

Appendix F – Entrainment and Impingement Estimates, Updated for Delta Plants (Steinbeck, January 2010)

Impingement Reported Values - Fish

Impingement Reported Values - Fish only						
Plant	Design Flow (mgd)	Average Flow (mgd) based on 2000-2005 data	Reported Total Impingement Estimates			
			Design Flow Total # Estimate	Design Flow Total Biomass (lb) Estimate	Actual Flow Total # Estimate	Actual Flow Total Biomass (lb) Estimate
Alamitos Generating Station Units 1&2	207	121	nc	nc	29,013	1,252
Alamitos Generating Station Units 3&4	392	281				
Alamitos Generating Station Units 5&6	674	413				
Contra Costa Power Plant Units 6&7 ¹	440	257	44,702	849	26,110	496
Diablo Canyon Power Plant	2,528	2,287	nc	nc	nc	nc
El Segundo Generating Station Units 1&2	207	69	nc	nc	186	63
El Segundo Generating Station Units 3&4	399	265	2,521	542	1,527	473
Encina Power Plant	857	621	289,562	12,878	215,583	9,609
Harbor Generating Station	108	59	19,861	6,478	8,851	2,903
Haynes Generating Station	968	258	56,613	1,227	53,442	1,168
Huntington Beach Generating Station	514	179	nc	nc	51,082	2,848
Mandalay Generating Station	253	234	30,347	1,308	8,979	199
Morro Bay Power Plant	668	257	nc	nc	78,139	2,957
Moss Landing Power Plant Units 1&2	361	193	75,133	804	57,554	600
Moss Landing Power Plant Units 6&7	865	387	135,699	2,297	118,778	2,033
Ormond Beach Generating Station	685	521	7,821	844	517	76
Pittsburg Power Plant Units 5 - 7 ²	506	274	26,360	390	14,274	211
Potrero Power Plant	231	193	146,098	3,035	108,727	2,446
Redondo Generating Station Units 5&6	217	51	263	71	133	60
Redondo Generating Station Units 7&8	675	254	2,910	1,315	1,101	388
San Onofre Nuclear Generating Station Unit 2	1,219	1,139	nc	nc	1,353,158	28,746
San Onofre Nuclear Generating Station Unit 3	1,219	1,154				
Scattergood Generating Station	495	309	108,843	11,619	95,241	9,422
South Bay Power Plant	601	417	385,588	1,226	nc	nc
Totals	15,289	10,191				

