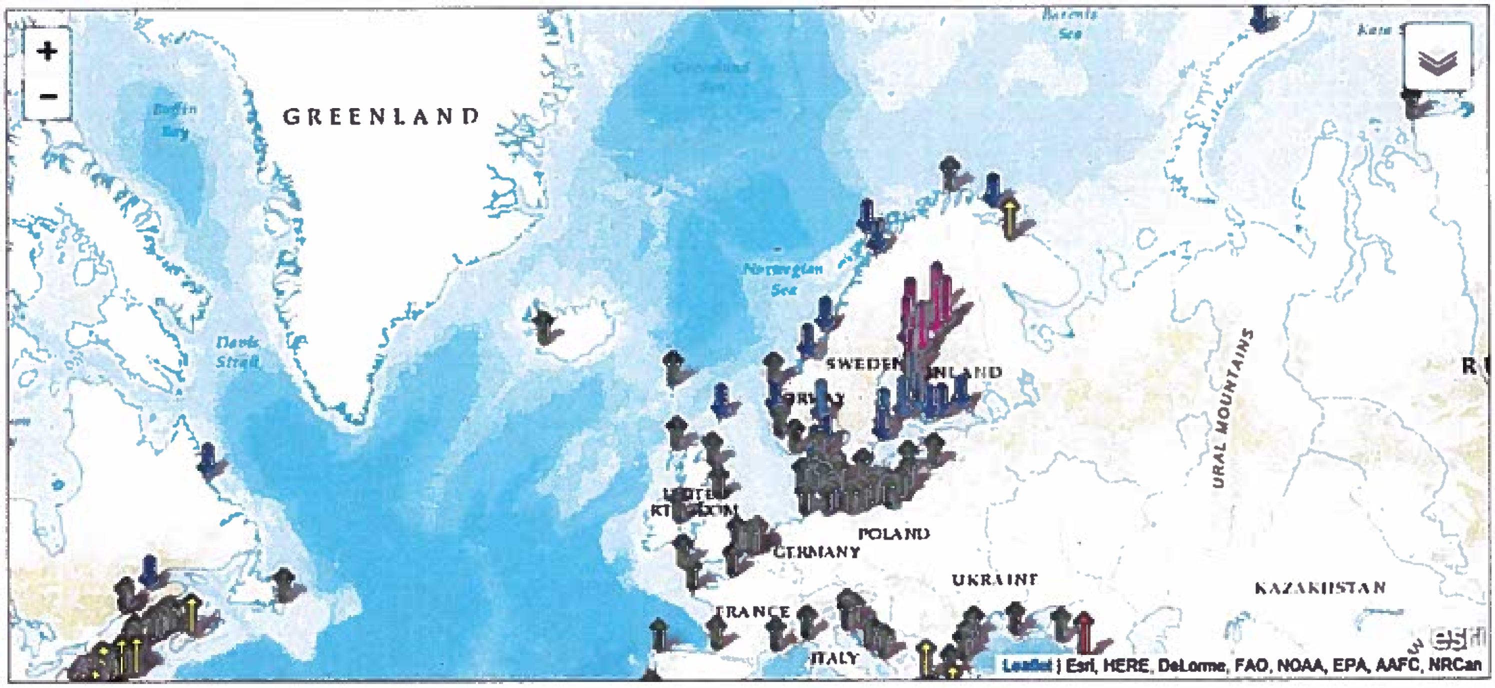
U.S. Trends Map (/sltrends/slrmap.htm)

U.S. Regional Trends

Mean Sea Level Trends
060-041 Pietarsaari/Jakobstad, Finland

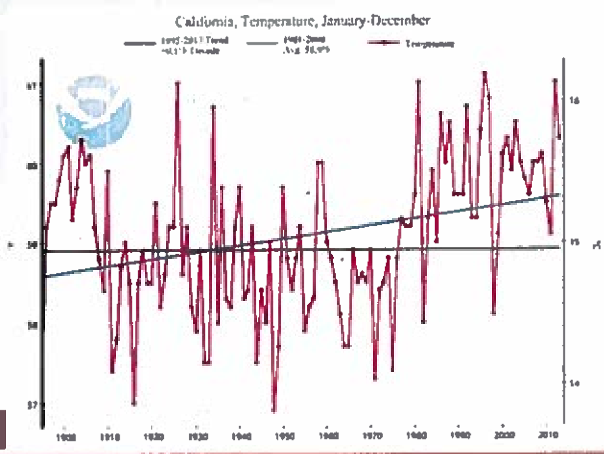



+
−
UNITED STATES
Bering Sea
Hudson Bay
Davis Strait
CANADA
ROCKY MOUNTAINS
UNITED STATES
Atlantic Ocean
esri
Leaflet | Esri, HERE, DeLorme, FAO, NOAA, EPA, NRCan, AAFC


