

## **APPENDIX 4**

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### Revised Boat Use and Emission Calculations

Alternative 6 Summary	
BAOT	10262
Boat Trips/year	296813
Launches/year	70796
Piers	998
Ramps	43
Bouys	6316
Slips	2929

1041

\* BAOT = Boats on water at one time

**ESTIMATES OF NUMBER OF BOATS AT ONE TIME ON LAKE TAHOE NOT INCLUDING CONCESSIONAIRE**

Numbers for each alternative at buildout or full implementation (4-13-04 and 6-20-05)

**Alternative 1**

Structure Type	Private # boats	Quasi # boats	Public # boats	Total # of Structures	Total # boats
Piers	727 727	67	45	839	907
Buoys	2584 2584	1751 1751	1516 1516	5851	5851
Ramps	88 88	19	21	128	88
Floating Docks	143 0	24 0	7 0	174	0
Slips	306 306	1610 1610	1228 1228	3144	3144
				<b>TOTAL</b>	<b>9990</b>

Assume that boats in Quasi and Public facilities are in a slip or boathouse or buoy  
 Assume 1 boat per private pier plus 182 from boathouses (BH). Proportional increase in number of boathouses versus structures.  
 Currently 164 boathouses and 261 boat lifts, per David Atkins, TRPA. Assume proportional increase with 13 new piers for this Alternative  
 Assume 1 boat per buoy  
 Quasi and Public Ramps are Separate Calculation. The total number of boats is based on the Boat Launching Numbers in the 1994 Boat Launching Survey in Figure 2-5 in the 1997 EA. The l  
 Boats using floating docks would come from a facility that is already accounted for.  
 1 boat per slip, regardless of the type of facility.

**Alternative 2**

Structure Type	Private # boats	Quasi # boats	Public # boats	Total # of Structures	Total # boats
Piers	1067 1067	86	43	1196	1323
Buoys	3193 3193	3426 3426	1516 1516	8135	8135
Ramps	16 16	26	30	72	16
Floating Docks	10 10	63	10	83	0
Slips	306 306	1610 1610	1228 1228	3144	3144
				<b>TOTAL</b>	<b>12618</b>

% BH = 0.213542 179.546  
 255.944  
 Assume that boathouses increase in the same proportion as the piers.  
 Assume 1 boat per buoy  
 Quasi and Public Ramps are Separate Calculation  
 Boats using floating docks would come from a facility that is already accounted for.  
 Assume 1 boat per slip

**Alternative 3**

Structure Type	Private # boats	Quasi # boats	Public # boats	Total # of Structures	Total # boats
Piers	1249 1249	88	62	1399	1548
Buoys	3460 3460	3761 3761	3266 3266	10487	10487
Ramps	628 628	46	32	706	628
Floating Docks	1172 1172	72	12	1256	0
Slips	306 306	1610 1610	1228 1228	3144	3144
				<b>TOTAL</b>	<b>15807</b>

299.386  
 Assume that boathouses increase in the same proportion as the piers.  
 Assume 1 boat per buoy  
 Quasi and Public Ramps are Separate Calculation  
 Boats using floating docks would come from a facility that is already accounted for.  
 Assume 1 boat per slip

**Alternative 4**

Structure Type	Private # boats	Quasi # boats	Public # boats	Total # of Structures	Total # boats
Piers	673 673	55	60	788	842
Buoys	2453 2453	995 995	3094 3094	6542	6542
Ramps	16 16	3	31	50	16
Floating Docks	10 10	2	10	22	0
Slips	306 306	1490 1490	1228 1228	3024	3024
				<b>TOTAL</b>	<b>10424</b>

168.632  
 Assume that boathouses increase in the same proportion as the piers.  
 Assume 1 boat per buoy  
 Quasi and Public Ramps are Separate Calculation  
 Boats using floating docks would come from a facility that is already accounted for.  
 Assume 1 boat per slip

**Alternative 5**

Structure Type	Private # boats	Quasi # boats	Public # boats	Total # of Structures	Total # boats
Piers	636 636	52	44	732	800
Buoys	2228 2228	945 945	1134 1134	4307	4307
Ramps	14 14	3	20	37	14
Floating Docks	9 9	2	7	18	0
Slips	211 211	1490 1490	1044 1044	2745	2745
				<b>TOTAL</b>	<b>7866</b>

No increase in Piers, therefore no increase in boathouses

**Alternative 6**

Structure Type	Private # boats	Quasi # boats	Public # boats	Total # of Structures	Total # boats
Piers	947 947	0	51	998	998
Buoys	5126 5126	0 0	1190 1190	6316	6316
Ramps	19 19	0	24	43	19
Floating Docks	11 11	0	9	20	0
Slips	1746 1746	0 0	1183 1183	2929	2929
				<b>TOTAL</b>	<b>10262</b>

Assumes no new boathouses under this alternative  
 Assume 1 boat per buoy  
 Public Ramps are Separate Calculation  
 Boats using floating docks would come from a facility that is already accounted for.  
 Assume 1 boat per slip

Source: Chapter 2, Draft EIS

**Existing - 2004**

Structure Type	Private # boats	Quasi # boats	Public # boats	Total # of Structures	Total # boats
Piers	673 673	55	40	768	837
Buoys	2453 2453	995 995	1031 1031	4479	4479
Ramps	16 16	3	18	37	16
Floating Docks	10 10	2	6	18	0
Slips	306 306	1490 1490	949 949	2745	2745
				<b>TOTAL</b>	<b>8077</b>

launch numbers vary by type of day (peak, weekend, weekday). Therefore, the total number must be calculated separately and then added during Step 3