nc = not calculated in report

Impingement Estimated Values - Fish

Impingement Estimated Values - Fish only															
Plant	Design Flow (mgd)	Average Flow (mgd) based on 2000-2005 data	Average # fish per million gal	Average Biomass (lbs) per million gal	Annual Normal Operations Impingement				Heat Treatments (HT)			Total Estimated Impingement			
					Based on Count and Design Flow	Based on Biomass (lbs) and Design Flow	Based on Count and Average Flow	Based on Biomass (lbs) and Average Flow	Average # per HT	Average Biomass (lb) per HT	Average Number of HT per year (2000 - 2005)	Design Flow Total # Estimate	Design Flow Total Biomass (lb) Estimate	Average Flow Total # Estimate	Average Flow Total Biomass (lb) Estimate
Alamitos Generating Station Units 1&2	207	121							n/a	n/a	n/a				
Alamitos Generating Station Units 3&4	392	281	0.1750	0.0076	81,419	3,514	52,106	2,249	n/a	n/a	n/a	81,419	3,514	52,106	2,249
Alamitos Generating Station Units 5&6	674	413							n/a	n/a	n/a				
Contra Costa Power Plant Units 6&7	440	257	0.2782	0.0053	44,702	849	26,110	496	n/a	n/a	n/a	44,702	849	26,110	496
Diablo Canyon Power Plant	2,528	2,287	0.0058	0.0009	5,330	785	4,821	710	n/a	n/a	n/a	5,330	785	4,821	710
El Segundo Generating Station Units 1&2	207	69	0.0103	0.0035	779	265	260	89	227.25	72.18	1.3	1,074	359	556	182
El Segundo Generating Station Units 3&4	399	265	0.0220	0.0068	3,209	995	2,136	662	229.00	94.60	3.7	4,057	1,345	2,983	1,012
Encina Power Plant	857	621	0.6128	0.0256	191,824	8,016	138,932	5,806	15,831.83	747.70	6	286,815	12,502	233,923	10,292
Harbor Generating Station	108	59	0.4945	0.1622	19,508	6,399	10,666	3,498	n/a	n/a	n/a	19,508	6,399	10,666	3,498
Haynes Generating Station	968	258	0.1893	0.0041	66,901	1,462	17,838	390	n/a	n/a	n/a	66,901	1,462	17,838	390
Huntington Beach Generating Station	514	179	0.4079	0.0227	76,582	4,270	26,666	1,487	5,887.00	338.70	4.8	104,840	5,895	54,924	3,112
Mandalay Generating Station	253	234	0.7940	0.0299	73,497	2,771	67,733	2,553	101.90	4.20	1.4	73,640	2,776	67,876	2,559
Morro Bay Power Plant	668	257	0.3497	0.0140	85,315	3,419	32,763	1,313	n/a	n/a	n/a	85,315	3,419	32,763	1,313
Moss Landing Power Plant Units 1&2	361	193	0.5804	0.0058	76,526	762	40,816	406	n/a	n/a	n/a	76,526	762	40,816	406
Moss Landing Power Plant Units 6&7	865	387	1.7895	0.0287	565,390	9,071	253,067	4,060	n/a	n/a	n/a	565,390	9,071	253,067	4,060

Ormond Beach Generating Station	685	521	0.071	0.016	17,806	4,094	13,534	3,112	677.80	87.20	4.5	20,856	4,487	16,584	3,504
Pittsburg Power Plant Units 5-7	506	274	0.142	0.002	26,360	390	14,274	211	n/a	n/a	n/a	26,360	390	14,274	211
Potrero Power Plant	231	193	1.509	0.033	127,464	2,847	106,182	2,371	n/a	n/a	n/a	127,464	2,847	106,182	2,371
Redondo Generating Station Units 5&6	217	51	0.007	0.003	593	268	139	63	10.08	7.32	2	613	282	159	77
Redondo Generating Station Units 7&8	675	254	0.024	0.008	5,913	2,084	2,227	785	157.50	37.90	4.8	6,669	2,266	2,983	967
San Onofre Nuclear Generating Station Unit 2	1,219	1,139	1.578	0.033	1,405,342	29,854	1,322,490	28,094	2,494.00	627.80	7.5	1,424,047	34,563	1,341,195	32,802
San Onofre Nuclear Generating Station Unit 3	1,219	1,154	0.822	0.081	148,840	14,727	92,829	9,185	10,155.00	788.40	5.2	201,646	18,827	145,635	13,285
Scattergood Generating Station	495	309	1.592	0.004	349,490	1,082	242,401	751	n/a	n/a	n/a	349,490	1,082	242,401	751
South Bay Power Plant	601	417	1.592	0.004	349,490	1,082	242,401	751	n/a	n/a	n/a	349,490	1,082	242,401	751
Totals	15,289	10,191			3,301,730	96,685	2,427,607	67,584				3,572,664	113,883	2,667,863	84,250
n/a = not applicable															