GREENLAND
Baffin Bay
Davis Strait
Norwegian Sea
Barents Sea
SWEDEN
POLAND
GERMANY
UKRAINE
FRANCE
ITALY
KAZAKHSTAN
URAL MOUNTAINS
Leaflet | Esri, HERE, DeLorme, FAO, NOAA, EPA, AAFC, NRCan

Why Climate Change in CVFPP

- Future climate different from historical climate
  - Warmer temperatures
  - Increasing precipitation extremes
  - Sea level rise
- Flood planning, long-term planning for resiliency
- Policy and technical guidance on climate change



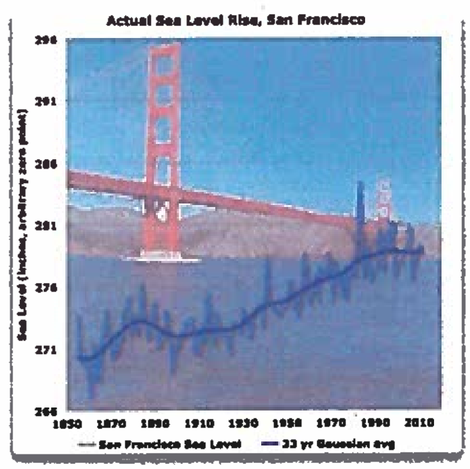
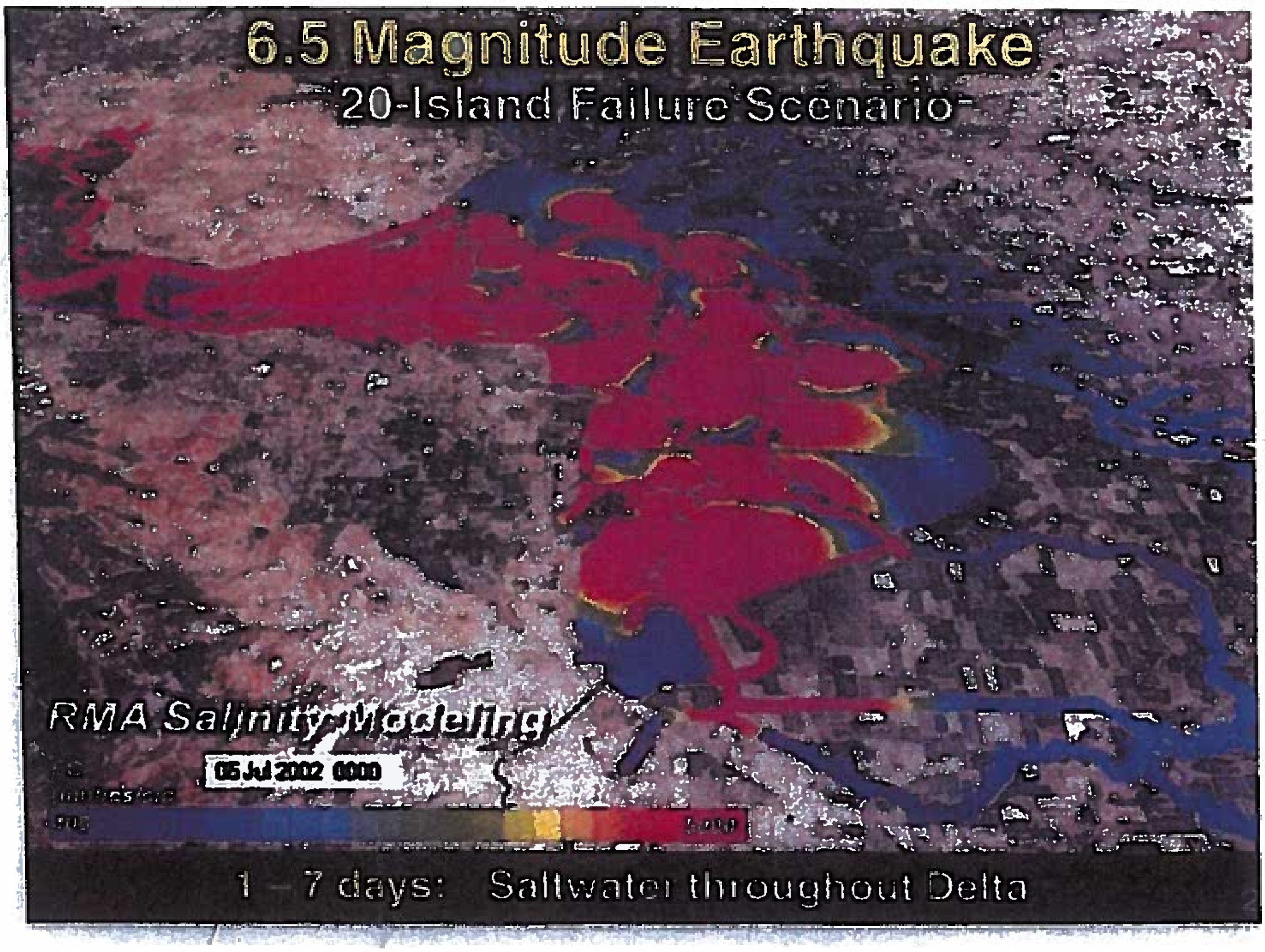
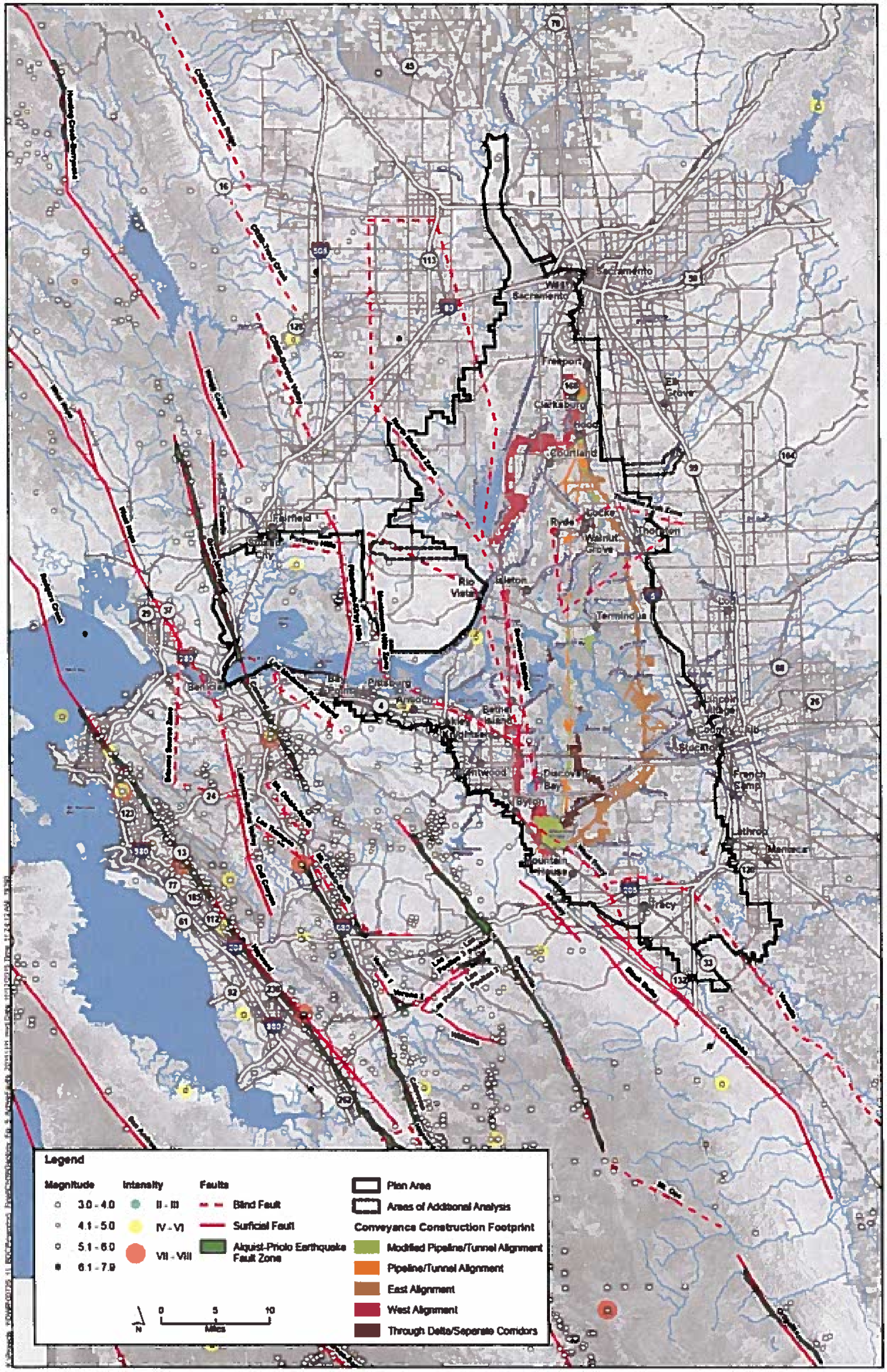