**\*CALCULATIONS TO OBTAIN NUMBER OF BOATS LAUNCHED AND IN-USE ON A DAILY BASIS FROM QUASI AND PUBLIC RAMPS**

**\*Launchings Per Ramp - Data from the 1997 EA (1994 TRPA Boat Launching Survey)**

Existing	Peak	Weekend	Week day	
<b>Marinas</b>				
Lakeside	45	15	8	
Tahoe Keys	108	50	20	
Tahoe Boat Co.	20	6	1	
Meeks Bay	50	25	20	
Obexer's	80	60	30	
Homewood	70	45	25	
Sunnyside	25	10	5	
Sierra Boat Co.	15	4	2	
North Tahoe	25	12	8	
Zephyr Cove	70	45	25	Used same #'s as Homewood
Timber Cove	25	10	5	Used same #'s as Sunnyside
<b>Ramps</b>				
Lake Forest	65	50	25	
Kings Beach	50	25	17	
Incline Village	65	50	30	
Sand Harbor	93	80	17	
Cave Rock	90	56	22	
El Dorado Beach	80	50	20	
Anchorage	65	50	25	Used same #'s as Lake Forest
National Ave Boat Ramp	15	4	2	Used same #'s as Sierra Boat Co.
Round Hill	25	10	5	Used same #'s as Sunnyside
Ski Run	25	10	5	Used same #'s as Sunnyside
<b>Alternative 1 = 19 New Quasi/Public Ramps</b>				
4X very small (Sierra)	60	16	8	
4X small (Sunnyside)	100	40	20	
4X med (Meeks Bay)	200	100	80	1106
4X large (El Dorado)	320	200	80	
3X very large (Sand Harb)	279	240	51	
<b>TOTAL</b>	<b>2065</b>	<b>1263</b>	<b>556</b>	
<b>Alternative 2 = 35 New Quasi/Public Ramps</b>				
Existing	1106	667	317	
7X very small (Sierra)	105	28	14	
7X small (Sunnyside)	175	70	35	
7X med (Meeks Bay)	350	175	140	
7X large (El Dorado)	560	350	140	
7X very large (Sand Harb)	651	560	119	
<b>TOTAL</b>	<b>2947</b>	<b>1850</b>	<b>765</b>	
<b>Alternative 3 = 57 New Quasi/Public Ramps</b>				
Existing	1106	667	317	
11X very small (Sierra)	165	44	22	
12X small (Sunnyside)	300	120	60	
12X med (Meeks Bay)	600	300	240	
11X large (El Dorado)	880	550	220	
11X very large (Sand Harb)	1023	880	187	
<b>TOTAL</b>	<b>4074</b>	<b>2561</b>	<b>1046</b>	
<b>Alternative 4 = 13 New Quasi/Public Ramps</b>				
Existing	1106	667	317	
2X very small (Sierra)	30	8	4	
3X small (Sunnyside)	75	30	15	
3X med (Meeks Bay)	150	75	60	
3X large (El Dorado)	240	150	60	
2X very large (Sand harb)	186	160	34	
<b>TOTAL</b>	<b>1787</b>	<b>1090</b>	<b>490</b>	
<b>Alternative 5 = 0 New Quasi/Public Ramps</b>				
Existing	1106	667	317	
<b>TOTAL</b>	<b>1106</b>	<b>667</b>	<b>317</b>	
<b>Alternative 6 = 6 New Public Ramps</b>				
Existing	1106	667	317	
1X very small (Sierra)	15	4	2	
1X small (Sunnyside)	25	10	5	
1X med (Meeks Bay)	50	25	20	
2X large (El Dorado)	160	100	40	
1X very large (Sand harb)	93	80	17	
<b>TOTAL</b>	<b>1449</b>	<b>886</b>	<b>401</b>	

Lowest  
Small  
Sunnyside

**1998 Survey Data - Number of Rentals During Summer Boating Season**

Data from Hagler-Bailly Report, 1999

Assume same numbers of PWC, but they are now 2-stroke FI or 4-stroke

<b>Type of Watercraft</b>	<b># boats available</b>	<b>Total # rentals</b>	<b>Total Rental Hours</b>	<b>Total Gallons of Fuel Used</b>
Personal Watercraft	144	26941		

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<b>ALT 1 TOTAL FOR SEASON</b>	<b>29280</b>	~9% of total boat trips for Alternative 1
<b>ALT 2 TOTAL FOR SEASON</b>	<b>32591</b>	~9% of total boat trips for Alternative 2
<b>ALT 3 TOTAL FOR SEASON</b>	<b>49918</b>	~9% of total boat trips for Alternative 3
<b>ALT 4 TOTAL FOR SEASON</b>	<b>28853</b>	~9% of total boat trips for Alternative 4
<b>ALT 5 TOTAL FOR SEASON</b>	<b>20702</b>	~9% of total boat trips for Alternative 5
<b>ALT 6 TOTAL FOR SEASON</b>	<b>26983</b>	~9% of total boat trips for Alternative 6

According to JD Franz Survey, about 9% of those surveyed were using a PWC.

**ESTIMATION OF TOTAL FUEL USE PER WATERCRAFT AND ENGINE TYPE**

**BASELINE**

**Private Watercraft**

Watercraft	Engine	Fuel		Number of		Total	Total Fuel Use		% Trips
		gal/hour*	hours/trip	boat trips*	hours		gallons		
Inboard	G2 FI	1.6	4	11822	47288	47288	75661	5.1%	
Outboard	G2 FI	1.6	4	5489	21956	21956	35130	2.4%	
Inboard/Outboard	G2 FI	1.6	4	1013	4052	4052	6483	0.4%	
Jet	G2 FI	1.6	3	7093	21279	21279	34046	3.1%	
Inboard	G4 FI	3.1	4	45808	183232	183232	568019	19.7%	
Outboard	G4 FI	1.6	4	9711	38844	38844	62150	4.2%	
Inboard/Outboard	G4 FI	3.8	4	62823	251292	251292	954910	27.1%	
Jet	G4 FI	3.1	3	4560	13680	13680	42408	2.0%	
Inboard	G4	3.1	4	15516	62064	62064	192398	6.7%	
Outboard	G4	1.6	2	5911	11822	11822	18915	2.5%	
Inboard/Outboard	G4	3.8	4	37491	149964	149964	569863	16.2%	
Jet	G4	3.1	3	1013	3039	3039	9421	0.4%	
Auxiliary Sail	G4	1.0	2		0	0	0	0.0%	
PWC	G4/G2FI	1.1	3	20878	62634	62634	68897	9.0%	
Inboard Diesel	D	1.2	2	739	1478	1478	1774	0.3%	
Auxiliary Sail	D	1.0	1	2111	2111	2111	2111	0.9%	
				231978			2642187	100.0%	

\*Source of fuel consumption in gal/hour from TRPA Boating Assumptions S

\*Proportions from JD Franzz 2002

Assume fuel consumption for the numbers in red are same as similar engine type

0.089999914

**Proportion of Motor Types For 5 Alternatives. Percents are from 2002 JD Franzz Boating Survey**

Type of Motor	Percent	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Inboard	35	96879	149720	214366	142939	73885	94441
Outboard	10	27680	42777	61247	40840	21110	26983
Inboard/Outboard	48	132863	205330	293988	196031	101328	129518
Jet	6	16608	25666	36748	24504	12666	16190
Auxiliary Sail Diesel	1	2768	4278	6125	4084	2111	2698
	100	276797	427771	612474	408398	211099	269830