Entrainment Estimates - Larval Fish

Entrainment - larval fish only

Plant	Design Flow (mgd)	Average Flow (mgd) based on 2000-2005 data	Average Larval Fish Concentration (# per million gallons)	Average Concentration and Design Flow Entrainment Estimate	Average Concentration and Average Flow (2000-2005) Entrainment Estimate	Study Result Entrainment Estimate (calculated for Design flow)	Study Result Entrainment Estimate (for Actual flow during study period)
Alamitos Generating Station Units 1&2	207	121	9,880.6	748,306,544	437,854,835	nc	121,970,937
Alamitos Generating Station Units 3&4	392	281	9,880.6	1,414,971,165	1,013,733,478	1,109,972,442	728,944,910
Alamitos Generating Station Units 5&6	674	413	9,972.2	2,455,020,121	1,503,394,233	nc	835,841,962
Contra Costa Power Plant Units 6&7 ¹	440	257	230.8	37,098,716	21,669,023	37,098,716	21,669,023
Diablo Canyon Power Plant	2,528	2,287	1,912.5	1,765,916,778	1,597,319,020	nc	1,481,948,383
El Segundo Generating Station Units 1&2	207	69	1,953.7	147,969,610	49,437,254	nc	35,743,328
El Segundo Generating Station Units 3&4	399	265	1,953.7	284,430,472	189,290,759	276,934,913	186,532,003
Encina Power Plant	857	621	13,950.2	4,366,667,796	3,162,648,118	4,494,849,115	3,627,641,744
Harbor Generating Station	108	59	3,961.9	156,285,731	85,447,634	153,331,013	65,298,000
Haynes Generating Station	968	258	12,305.3	4,349,235,947	1,159,662,085	4,527,644,084	3,649,208,392
Huntington Beach Generating Station	514	179	1,596.1	299,647,084	104,339,074	344,570,635	nc
Mandalay Generating Station	253	234	1,514.5	140,195,151	129,201,071	141,736,337	33,422,317
Morro Bay Power Plant	668	257	3,404.0	830,540,168	318,942,511	859,337,744	nc
Moss Landing Power Plant Units 1&2	361	193	4,429.9	584,101,411	311,537,103	522,319,740	nc
Moss Landing Power Plant Units 6&7	865	387	2,958.3	934,658,478	418,350,825	888,204,836	nc
Ormond Beach Generating Station	685	521	168.9	42,276,804	32,133,537	40,810,043	6,351,783
Pittsburg Power Plant Units-5-7 ²	506	274	377.0	69,678,481	37,731,035	69,678,481	37,731,035
Potrero Power Plant	231	193	3,593.3	303,519,077	252,843,159	289,731,811	nc
Redondo Generating Station Units 5&6	217	51	4,485.6	354,702,404	83,037,227	356,000,276	101,659,379
Redondo Generating Station Units 7&8	675	254	3,133.5	772,198,644	290,801,357	744,808,585	189,537,344
San Onofre Nuclear Generating Station Unit 2	1,219	1,139	7,439.6	3,311,307,168	3,095,251,683	nc	3,555,787,272
San Onofre Nuclear Generating Station Unit 3	1,219	1,154	7,439.6	3,311,307,168	3,136,923,690	nc	3,261,783,562
Scattergood Generating Station	495	309	2,796.9	506,083,227	315,634,578	524,202,652	365,258,133
South Bay Power Plant	601	417	10,951.6	2,404,046,574	1,667,406,878	2,420,527,779	nc
Totals	15,289	10,191		29,590,164,718	19,414,590,166		
Average			5,012.1				

nc = not calculated

¹ Calculated and reported estimates for Contra Costa based on sampling from March - July 2008 using 1,600 micron mesh. No annual estimates reported.

² Calculated and reported estimates for Pittsburg based on sampling from March - July 2008 using 1,600 micron mesh. No annual estimates reported.

