Dolphin Club
Tides, Currents and Row Planning

The key to safe rowing on San Francisco Bay is good planning and good judgment about weather and tide conditions. Before any row a Dolphin rower is expected to know the state of the currents, the expected change in tides and currents during the row, and the expected weather conditions.

On all but a few a days there will be times and places on the bay where is is *not* safe (or much fun) to row, and other times when a row can be both fun and safe. The art of row planning is learning to predict the likely conditions and learning the local variations, and then planning accordingly.

You will learn enough in this class to be basically safe in your rowing, but the small, micro-scale variations in water conditions must be learned by exploring the bay with eyes open, noticing how this incredibly dynamic and varied body of water behaves. It is a fascinating, lifelong study that Dolphin rowers are uniquely able to enjoy.

Tides and Current: Some Definitions.

The first thing to know is that these are two different things, although people will use the term "tide" to cover both. But we need to be clear about the distinction.

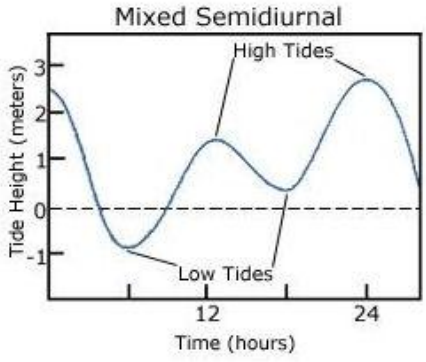
TIDE: The tide is the height of the surface of the water. As you probably know, the ocean surface moves up and down during the day, under the influence of the moon and sun, and other factors. So, when we are speaking carefully, as in this class, the word "tide" refers to the height of the water.

CURRENT: In San Francisco Bay, as the water moves up to a high tide and down to a low tide, seawater must move into and out of the bay (and all the lesser sub-elements of the bay, like our cove at Aquatic Park). This moving water, generated by the daily tidal changes, is a "tidal current". In general currents concern rowers more than the height of the tide, but here we will lean about both

The Daily Tidal Cycle - "Highs and Lows"

On this coast the tidal cycle is called "**mixed semi-diurnal"**, meaning that we have two high-tides and two low-tides each day, and one high-tide is higher and one low tide is lower.

Tide height is measured relative to a datum calculated by averaging the lower of the low-tides for a long period (years). This means that only the lowest tides will be below the datum level, and are expressed as negative numbers or "**minus tides**".



A good example of mixed semi-diurnal tides are the predicted tides for Golden Gate in early December 2014. The times shaded blue are periods of rising water and those in green of falling water levels. Note that one high is higher than the other, and one low is lower. On these days the lowest tide is below the zero line (called the "datum"), so these are "minus tides."

Tides at Golden Gate

Moon and Sun

The tide is driven by the gravity of both the moon and the sun, and is linked to their positions. The moon is the primary driver, creating a bulge in the oceans on the side of the earth that faces the moon and on the side facing away. As the earth turns on its axis, a spot like SF Bay moves through both bulges and both troughs, creating two high tides and two low tides approximately six hours apart.

But... the moon is itself in motion around the earth, pulling those bulges along with it. The tidal cycle, therefor, is actually 24 hours and 50 minutes, almost an hour longer than a normal day, and the time between each tide is around six hours and 13 minutes. In our area that time will vary a bit from tide to tide, but a "rule of thumb" of 6 hrs between tides is good enough for our purposes.

Shifting Though the Weeks

Because the tides are linked to the "lunar day" of 24 hrs, 50 minutes, the cycle shifts back 50 minutes (or "about an hour") later each day. If the high tide happens at 9:00 AM on Saturday, then it will occur close to 9:50 am on Sunday.

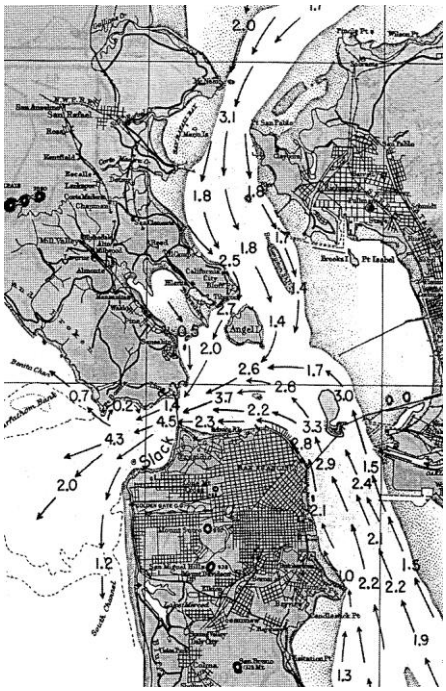
(This is why, at the Dolphin Club, when we schedule a test swim the day before a major swim, the "jump time" is about an hour earlier than the jump time of the big swim.)