**Proportion of Engine Types for Inboard Motors For 5 Alternatives (JD Franzz Survey 2002)**

Inboard	Percent*	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
2-Stroke FI	16	15501	23955	34299	22870	11822	15110
4-Stroke FI	62	60065	92826	132907	88622	45808	58553
4-Stroke Carb	21	20345	31441	45017	30017	15516	19833
Diesel	1	969	1497	2144	1429	739	944
	100	96879	149720	214366	142939	73885	94441

\*Other/Don't Know %: 1% allotted to Diesel and remainder proportionally distributed to other categories

**Proportion of Engine Types for Outboard Motors For 5 Alternatives (JD Franz Survey 2002)**

<b>Outboard</b>	<b>Percent*</b>	<b>Alt 1</b>	<b>Alt 2</b>	<b>Alt 3</b>	<b>Alt 4</b>	<b>Alt 5</b>	<b>Alt 6</b>
2-Stroke FI	26	7197	11122	15924	10618	5489	7016
4-Stroke FI	46	12733	19677	28174	18786	9711	12412
4-Stroke Carb	28	7750	11978	17149	11435	5911	7555
	100	27680	42777	61247	40840	21110	26983

**Proportion of Engine Types for Inboard/Outboard Motors For 5 Alternatives (JD Franz Survey 2002)**

<b>Inboard/Outboard</b>	<b>Percent*</b>	<b>Alt 1</b>	<b>Alt 2</b>	<b>Alt 3</b>	<b>Alt 4</b>	<b>Alt 5</b>	<b>Alt 6</b>
2-Stroke FI	1	1329	2053	2940	1960	1013	1295
4-Stroke FI	62	82375	127305	182272	121539	62823	80301
4-Stroke Carb	37	49159	75972	108775	72531	37491	47922
	100	132863	205330	293988	196031	101328	129518

**Proportion of Engine Types for Jet Motors For 5 Alternatives (JD Franz Survey 2002)**

<b>Jet</b>	<b>Percent*</b>	<b>Alt 1</b>	<b>Alt 2</b>	<b>Alt 3</b>	<b>Alt 4</b>	<b>Alt 5</b>	<b>Alt 6</b>
2-Stroke FI	56	9300	14373	20579	13722	7093	9066
4-Stroke FI	36	5979	9240	13229	8821	4560	5828
4-Stroke Carb	8	1329	2053	2940	1960	1013	1295
	100	16608	25666	36748	24504	12666	16190

**ESTIMATION OF TOTAL FUEL USE PER WATERCRAFT AND ENGINE TYPE**

**2014 10-Year Projection (15% Increase)**

**Private Watercraft**

<b>Watercraft</b>	<b>Engine</b>	<b>Fuel gal/hour*</b>	<b>hours/trip</b>	<b>Number of boat trips*</b>	<b>Total hours</b>	<b>Total Fuel Use gallons</b>	<b>% Trips</b>	<b># Trips 15% Increase</b>
Inboard	G2 FI	1.6	4	13595	54381	87010	5.1%	13595.3
Outboard	G2 FI	1.6	4	6312	25249	40399	2.4%	6312.35
Inboard/Outboard	G2 FI	1.6	4	1165	4660	7456	0.4%	1164.95
Jet	G2 FI	1.6	3	8157	24471	39153	3.1%	8156.95
Inboard	G4 FI	3.1	4	52679	210717	653222	19.7%	52679.2
Outboard	G4 FI	1.6	4	11168	44671	71473	4.2%	11167.65
Inboard/Outboard	G4 FI	3.8	4	72246	288986	1098146	27.1%	72246.45
Jet	G4 FI	3.1	3	5244	15732	48769	2.0%	5244
Inboard	G4	3.1	4	17843	71374	221258	6.7%	17843.4
Outboard	G4	1.6	2	6798	13595	21752	2.5%	6797.65
Inboard/Outboard	G4	3.8	4	43115	172459	655343	16.2%	43114.65
Jet	G4	3.1	3	1165	3495	10834	0.4%	1164.95
Auxiliary Sail	G4	1.0	2	0	0	0	0.0%	0
PWC	G4/G2FI	1.1	3	24010	72029	79232	9.0%	24009.7
Inboard Diesel	D	1.2	2	850	1700	2040	0.3%	849.85
Auxiliary Sail	D	1.0	1	2428	2428	2428	0.9%	2427.65
*Source of fuel consumption in gal/hour from TRPA Boating Assumption:				266775		3038515	100.0%	

\*Proportions from JD Fransz 2002

Assume fuel consumption for the numbers in red are same as similar engine type

**ESTIMATION OF TOTAL FUEL USE PER WATERCRAFT AND ENGINE TYPE**

**2024 10-Year Projection (30% Increase)**

Private Watercraft								# Trips
Watercraft	Engine	Fuel gal/hour*	hours/trip	Number of boat trips*	Total hours	Total Fuel Use gallons	% Trips	30% Increase
Inboard	G2 FI	1.6	4	17674	70696	113113	5.1%	17674
Outboard	G2 FI	1.6	4	8206	32824	52519	2.4%	8206
Inboard/Outboard	G2 FI	1.6	4	1514	6058	9692	0.4%	1514
Jet	G2 FI	1.6	3	10604	31812	50899	3.1%	10604
Inboard	G4 FI	3.1	4	68483	273932	849189	19.7%	68483
Outboard	G4 FI	1.6	4	14518	58072	92915	4.2%	14518
Inboard/Outboard	G4 FI	3.8	4	93920	375682	1427590	27.1%	93920
Jet	G4 FI	3.1	3	6817	20452	63400	2.0%	6817
Inboard	G4	3.1	4	23196	92786	287636	6.7%	23196
Outboard	G4	1.6	2	8837	17674	28278	2.5%	8837
Inboard/Outboard	G4	3.8	4	56049	224196	851945	16.2%	56049
Jet	G4	3.1	3	1514	4543	14084	0.4%	1514
Auxiliary Sail	G4	1.0	2	0	0	0	0.0%	0
PWC	G4/G2FI	1.1	3	31213	93638	103002	9.0%	31213
Inboard Diesel	D	1.2	2	1105	2210	2652	0.3%	1105
Auxiliary Sail	D	1.0	1	3156	3156	3156	0.9%	3156
*Source of fuel consumption in gal/hour from TRPA Boating Assumption:				346807		3950069	100.0%	