Figure 1 160 years of sea level observations in San Francisco, California. Source: PSMSL


6.5 Magnitude Earthquake
20-Island Failure Scenario
RMA Salinity Modeling
05 Jul 2002 0000
1 – 7 days: Saltwater throughout Delta



Sources: Plan Area, ICF 2012; Alquist-Priolo Earthquake Fault Zones (EFZ), California Geological Survey 2001; Faults, DRMS 2008; Seismicity/Magnitude, URS 2010; Constructability (Rev 5b), DHCCP DWR 2015; Constructability (Rev 10b), DHCCP DWR 2012; Constructability (Rev 1b), DHCCP DWR 2012

Figure 9-5
Active Faults and Historical Seismicity of the Bay and Delta Region, 1800–2010

EXTRACTS OF USACE MAY 23, 2007 COMMENTS

The assumption that the 23 large watershed's 100-year flows can be added together to produce the 100-year Delta flow is invalid.

The assumption that failures in a levee system will not significantly reduce stage elevations along channel is questionable.

Annual mean number for seismic levee failures is 3.41 .... 341 failures per 100 years which is 341 more than observed in the past 100+ years .... Surely, these numbers cannot be credible results.

The average of 7.35 flood failures per year is three times the (undocumented) 2.60 number and nearly 6 times the observed flood failure rate from 1950 to 2006. Thus, as with the seismic failure number above, this flood number simply appears way outside the bounds of credibility.

Return periods of 2.7 or 5 years for many levees just seem incorrect and incompatible with decades of recent data.

Overall, the seismic fragilities simply appear unrealistic - with far too many breaks to be credible.

Figure 6-40 implies that for a M 7.5 event this type of levee has a 10% chance of displacing 10 ft. at all PGAs > 0.10. This seems Really Extreme.

Conclusion that 40% of historical failures (2.6) are from through seepage results in over 1.0 per year is different than historical rate and needs to be explained.

At first glance, the calculated annual number of failures is, to be polite, "extraordinary" albeit not as extreme as the seismic results above.

The estimated 30 or more island breaches in the next 25 years due to flood events seem too high/pessimistic.

The BAU assumption that levee crest elevations will not be raised in response to increased tidal and flood elevations is not realistic.
1 ft easy, 3 ft maybe doable for 100 years of effort.



STATE WATER PROJECT:

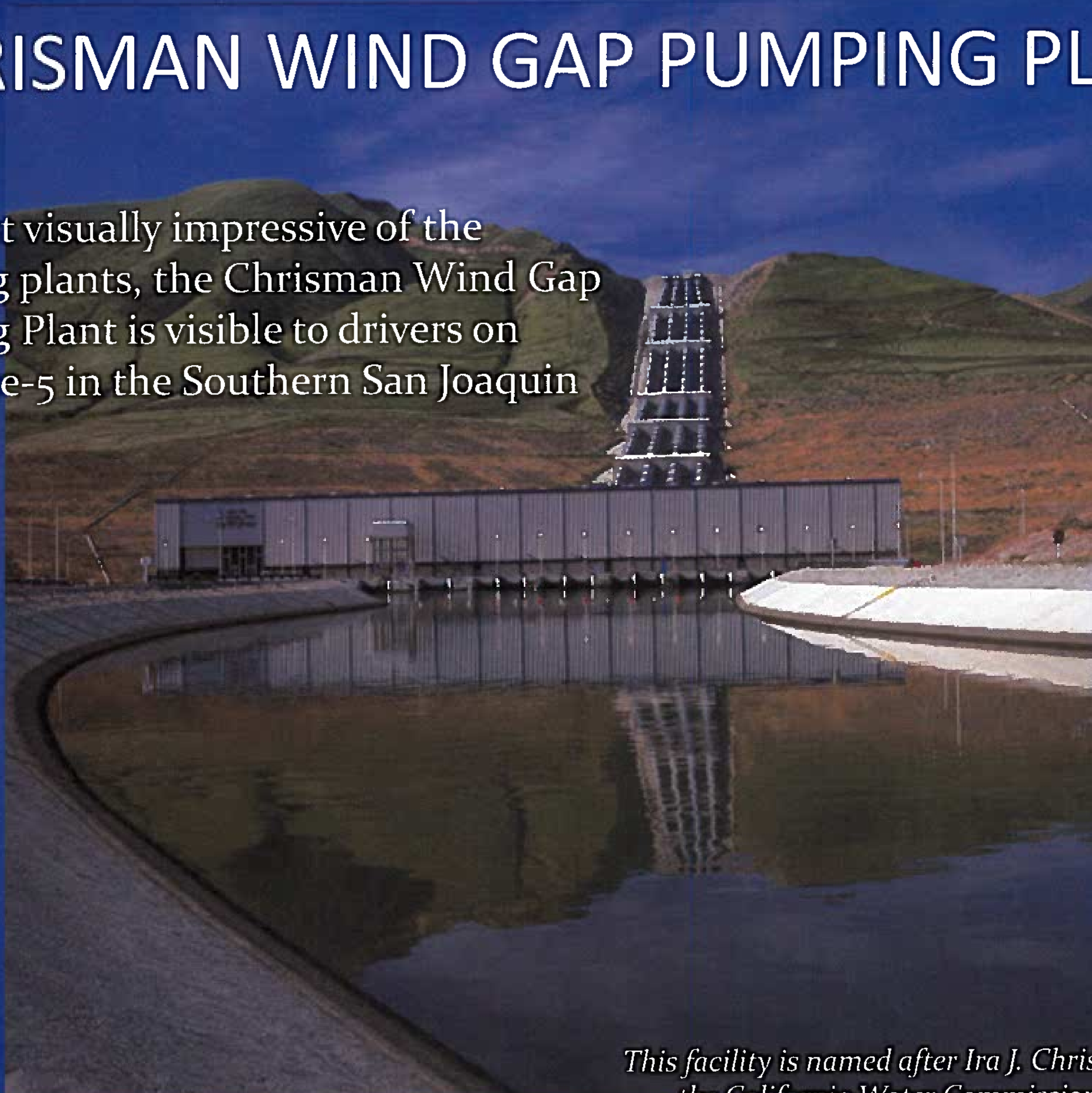
Connecting California's Water



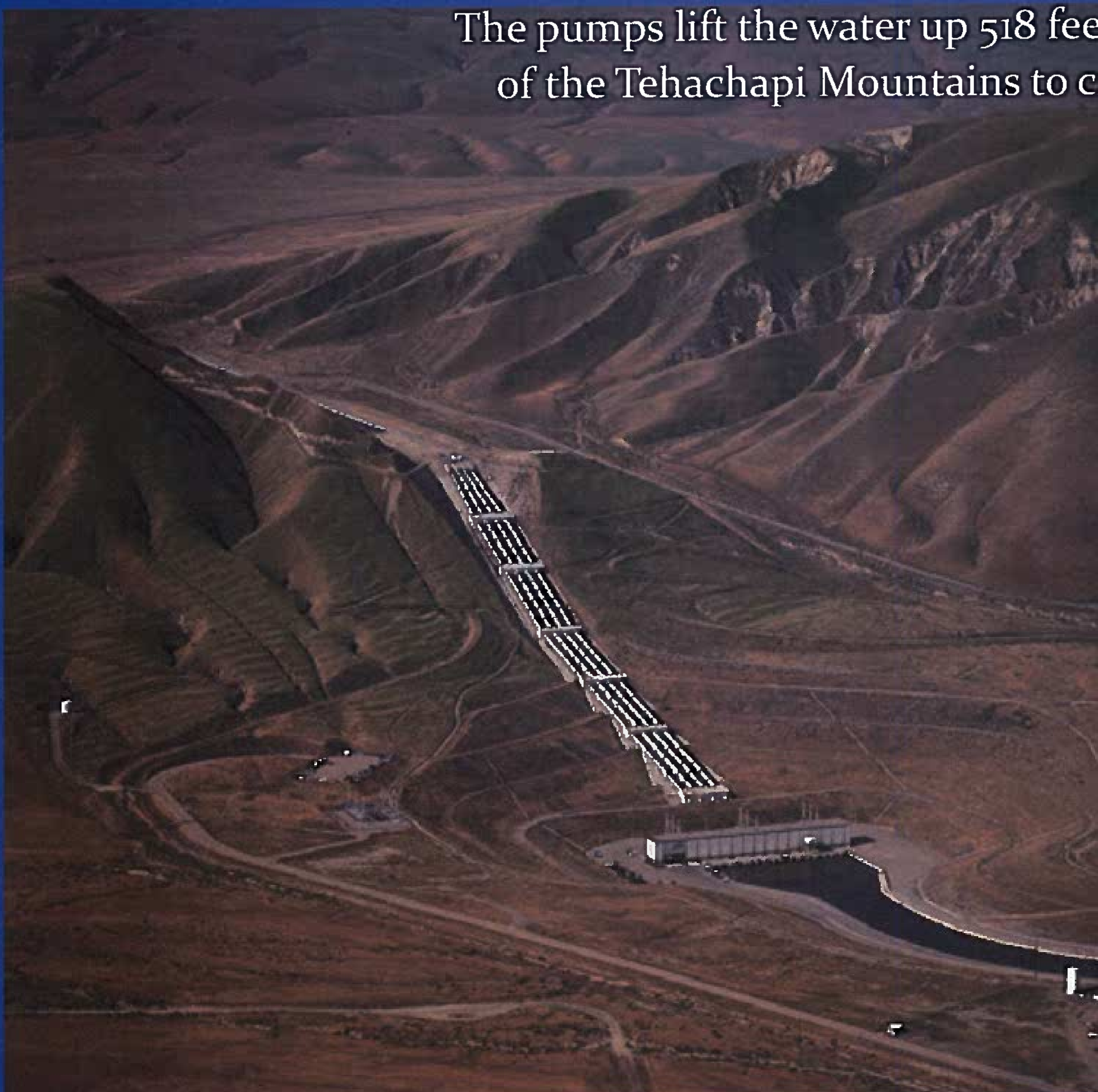
SDWA 306

CHRISMAN WIND GAP PUMPING PLANT

The most visually impressive of the pumping plants, the Chrisman Wind Gap Pumping Plant is visible to drivers on Interstate-5 in the Southern San Joaquin Valley.



This facility is named after Ira J. Chrisman, member of the California Water Commission from 1960-1976.