Over a seven-day week the shift backwards in time comes to nearly six hours, which is the time between tides. That means that if you experience dropping water and ebb currents on one weekend, on the next weekend you will have shifted through one part of the cycle, and will experience rising water and flood currents. A week later, the ebb currents will be back. After four weeks you have come full cycle back to where you started. This is no accident, as the "month" is based on the same lunar cycle.

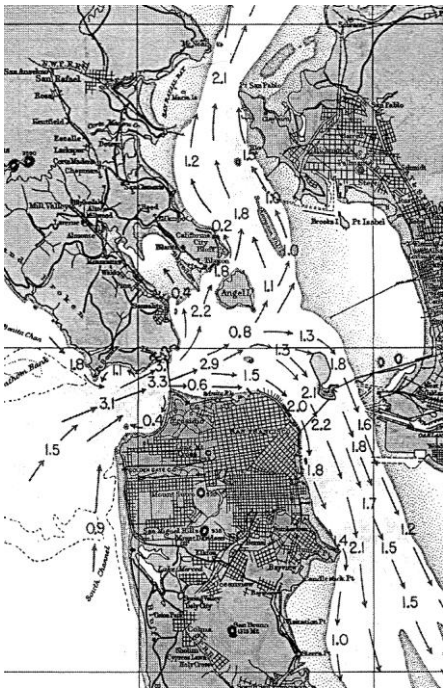
The Tidal Currents – Ebb and Flood

For a coastal bay like San Francisco Bay, a rising tide will cause ocean water to flow into the bay, and spread throughout. This is called a **Flood** Current. Conversely the falling tide allows water to drain out of the bay to the ocean; this is called the **Ebb** Current. Because of the complex shape of the bay the direction of flood and ebb currents vary in different parts of the bay. Near the Dolphin Club a flood current moves from the west towards the east, and an ebb current in the opposite direction, from the east towards the Golden Gate and the ocean.

Flows At **Max Ebb** at Golden Gate

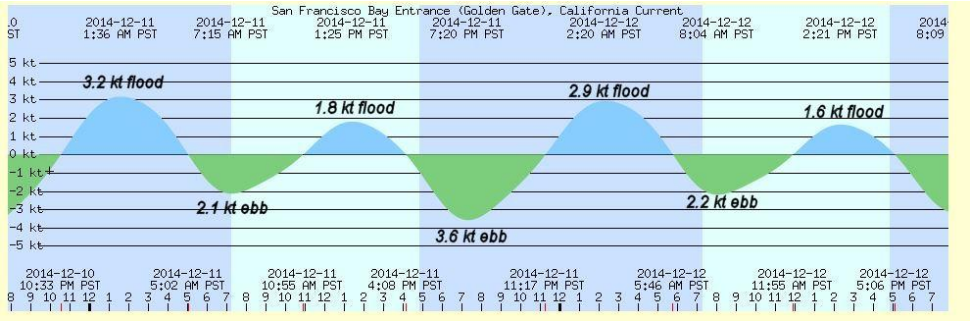


Flows at **Max Flood** At Golden Gate



In the maps above the speed of the current is shown in knots (kts), a nautical mile per hour. A nautical mile is a bit longer than a statute mile (1 nm =1.15 mile), and not quite two kilometers (1nm = 1.85 km). So a knot is a bit more than a mile per hour. A 3 knot current is moving at about 3.5 mph.

The chart below shows the currents at Golden Gate. The curve above the zero line is flood current (into the bay) and that below is ebb current (out of the bay). This sort of graph can be confusing as it looks like the tide graph, but it is *not* showing the height of the water, it is showing the *speed of the current*.



The speeds shown above are typical and relatively moderate. In SF Bay, ebb currents are usually faster than flood currents. Strong ebbs over 5 kts at GG are possible. Five knots is nearly six mph... faster than our wooden singles boats can be rowed. It's important to know the conditions on the bay.