\*Proportions from JD Franz 2002

Assume fuel consumption for the numbers in red are same as similar engine type

ESTIMATION OF TOTAL FUEL USE PER WATERCRAFT AND ENGINE TYPE

BASELINE Private Watercraft								BASELINE EMISSIONS CALCULATIONS (grams to pounds to tons)						
Watercraft	Engine	Fuel		Number of		Total Fuel Use		% Trips	HC's		NOx		PAH	
		gal/hour*	hours/trip	boat trips*	hours	gallons	grams		EF	EF	EF	EF		
Inboard	G2 FI	1.6	4	11822	47286	75658		5.1%	14280425	3.02 g/hp-hr	40098677	8.48	55372	1.171 g/hour
Outboard	G2 FI	1.6	4	5489	21954	35127		2.4%	20472381	18.65 g/hp-hr	9007848	8.206	25708	1.171 g/hour
Inboard/Outboard	G2 FI	1.6	4	1013	4053	6485		0.4%	7559033	18.65 g/hp-hr	3325975	8.206	4746	1.171 g/hour
Jet	G2 FI	1.6	3	7093	21279	34046		3.1%	19842462	18.65 g/hp-hr	8730683	8.206	24917	1.171 g/hour
Inboard	G4 FI	3.1	4	45808	183234	568025		19.7%	110673295	3.02 g/hp-hr	310764749	8.48	10261	0.056 g/hour
Outboard	G4 FI	1.6	4	9711	38842	62148		4.2%	28976293	7.46 g/hp-hr	34771552	8.952	2175	0.056 g/hour
Inboard/Outboard	G4 FI	3.8	4	62823	251292	954911		27.1%	151780519	3.02 g/hp-hr	426191655	8.48	14072	0.056 g/hour
Jet	G4 FI	3.1	3	4560	13679	42406		2.0%	10204695	7.46 g/hp-hr	12245633	8.952	766	0.056 g/hour
Inboard	G4	3.1	4	15516	62063	192396		6.7%	72986213	5.88 g/hp-hr	66407523	5.35	3476	0.056 g/hour
Outboard	G4	1.6	2	5911	11822	18914		2.5%	4409436	7.46 g/hp-hr	5291323	8.952	662	0.056 g/hour
Inboard/Outboard	G4	3.8	4	37491	149965	569866		16.1%	111873688	7.46 g/hp-hr	134248426	8.952	8398	0.056 g/hour
Jet	G4	3.1	3	1013	3040	9423		0.4%	1133855	7.46 g/hp-hr	1360626	8.952	170	0.056 g/hour
Auxiliary Sail	G4	1.0	2		0	0		0.0%	0		0		0	0.056 g/hour
PWC	G4/G2FI	1.1	3	21110	63330	69663		9.1%	40309545	12.73 g/hp-hr	17216261	5.437	3546	0.056 g/hour
Inboard Diesel	D	1.2	2	739	1478	1773		0.3%	124426	70169 g/1000 g	256794	144817 g/1000 gal	n/a	
Auxiliary Sail	D	1.0	1	2111	2111	2111		0.9%	148126	70169 g/1000 g	305707	144817 g/1000 gal	n/a	
*Source of fuel consumption in gal/hour from TRPA Boating Assumptions				232209		2642951		100%	594774391	grams	1070223432	grams	154271	grams
*Proportions from JD Fransz 2002									1311253	pounds	2359439	pounds	340	pounds
Assume fuel consumption for the numbers in red are same as similar engine type									<b>656 tons</b>		<b>1180 tons</b>		<b>0.170 tons</b>	
									399086 lbs		266938 lbs			
									200 tons		133 tons			

ESTIMATION OF TOTAL FUEL USE PER WATERCRAFT AND ENGINE TYPE

**ALTERNATIVE 1**  
Private Watercraft

Watercraft	Engine	Fuel gal/hour*	hours/trip	Number of boat trips*	Total hours	Total Fuel Use gallons	% Trips
Inboard	G2 FI	1.6	4	16397	65587	104940	5.1%
Outboard	G2 FI	1.6	4	7613	30451	48722	2.4%
Inboard/Outboard	G2 FI	1.6	4	1405	5622	8995	0.4%
Jet	G2 FI	1.6	3	9838	29514	47223	3.1%
Inboard	G4 FI	3.1	4	63538	254150	787866	19.7%
Outboard	G4 FI	1.6	4	13469	53875	86200	4.2%
Inboard/Outboard	G4 FI	3.8	4	87137	348549	1324487	27.1%
Jet	G4 FI	3.1	3	6324	18973	58818	2.0%
Inboard	G4	3.1	4	21521	86083	266858	6.7%
Outboard	G4	1.6	2	8198	16397	26235	2.5%
Inboard/Outboard	G4	3.8	4	52001	208005	790419	16.1%
Jet	G4	3.1	3	1405	4216	13071	0.4%
Auxiliary Sail	G4	1.0	2		0	0	0.0%
PWC	G4/G2FI	1.1	3	29280	87840	96624	9.1%
Inboard Diesel	D	1.2	2	1025	2050	2460	0.3%
Auxiliary Sail	D	1.0	1	2928	2928	2928	0.9%
				322080		3665844	100%

\*Source of fuel consumption in gal/hour from TRPA Boating Assumptions

\*Proportions from JD Fransz 2002

Assume fuel consumption for the numbers in red are same as similar engine type

**ALTERNATIVE 1**

EMISSIONS CALCULATIONS (grams to pounds to tons)					
HC's	EF	NOx	EF	PAH	EF
19807334	3.02 g/hp-hr	55617946	8.48	76803	1.171 g/hour
28395744	18.65 g/hp-hr	12494127	8.206	35658	1.171 g/hour
10484582	18.65 g/hp-hr	4613216	8.206	6583	1.171 g/hour
27522029	18.65 g/hp-hr	12109693	8.206	34561	1.171 g/hour
153506842	3.02 g/hp-hr	431039078	8.48	14232	0.056 g/hour
40190899	7.46 g/hp-hr	48229079	8.952	3017	0.056 g/hour
210523668	3.02 g/hp-hr	591139308	8.48	19519	0.056 g/hour
14154186	7.46 g/hp-hr	16985023	8.952	1063	0.056 g/hour
101233843	5.88 g/hp-hr	92109024	5.35	4821	0.056 g/hour
6116006	7.46 g/hp-hr	7339208	8.952	918	0.056 g/hour
155171820	7.46 g/hp-hr	186206183	8.952	11648	0.056 g/hour
1572687	7.46 g/hp-hr	1887225	8.952	236	0.056 g/hour
0		0		0	0.056 g/hour
55910160	12.73 g/hp-hr	23879304	5.437	4919	0.056 g/hour
172582	70169 g/1000 gal	356180	144817 g/1000 gal	n/a	
205455	70169 g/1000 gal	424024	144817 g/1000 gal	n/a	
824967838	grams	1484428619	grams	213978	grams
1818743	pounds	3272605	pounds	472	pounds
<b>909 tons</b>		<b>1636 tons</b>		<b>0.236 tons</b>	