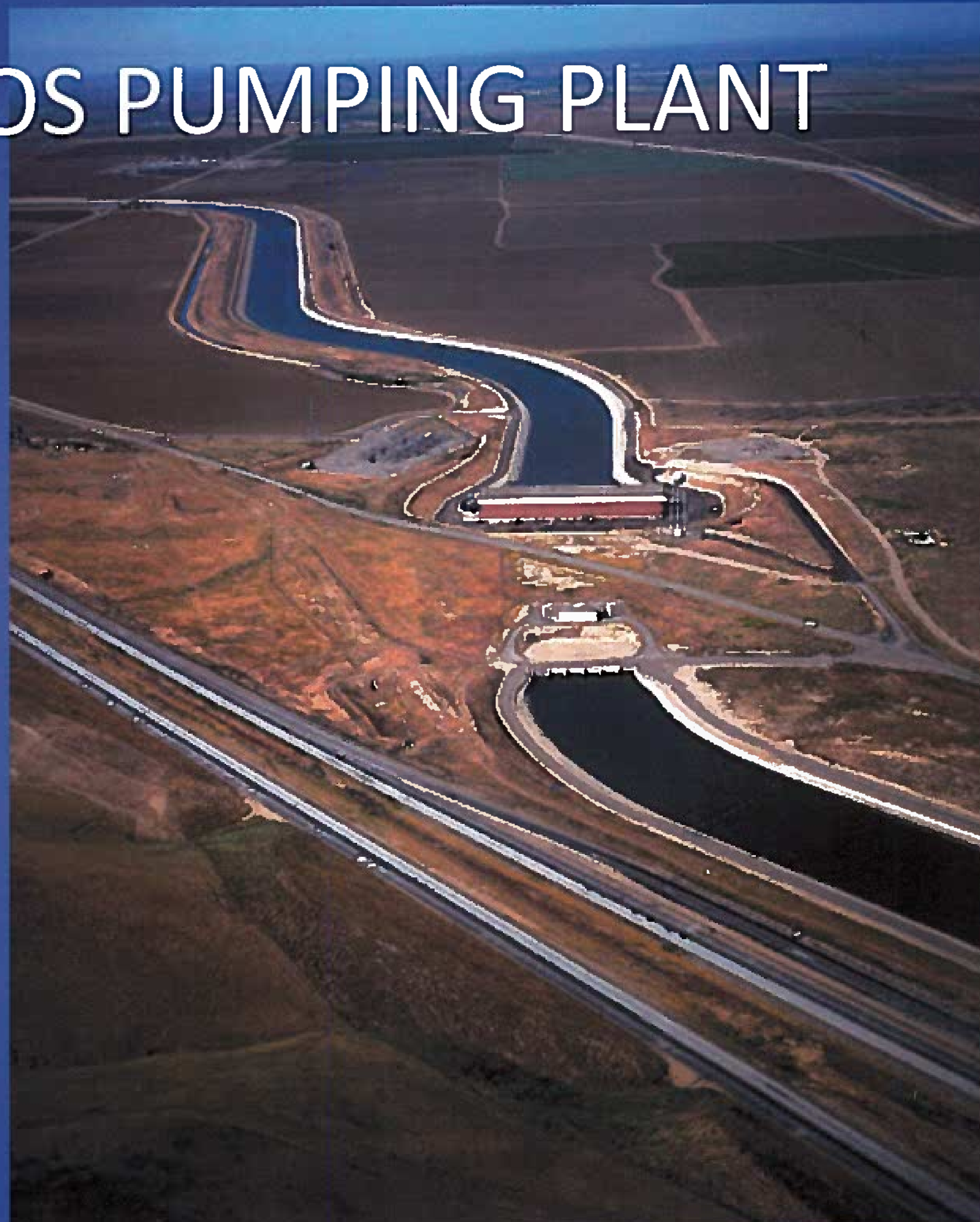
The pumps lift the water up 518 feet up into the foothills of the Tehachapi Mountains to cross the Tejon Ranch.