Predicting the Tides and Currents

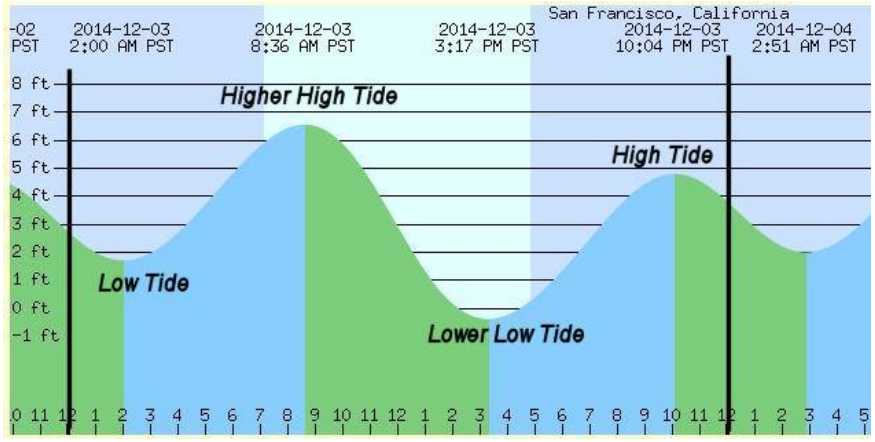
We use published tide tables and charts to predict the currents we will experience in our rows. Based on this knowledge, we can plan a row that is safe and fun.

The tide prediction tables give us the expected times and magnitudes of the important "events" in the tidal cycle. There are *four* such events each day for the tide (height) and *eight* for the current (flow).

Tide Events

The vertical lines on the chart at right denote a single day. In that time there are four key tide events:

- Two High Tides (one higher than the other)
- Two Low Tides (one lower than the other)

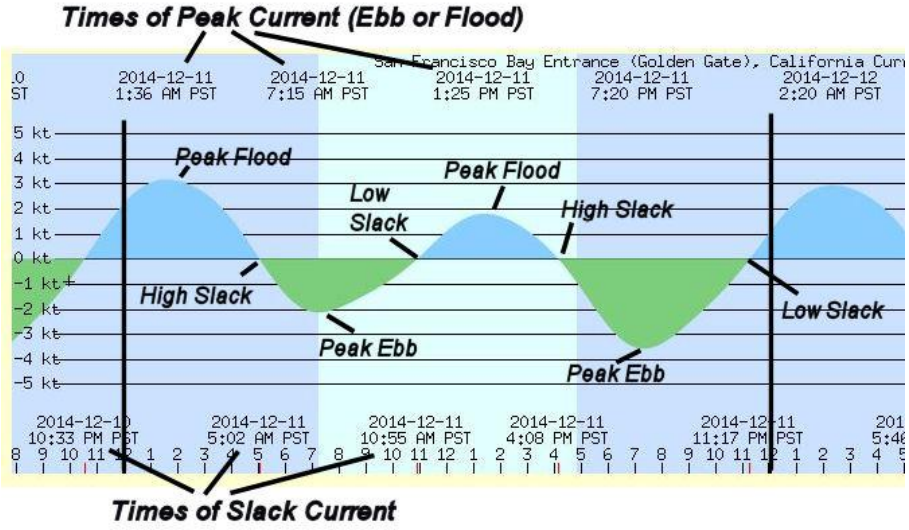


Tidal Current Events

In the day marked at right there are eight events in the cycle of currents:

- Two times of **peak flood** current
- Two times of **peak ebb** current
- Four times of "Slack Water" between those currents

Slack after a flood (higher water) is called high slack, after an ebb (lower water) is called low slack)



The Importance of Location

As the tide and associated currents advance into the bay from the Pacific Ocean, the times of peak tide and peak current happen at different times at different places. And the speed of the peak current will also be different in different places.

Tides are calculated and published for certain prominent locations; the closest to our area is "Golden Gate" (a spot about ½ mile west of the bridge). Of course, we are not rowing there, we are rowing in the waters outside Aquatic Park. Fortunately, the same authority (NOAA) has calculated and published the *differences* in time and speed relative to the GG for many other places.

We'll use the tide tables for GG, and the published differences in time and speed relative to GG, to calculate the times and speed for the waters outside our cove.

A Three Step Process

Think of the tide and current calculation as three steps...