ESTIMATION OF TOTAL FUEL USE PER WATERCRAFT AND ENGINE TYPE

ALTERNATIVE 2

Private Watercraft

Watercraft	Engine	Fuel		Number of		Total		% Trips
		gal/hour*	hours/trip	boat trips*	hours	gallons	Total Fuel Use	
Inboard	G2 FI	1.6	4	18251	73004	116806	5.1%	
Outboard	G2 FI	1.6	4	8474	33895	54231	2.4%	
Inboard/Outboard	G2 FI	1.6	4	1564	6257	10012	0.4%	
Jet	G2 FI	1.6	3	10951	32852	52563	3.1%	
Inboard	G4 FI	3.1	4	70722	282890	876959	19.7%	
Outboard	G4 FI	1.6	4	14992	59967	95948	4.2%	
Inboard/Outboard	G4 FI	3.8	4	96991	387963	1474260	27.1%	
Jet	G4 FI	3.1	3	7040	21119	65469	2.0%	
Inboard	G4	3.1	4	23954	95818	297034	6.7%	
Outboard	G4	1.6	2	9125	18251	29202	2.5%	
Inboard/Outboard	G4	3.8	4	57882	231526	879801	16.1%	
Jet	G4	3.1	3	1564	4693	14549	0.4%	
Auxiliary Sail	G4	1.0	2		0	0	0.0%	
PWC	G4/G2FI	1.1	3	32591	97773	107550	9.1%	
Inboard Diesel	D	1.2	2	1141	2281	2738	0.3%	
Auxiliary Sail	D	1.0	1	3259	3259	3259	0.9%	
				358501		4080380	100%	

\*Source of fuel consumption in gal/hour from TRPA Boating Assumptions :

\*Proportions from JD Franz 2002

Assume fuel consumption for the numbers in red are same as similar engine type

ALTERNATIVE 2

EMISSIONS CALCULATIONS (grams to pounds to tons)					
HC's	EF	NOx	EF	PAH	EF
22047160	3.02 g/hp-hr	61907256	8.48	85487	1.171 g/hour
31606752	18.65 g/hp-hr	13906971	8.206	39691	1.171 g/hour
11670185	18.65 g/hp-hr	5134882	8.206	7327	1.171 g/hour
30634236	18.65 g/hp-hr	13479064	8.206	38469	1.171 g/hour
170865488	3.02 g/hp-hr	479781236	8.48	15842	0.056 g/hour
44735710	7.46 g/hp-hr	53682852	8.952	3358	0.056 g/hour
234329811	3.02 g/hp-hr	657985696	8.48	21726	0.056 g/hour
15754750	7.46 g/hp-hr	18905700	8.952	1183	0.056 g/hour
112681427	5.88 g/hp-hr	102524768	5.35	5366	0.056 g/hour
6807608	7.46 g/hp-hr	8169130	8.952	1022	0.056 g/hour
172718742	7.46 g/hp-hr	207262491	8.952	12965	0.056 g/hour
1750528	7.46 g/hp-hr	2100633	8.952	263	0.056 g/hour
0		0		0	0.056 g/hour
62232515	12.73 g/hp-hr	26579590	5.437	5475	0.056 g/hour
192098	70169 g/1000	396457	144817 g/1000 gal		n/a
228688	70169 g/1000	471973	144817 g/1000 gal		n/a
918255698	grams	1652288699	grams	238175	grams
2024407	pounds	3642673	pounds	525	pounds
<b>1012</b>	<b>tons</b>	<b>1821</b>	<b>tons</b>	<b>0.263</b>	<b>tons</b>
616137	lbs	412118	lbs		
308	tons	206	tons		

ESTIMATION OF TOTAL FUEL USE PER WATERCRAFT AND ENGINE TYPE

**ALTERNATIVE 3**  
Private Watercraft

**ALTERNATIVE 3**

Watercraft	Engine	Fuel		Number of		Total		Total Fuel Use		EMISSIONS CALCULATIONS (grams to pounds to tons)					
		gal/hour*	hours/trip	boat trips*	hours	gallons	% Trips	HC's	EF	NOx	EF	PAH	EF		
Inboard	G2 FI	1.6	4	27954	111816.544	178906	5.1%	33768596	3.02 g/hp-hr	94820429	8.48	130937	1.171 g/hour		
Outboard	G2 FI	1.6	4	12979	51914.824	83064	2.4%	48410573	18.65 g/hp-hr	21300652	8.206	60792	1.171 g/hour		
Inboard/Outboard	G2 FI	1.6	4	2396	9584.2752	15335	0.4%	17874673	18.65 g/hp-hr	7864856	8.206	11223	1.171 g/hour		
Jet	G2 FI	1.6	3	16772	50317.4448	80508	3.1%	46921017	18.65 g/hp-hr	20645248	8.206	58922	1.171 g/hour		
Inboard	G4 FI	3.1	4	108322	433289.108	1343196	19.7%	261706621	3.02 g/hp-hr	734858327	8.48	24264	0.056 g/hour		
Outboard	G4 FI	1.6	4	22962	91849.304	146959	4.2%	68519581	7.46 g/hp-hr	82223497	8.952	5144	0.056 g/hour		
Inboard/Outboard	G4 FI	3.8	4	148556	594225.062	2258055	27.1%	358911938	3.02 g/hp-hr	1007805706	8.48	33277	0.056 g/hour		
Jet	G4 FI	3.1	3	10782	32346.9288	100275	2.0%	24130809	7.46 g/hp-hr	28956971	8.952	1811	0.056 g/hour		
Inboard	G4	3.1	4	36690	146759.214	454954	6.7%	172588836	5.88 g/hp-hr	157032359	5.35	8219	0.056 g/hour		
Outboard	G4	1.6	2	13977	27954.136	44727	2.5%	10426893	7.46 g/hp-hr	12512271	8.952	1565	0.056 g/hour		
Inboard/Outboard	G4	3.8	4	88655	354618.182	1347549	16.1%	264545164	7.46 g/hp-hr	317454197	8.952	19859	0.056 g/hour		
Jet	G4	3.1	3	2396	7188.2064	22283	0.4%	2681201	7.46 g/hp-hr	3217441	8.952	403	0.056 g/hour		
Auxiliary Sail	G4	1.0	2		0	0	0.0%	0		0		0	0.056 g/hour		
PWC	G4/G2FI	1.1	3	49918	149754	164729	9.1%	95318421	12.73 g/hp-hr	40710625	5.437	8386	0.056 g/hour		
Inboard Diesel	D	1.2	2	1747	3494.267	4193	0.3%	294227	70169 g/1000	607235	144817 g/1000 gal	n/a			
Auxiliary Sail	D	1.0	1	4992	4991.81	4992	0.9%	350270	70169 g/1000	722899	144817 g/1000 gal	n/a			
*Source of fuel consumption in gal/hour from TRPA Boating Assumptions E				549099		6249726	100%	1406448821	grams	2530732713	grams	364801	grams		
*Proportions from JD Franz 2002								3100689	pounds	5579310	pounds	804	pounds		
Assume fuel consumption for the numbers in red are same as similar engine type								<b>1550 tons</b>		<b>2790 tons</b>		<b>0.402 tons</b>			
								943709	lbs	631222	lbs				
								472	tons	316	tons				