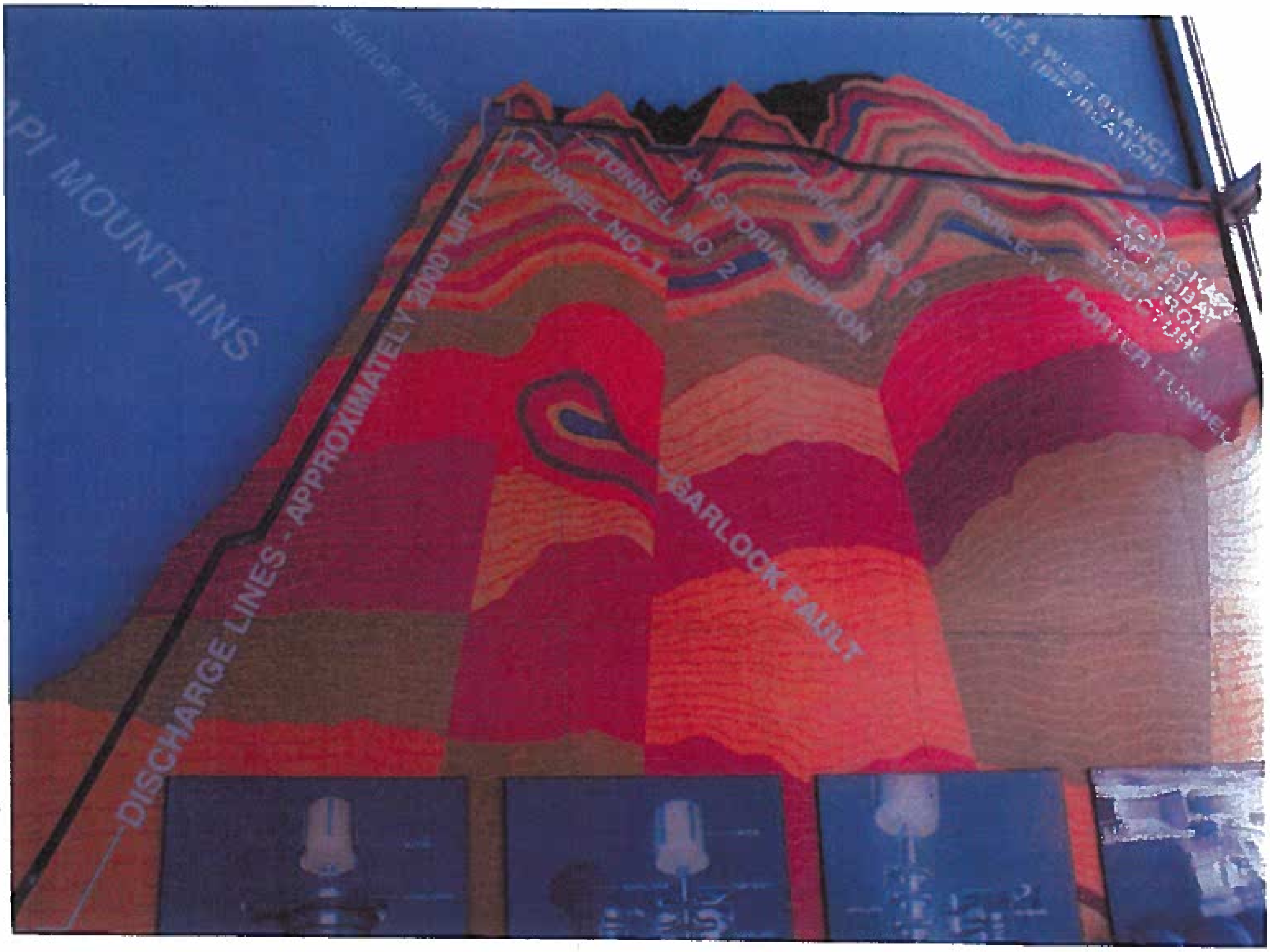
With 34 reservoirs and over 700 miles of aqueducts...

the State Water Project is the largest state-financed water project ever built.

DOS AMIGOS PUMPING PLANT

The water flows to the Dos Amigos Pumping Plant, which lifts the water 113 feet. Pumping plants are necessary along the length of the California Aqueduct to match the increased elevation as the aqueduct moves southward.





PI MOUNTAINS
SURGE TANK
DISCHARGE LINES - APPROXIMATELY 2000 LIFT
TUNNEL NO. 1
TUNNEL NO. 2
PASTORIA SIPHON
TUNNEL NO. 3
CARLEY V. PORTER TUNNEL
GARLOCK FAULT

Table 7-8 Comparison of Total Replacement Costs of Delta Infrastructure - Current and 2050[a]

Inundation Level	Current (2005)[c]	2050	Cost Ratio: 2050/Current
Within Mean Higher High Water (MHHW) Limits [b]	$6.7 billion	$8.5 billion [e]	1.3
Within 100-year Flood Limits [b,c]	$56.3 billion	$67.1 billion [e]	1.2

[a] Costs in this table are for infrastructure assets and their contents that could be damaged as a result of levee breaching and island flooding.
[b] See Section 4.1.2 and Figure 4-1 for limits of inundation.
[c] Flood plain limits were developed from FEMA Flood Insurance Rate Maps.
[d] Costs are in 2005 dollars.
[e] Costs are in 2005 dollars; not escalated to 2050.