IM&E Sources and notes

Revised January, 2010

Plant	Entrainment collection period & frequency / Reference	Impingement collection period & frequency / Reference
Alamitos Generating Station Units 1&2	Jan-Dec 2006, bi-weekly / MBC and Tenera 2008a	Jan 2006 - Dec 2006; weekly / MBC and Tenera 2008a
Alamitos Generating Station Units 3&4	Jan-Dec 2006, bi-weekly / MBC and Tenera 2008a	Jan 2006 - Dec 2006; weekly / MBC and Tenera 2008a
Alamitos Generating Station Units 5&6	Jan-Dec 2006, bi-weekly / MBC and Tenera 2008a	Jan 2006 - Dec 2006; weekly / MBC and Tenera 2008a
Contra Costa Power Plant	March 2008 - Jun 2008, ca. bi-weekly / Mirant Delta LLC 2009	Nov 2007 - Oct 2008; monthly sampling / Mirant Delta LLC 2009
Diablo Canyon Power Plant	Oct 1996 - Jun 1999, weekly / estimates from Oct 96-Oct 98 Tenera 2000a	Feb 1985 - Mar 1986; weekly sampling / Tenera 1988
El Segundo Generating Station Units 1&2	Jan-Dec 2006, monthly / Tenera and MBC 2008	Jan 2006 - Dec 2006; monthly / Tenera and MBC 2008
El Segundo Generating Station Units 3&4	Jan-Dec 2006, monthly / Tenera and MBC 2008	Jan 2006 - Dec 2006; monthly / Tenera and MBC 2008
Encina Power Plant	Jun 2004 - May 2005, monthly / Tenera 2008	Jun 2004 - Jun 2005; weekly / Tenera 2008
Harbor Generating Station	Jan-Dec 2006, bi-weekly / MBC, Tenera, and URS 2008b	Jan 2006 - Dec 2006; weekly / MBC, Tenera, and URS 2008b
Haynes Generating Station	Jan-Dec 2006, bi-weekly / MBC, Tenera, and URS 2008a	Jan 2006 - Dec 2006; weekly / MBC, Tenera, and URS 2008a
Huntington Beach Generating Station	Sep 2003 - Aug 2004, weekly / MBC and Tenera 2005	Jul 2003 - Jul 2004; weekly / MBC and Tenera 2005
Mandalay Generating Station	Feb 2006 - Feb 2007; biweekly / ENSR Corp. 2008a	Feb 2006 - Feb 2007; biweekly / rates and totals from ENSR Corp. 2008a; average rates and HT data from NPDES data supplied by MBC
Morro Bay Power Plant	Jan 2000 - Dec 2000, weekly / Tenera 2001	Sep 1999 - Sep 2000; weekly / Tenera 2001
Moss Landing Power Plant Units 1&2	Mar 1999 - Feb 2000, weekly / Tenera 2000b	Nov 2005 - Nov 2006; weekly / Tenera 2007b
Moss Landing Power Plant Units 6&7	Mar 1999 - Feb 2000, weekly / Tenera 2000b	Nov 2005 - Nov 2006; weekly / Tenera 2007b
Ormond Beach Generating Station	Feb 2006 - Feb 2007; biweekly / ENSR Corp. 2008b	Feb 2006 - Feb 2007; biweekly / rates and totals from ENSR Corp. 2008b; average rates and HT data from NPDES data supplied by MBC
Pittsburg Power Plant Units 5&6	March 2008 - Jun 2008, ca. bi-weekly / Mirant Delta LLC 2009	Nov 2007 - Oct 2008; monthly sampling / Mirant Delta LLC 2009
Potrero Power Plant	Jan 2001 - Feb 2002, weekly (Dec-Mar) or monthly (Apr-Nov) / Tenera 2007a	May 2006 - May 2007; weekly / Tenera 2007a
Redondo Generating Station Units 5&6	Jan 2006 - Jan 2007, monthly / MBC and Tenera 2008b	Jan 2006 - Jan 2007; weekly / MBC and Tenera 2008b
Redondo Generating Station Units 7&8	Jan 2006 - Jan 2007, bi-weekly / MBC and Tenera 2008b	Jan 2006 - Jan 2007; weekly / MBC and Tenera 2008b
San Onofre Nuclear Generating Station Unit 2	Mar 2006 - Apr 2007; biweekly in plant, monthly offshore / MBC 2008	Mar 2006 - May 2007; biweekly / MBC 2008
San Onofre Nuclear Generating Station Unit 3	Mar 2006 - Apr 2007; biweekly in plant, monthly offshore / MBC 2008	Mar 2006 - May 2007; biweekly / MBC 2008
Scattergood Generating Station	Jan 2006 - Jan 2007, bi-weekly / MBC, Tenera, and URS 2008c	Jan 2006 - Jan 2007; weekly / MBC, Tenera, and URS 2008c
South Bay Power Plant	Feb 2001 - Jan 2002, monthly / Tenera 2004	Dec 2002 - Nov 2003; weekly / Tenera 2004