ESTIMATION OF TOTAL FUEL USE PER WATERCRAFT AND ENGINE TYPE

**ALTERNATIVE 4**

Private Watercraft

Watercraft	Engine	Fuel		Number of boat trips*	Total hours	Total Fuel Use		% Trips
		gal/hour*	hours/trip			gallons		
Inboard	G2 FI	1.6	4	16158	64632	103412	5.1%	
Outboard	G2 FI	1.6	4	7502	30008	48013	2.4%	
Inboard/Outboard	G2 FI	1.6	4	1385	5540	8864	0.4%	
Jet	G2 FI	1.6	3	9695	29085	46535	3.1%	
Inboard	G4 FI	3.1	4	62613	250450	776395	19.7%	
Outboard	G4 FI	1.6	4	13273	53091	84945	4.2%	
Inboard/Outboard	G4 FI	3.8	4	85869	343474	1305203	27.1%	
Jet	G4 FI	3.1	3	6232	18697	57961	2.0%	
Inboard	G4	3.1	4	21207	84830	262973	6.7%	
Outboard	G4	1.6	2	8079	16158	25853	2.5%	
Inboard/Outboard	G4	3.8	4	51244	204977	778911	16.1%	
Jet	G4	3.1	3	1385	4155	12880	0.4%	
Auxiliary Sail	G4	1.0	2		0	0	0.0%	
PWC	G4/G2FI	1.1	3	28853	86559	95215	9.1%	
Inboard Diesel	D	1.2	2	1010	2020	2424	0.3%	
Auxiliary Sail	D	1.0	1	2885	2885	2885	0.9%	

\*Source of fuel consumption in gal/hour from TRPA Boating Assumptions :

317390

3612469

100%

\*Proportions from JD Franz 2002

Assume fuel consumption for the numbers in red are same as similar engine type

**ALTERNATIVE 4**

EMISSIONS CALCULATIONS (grams to pounds to tons)

HC's	EF	NOx	EF	PAH	EF
19518951	3.02 g/hp-hr	54808180	8.48	75684	1.171 g/hour
27982318	18.65 g/hp-hr	12312220	8.206	35139	1.171 g/hour
10331933	18.65 g/hp-hr	4546050	8.206	6487	1.171 g/hour
27121324	18.65 g/hp-hr	11933382	8.206	34058	1.171 g/hour
151271870	3.02 g/hp-hr	424763397	8.48	14025	0.056 g/hour
39605743	7.46 g/hp-hr	47526891	8.952	2973	0.056 g/hour
207458565	3.02 g/hp-hr	582532658	8.48	19235	0.056 g/hour
13948109	7.46 g/hp-hr	16737731	8.952	1047	0.056 g/hour
99759937	5.88 g/hp-hr	90767969	5.35	4750	0.056 g/hour
6026961	7.46 g/hp-hr	7232353	8.952	905	0.056 g/hour
152912607	7.46 g/hp-hr	183495128	8.952	11479	0.056 g/hour
1549790	7.46 g/hp-hr	1859748	8.952	233	0.056 g/hour
0		0		0	0.056 g/hour
55094804	12.73 g/hp-hr	23531064	5.437	4847	0.056 g/hour
170069	70169 g/1000	350995	144817 g/1000 gal		n/a
202464	70169 g/1000	417851	144817 g/1000 gal		n/a
812955443	grams	1462815619	grams	210863	grams
1792260	pounds	3224956	pounds	465	pounds
<b>896 tons</b>		<b>1612 tons</b>		<b>0.232 tons</b>	
545483	lbs	364859	lbs		
273	tons	182	tons		

ESTIMATION OF TOTAL FUEL USE PER WATERCRAFT AND ENGINE TYPE

ALTERNATIVE 5

Private Watercraft

Watercraft	Engine	Fuel		Number of		Total		Total Fuel Use	
		gal/hour*	hours/trip	boat trips*	hours	gallons	% Trips		
Inboard	G2 FI	1.6	4	11593	46372	74195	5.1%		
Outboard	G2 FI	1.6	4	5382	21530	34447	2.4%		
Inboard/Outboard	G2 FI	1.6	4	994	3975	6360	0.4%		
Jet	G2 FI	1.6	3	6956	20867	33388	3.1%		
Inboard	G4 FI	3.1	4	44922	179690	557039	19.7%		
Outboard	G4 FI	1.6	4	9523	38091	60946	4.2%		
Inboard/Outboard	G4 FI	3.8	4	61608	246432	936441	27.1%		
Jet	G4 FI	3.1	3	4472	13415	41585	2.0%		
Inboard	G4	3.1	4	15216	60863	188674	6.7%		
Outboard	G4	1.6	2	5796	11593	18549	2.5%		
Inboard/Outboard	G4	3.8	4	36766	147064	558844	16.1%		
Jet	G4	3.1	3	994	2981	9241	0.4%		
Auxiliary Sail	G4	1.0	2		0	0	0.0%		
PWC	G4/G2FI	1.1	3	20702	62106	68317	9.1%		
Inboard Diesel	D	1.2	2	725	1449	1739	0.3%		
Auxiliary Sail	D	1.0	1	2070	2070	2070	0.9%		

\*Source of fuel consumption in gal/hour from TRPA Boating Assumptions : 227718

\*Proportions from JD Franz 2002

Assume fuel consumption for the numbers in red are same as similar engine type

ALTERNATIVE 5

EMISSIONS CALCULATIONS (grams to pounds to tons)