(remember... a "tidal event" means a high or low tide, or a peak current or slack water)

1. Find the times and magnitudes (how high, how fast) of the key tidal events at Golden Gate.
2. Apply the published differences to get the time and magnitude of these tidal events near Aquatic Park
3. Since you are probably not going rowing at exactly the time of the peak current or slack, estimate the current *right now* based on the hours since (or before) the predicted event.

The tide tables

There are many types of tide tables and tide smartphone apps available. They all are based on the same published predictions and you are encouraged to choose whatever tool works best for you. For the purpose of this class we will use the simple tide books distributed to Dolphin Club members each year.

Here are the tide tables for Dec. 2014 for Golden Gate, "Tides" on the left and "Currents" on the right.

DECEMBER

TIDES AT GOLDEN GATE, CALIFORNIA – 2014

Heights in feet — **Pacific Standard Time**

Moon	Day	Time	Ht.	Time	Ht.	Time	Ht.	Time	Ht.
		LOW		HIGH		LOW		HIGH	
	1 Mon	0010	1.0	0708	**6.1**	1335	0.7	1953	4.5
	2 Tue	0107	1.3	0753	**6.4**	1429	0.1	2103	4.6
	3 Wed	0201	1.7	0836	**6.5**	1517	**-0.4**	2204	4.8
	4 Thr	0251	2.0	0918	**6.6**	1601	**-0.8**	2259	4.9
	5 Fri	0340	2.2	0958	**6.6**	1643	**-0.9**	2349	5.0
○	6 Sat	0426	2.4	1036	**6.5**	1722	**-1.0**		
		HIGH		LOW		HIGH		LOW	
N	7 **Sun**	0036	5.0	0512	2.6	1115	**6.3**	1801	**-0.9**
	8 Mon	0120	5.0	0558	2.7	1153	**6.0**	1840	**-0.7**
	9 Tue	0203	5.0	0646	2.8	1232	5.7	1919	**-0.4**
	10 Wed	0245	4.9	0737	2.9	1314	5.3	1959	0.0
	11 Thr	0327	4.9	0834	2.9	1400	4.9	2041	0.3
A	12 Fri	0409	4.9	0939	2.8	1453	4.5	2126	0.8
	13 Sat	0451	5.0	1047	2.5	1556	4.1	2215	1.2
◑E	14 **Sun**	0532	5.2	1152	2.2	1711	3.8	2306	1.5
	15 Mon	0612	5.3	1249	1.7	1836	3.7	2359	1.9
	16 Tue	0652	5.6	1338	1.2	1956	3.8		
		LOW		HIGH		LOW		HIGH	
	17 Wed	0051	2.2	0731	5.8	1421	0.6	2102	4.0
	18 Thr	0141	2.4	0810	**6.0**	1501	0.1	2156	4.2
	19 Fri	0228	2.5	0850	**6.3**	1539	**-0.4**	2244	4.5
	20 Sat	0313	2.6	0931	**6.5**	1618	**-0.8**	2328	4.7
S●	21 **Sun**	0358	2.6	1013	**6.7**	1658	**-1.1**		
		HIGH		LOW		HIGH		LOW	
	22 Mon	0011	4.9	0444	2.6	1058	**6.7**	1740	**-1.3**
	23 Tue	0054	5.1	0533	2.6	1144	**6.6**	1823	**-1.3**
P	24 Wed	0138	5.3	0626	2.5	1234	**6.4**	1909	**-1.0**
	25 Thr	0223	5.4	0725	2.4	1328	**6.0**	1956	**-0.7**
E	26 Fri	0309	5.6	0832	2.2	1429	5.4	2046	**-0.1**
	27 Sat	0358	5.8	0945	1.9	1539	4.8	2140	0.4
◐	28 **Sun**	0448	5.9	1102	1.5	1700	4.4	2238	1.0
	29 Mon	0540	**6.1**	1216	1.0	1829	4.2	2339	1.6
	30 Tue	0632	**6.3**	1322	0.5	1954	4.2		
		LOW		HIGH		LOW		HIGH	
	31 Wed	0042	2.0	0722	**6.4**	1418	0.0	2106	4.4

December 21 = Solstice

LUNAR DATA

● = NEW MOON ◑ = LAST QUARTER N = FARTHEST NORTH OF EQUATOR
◐ = FIRST QUARTER A = IN APOGEE E = ON EQUATOR
○ = FULL MOON P = IN PERIGEE S = FARTHEST SOUTH OF EQUATOR