HC's	EF	NOx	EF	PAH	EF
14004218	3.02 g/hp-hr	39323103	8.48	54301	1.171 g/hour
20076412	18.65 g/hp-hr	8833621	8.206	25211	1.171 g/hour
7412829	18.65 g/hp-hr	3261645	8.206	4654	1.171 g/hour
19458676	18.65 g/hp-hr	8561817	8.206	24436	1.171 g/hour
108532692	3.02 g/hp-hr	304754050	8.48	10063	0.056 g/hour
28415844	7.46 g/hp-hr	34099013	8.952	2133	0.056 g/hour
148844835	3.02 g/hp-hr	417948411	8.48	13800	0.056 g/hour
10007319	7.46 g/hp-hr	12008783	8.952	751	0.056 g/hour
71574540	5.88 g/hp-hr	65123093	5.35	3408	0.056 g/hour
4324150	7.46 g/hp-hr	5188980	8.952	649	0.056 g/hour
109709868	7.46 g/hp-hr	131651842	8.952	8236	0.056 g/hour
1111924	7.46 g/hp-hr	1334309	8.952	167	0.056 g/hour
		0	0	0	0.056 g/hour
39530469	12.73 g/hp-hr	16883516	5.437	3478	0.056 g/hour
122019	70169 g/1000 gal	251827	144817 g/1000 gal		n/a
145261	70169 g/1000 gal	299794	144817 g/1000 gal		n/a
583271058	grams	1049523806	grams	151287	grams
1285892	pounds	2313804	pounds	334	pounds
<b>643</b>	<b>tons</b>	<b>1157</b>	<b>tons</b>	<b>0.167</b>	<b>tons</b>
391367	lbs	261775	lbs		
196	tons	131	tons		

**Proportion of Motor Types For 6 Alternatives. Percents are from 2002 JD Franz Boating Survey**

Type of Motor	Percent	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Inboard	35	102480	114069	174713	100988	72456	94441
Outboard	10	29280	32591	49918	28854	20702	26983
Inboard/Outboard	48	140544	156437	239607	138498	99368	129518
Jet	6	17568	19555	29951	17312	12421	16190
Auxiliary Sail Diesel	1	2928	3259	4992	2885	2070	2698
	100	292800	325910	499181	288537	207016	<b>269830</b>

188 lb/1000 gallons = 70169 grams/1000 gallons  
 388 lb/1000 gallons = 144817 grams/1000 gallons

**Proportion of Engine Types for Inboard Motors For 5 Alternatives (JD Franz Survey 2002)**

Inboard	Percent*	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
2-Stroke FI	16	16397	18251	27954	16158	11593	15110
4-Stroke FI	62	63538	70722	108322	62613	44922	58553
4-Stroke Carb	21	21521	23954	36690	21207	15216	19833
Diesel	1	1025	1141	1747	1010	725	944
	100	102480	114069	174713	100988	72456	94441

\*Other/Don't Know %: 1% allotted to Diesel and remainder proportionally distributed to other categories

**Proportion of Engine Types for Outboard Motors For 5 Alternatives (JD Franz Survey 2002)**

Outboard	Percent*	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
2-Stroke FI	26	7613	8474	12979	7502	5382	7016
4-Stroke FI	46	13469	14992	22962	13273	9523	12412
4-Stroke Carb	28	8198	9125	13977	8079	5796	7555
	100	29280	32591	49918	28854	20702	26983

**Proportion of Engine Types for Inboard/Outboard Motors For 5 Alternatives (JD Franz Survey 2002)**

Inboard/Outboard	Percent*	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
2-Stroke FI	1	1405	1564	2396	1385	994	1295
4-Stroke FI	62	87137	96991	148556	85869	61608	80301
4-Stroke Carb	37	52001	57882	88655	51244	36766	47922
	100	140544	156437	239607	138498	99368	129518

**Proportion of Engine Types for Jet Motors For 5 Alternatives (JD Franz Survey 2002)**

Jet	Percent*	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
2-Stroke FI	56	9838	10951	16772	9695	6956	9066
4-Stroke FI	36	6324	7040	10782	6232	4472	5828
4-Stroke Carb	8	1405	1564	2396	1385	994	1295
	100	17568	19555	29951	17312	12421	16190

**EMISSION FACTORS (LB/1000 GALLONS) FROM DEVELOPMENT OF AN IMPROVED INVENTORY OF EMISSIONS FROM PLEASURE CRAFT IN CALIFORNIA, JUNE 1995, SAI AS USED IN EPA DOCUMENT**

Engine Type	TOG	Nox	PAH
4-Stroke	151	101	
2-Stroke DFI			
Diesel	188	388	FROM TRPA 1997 EA

**EMISSION FACTORS FOR MARINE ENGINES (GRAMS PER POUND OF FUEL) FROM 1998 TRG LAKE TAHOE MOTORIZED WATERCRAFT REPORT**

Engine Type	TOG	Nox	PAH
4-STROKE 9.9 hp		3.9	

**BASELINE STERNDRIVE/INBOARD (SD/I) EXHAUST EMISSION DATA (g/kW-hr) FROM 2002 EPA REGULATORY DOCUMENT**

10 different engines varying from 79 to 229 kW power were tested. 6 are carbureted, 4 are fuel injected.

An example of the emission data follows:

A 167 kW carbureted SD/I emits 8.0 g/kW-hr of HC and 5.7 g/kW-hr of Nox

**TOTAL PAH FROM 2003 UNR PAH PAPER**

	ng/L PAH	liters	total ng of PAH in 30 minutes	ng/L Total PAH		2600 gallon test tank 3.7853 liters per gallon 9841.78 liters in test tank
				4-stroke 90 hp	2-stroke FI	
4-Stroke 90 hp	2854	9841	28086214	0.028 g PAH/30 minutes	778	29000
2-Stroke FI	59500	9841	585539500	0.586 g PAH/30 minutes	105	2000
4-Stroke 90 hp				0.056 g PAH/hour	400	6600
2-Stroke FI				1.171 g PAH/hour	535	8100
					385	2100
					140	3100
					85	4200
					253	320
					168	920
					5	960
					2854	2200
						59500

**Exhaust Emission Factors (g/hp-hr) for Nonroad Engine Modeling - Spark Ignition Recreational Marine Engines, from EPA November 2002**

	HC	NOx	HC X 1.3 TAF
4-stroke Outboard	7.46	8.952	9.70
Inboard	5.88	5.35	7.64
2-stroke outboard FI	18.65	8.206	24.25
PWC 4-stroke	12.73	5.437	16.55
Inboard FI	3.02	8.48	3.93
Direct Injection Outboa	38.05	3.73	49.47

**Number of DMV-Registered Boats per 1,000 Population\***

<b>Length</b>	<b>1973</b>	<b>1983</b>	<b>1988</b>	<b>1993</b>	<b>1994</b>	<b>1997</b>	<b>2000</b>	<b>2003</b>
< 16'	13.17	11.59	12.17	13.05	13.22	14.13	13.27	13.42
16' - 19' 11"			8.55	8.27	8.18	8.01	7.66	7.86
20' - 25' 11"			2.81	3.09	3.15	3.43	3.76	4.41
26' - 39' 11"	1.12	1.43	1.45	1.24	1.21	1.43	1.46	1.13
40' +	0.14	0.23	0.24	0.21	0.21	0.4	0.44	0.15
<b>TOTAL</b>	<b>22.36</b>	<b>23.45</b>	<b>25.21</b>	<b>25.87</b>	<b>25.96</b>	<b>27.39</b>	<b>26.58</b>	<b>27.1</b>
40'+ percentage	0.6%	1.0%	1.0%	0.8%	0.8%	1.5%	1.7%	0.6%
26-40' percentage	5.0%	6.1%	5.8%	4.8%	4.7%	5.2%	5.5%	4.2%
20-25' percentage			11.1%	11.9%	12.1%	12.5%	14.1%	16.3%
16-19' percentage			33.9%	32.0%	31.5%	29.2%	28.8%	29.0%
<16' percentage	58.9%	49.4%	48.3%	50.4%	50.9%	51.6%	49.9%	49.5%

\*Data Source: 1973-2000 From DMV, in the *California Boating Facilities Needs Assessment, October 15, 2002*

**2003 Calculations to determine # boats/1,000 population**

<b>Length</b>	<b>Number</b>	<b>Pop/1,000</b>	<b># boats/1,000</b>
< 16'	477,575	35,591	13.42
16' - 19' 11"	279,869	35,591	7.86
20' - 25' 11"	156,807	35,591	4.41
26' - 39' 11"	40,062	35,591	1.13
40' +	5,448	35,591	0.15
<b>TOTAL</b>	<b>959,761</b>		<b>27.0</b>

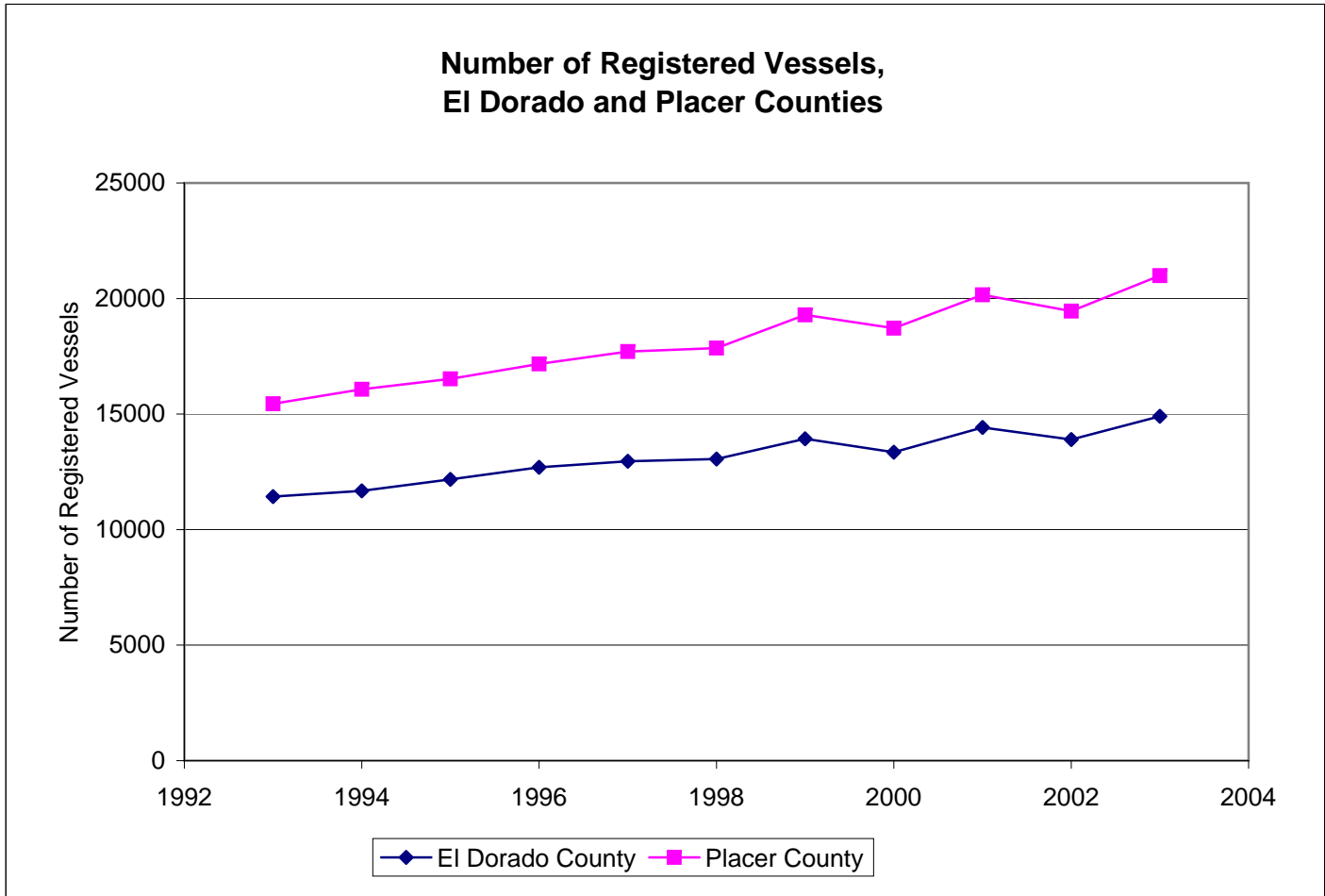
Data Source: Currently Registered Vessels as of 31 Dec 2003 from CA DMV Online

Number of Registered Vessels		
Years	El Dorado County	Placer County
1993	11429	15445
1994	11675	16074
1995	12172	16521
1996	12694	17168
1997	12956	17703
1998	13054	17857
1999	13928	19289
2000	13350	18716
2001	14423	20159
2002	13899	19457
2003	14906	20989

Years	% change	Annual
93 to 96	0.11	0.04
96 to 99	0.10	0.03
99 to 02	-0.002	-0.001
00 to 03	0.12	0.04
98 to 03	0.14	0.03
93 to 03	0.30	0.03

Conclude: 4-5% would be reasonable annual increase



Alternative 6 Summary	Total	New
BAOT	10262	
Boat Trips/year	296813	
Launches/year	70796	
Piers	998	230
Ramps	43	6
Bouys	6316	1862
Slips	2929	235
Floating Docks	20	2

Substrate Removal	
	m3
	322
	418
	689
	0.74
<b>Total</b>	<b>1430</b>