DECEMBER

CURRENTS AT GOLDEN GATE ENTRANCE 2014

SOUTH OF PT. DIABLO

Currents in Knots — **Pacific Standard Time**

		MAX Current			MAX Current			MAX Current			MAX Current	
Day	Slack	Time H.M.	Vel Knots	Slack	Time H.M.	Vel Knots	Slack	Time H.M.	Vel Knots	Slack	Time H.M.	Vel Knots	Slack
1 Mon	0234	0537	3.4F	0844	1140	4.0E	1537	1831	3.1F	2129			
2 Tue		0000	2.9E	0330	0630	3.3F	0931	1235	4.4E	1632	1933	3.5F	2234
3 Wed		0101	2.7E	0423	0720	3.3F	1016	1326	**4.8E**	1724	2028	3.8F	2333
4 Thr		0157	2.6E	0514	0808	3.2F	1101	1414	**5.1E**	1812	2118	4.0F	
5 Fri	0027	0248	2.5E	0602	0853	3.1F	1144	1458	**5.1E**	1858	2204	4.1F	
6 Sat	0117	0334	2.5E	0649	0937	3.0F	1227	1541	**5.1E**	1942	2248	4.0F	
7 **Sun**	0204	0418	2.4E	0735	1020	2.8F	1309	1624	**5.0E**	2025	2330	3.9F	
8 Mon	0250	0501	2.3E	0821	1103	2.5F	1351	1706	**4.7E**	2108			
9 Tue		0012	3.7F	0335	0544	2.2E	0909	1148	2.3F	1434	1749	4.4E	2151
10Wed		0053	3.4F	0419	0629	2.2E	1000	1235	2.0F	1519	1833	4.0E	2234
11 Thr		0136	3.2F	0503	0715	2.1E	1056	1325	1.8F	1609	1920	3.6E	2318
12 Fri		0221	2.9F	0547	0804	2.2E	1156	1421	1.6F	1706	2009	3.2E	
13 Sat	0003	0307	2.7F	0631	0856	2.4E	1259	1522	1.6F	1811	2102	2.8E	
14 **Sun**	0050	0354	2.6F	0714	0948	2.6E	1359	1627	1.7F	1919	2156	2.5E	
15Mon	0139	0442	2.5F	0756	1041	2.9E	1454	1731	1.9F	2027	2252	2.2E	
16 Tue	0228	0529	2.5F	0838	1132	3.4E	1544	1830	2.3F	2131	2348	2.1E	
17Wed	0316	0615	2.5F	0919	1220	3.8E	1631	1922	2.7F	2229			
18 Thr		0042	2.1E	0403	0700	2.6F	0959	1307	4.3E	1714	2009	3.1F	2322
19 Fri		0133	2.2E	0448	0744	2.7F	1039	1353	**4.7E**	1756	2053	3.5F	
20 Sat	0013	0223	2.3E	0532	0829	2.9F	1120	1439	**5.1E**	1838	2137	3.8F	
21 **Sun**	0101	0311	2.5E	0617	0913	3.0F	1202	1524	**5.4E**	1920	2220	4.1F	
22Mon	0147	0358	2.6E	0703	1000	3.0F	1247	1611	**5.5E**	2004	2305	4.2F	
23 Tue	0234	0447	2.7E	0753	1048	3.0F	1334	1658	**5.5E**	2049	2351	4.2F	
24Wed	0320	0536	2.9E	0847	1139	2.9F	1426	1747	**5.2E**	2136			
25 Thr		0038	4.1F	0407	0627	3.0E	0947	1235	2.8F	1523	1839	**4.8E**	2225
26 Fri		0128	4.0F	0454	0721	3.2E	1053	1335	2.7F	1627	1933	4.3E	2316
27 Sat		0220	3.7F	0542	0817	3.3E	1204	1442	2.6F	1739	2030	3.6E	
28 **Sun**	0011	0315	3.5F	0632	0916	3.6E	1314	1556	2.6F	1854	2131	3.1E	
29Mon	0108	0412	3.3F	0722	1017	3.8E	1421	1712	2.8F	2010	2236	2.6E	
30 Tue	0208	0510	3.1F	0813	1118	4.1E	1523	1824	3.1F	2121	2344	2.3E	
31Wed	0307	0607	3.0F	0903	1217	4.4E	1620	1926	3.4F	2226			

Step 1a: Get the Tides at Golden Gate: At right is a part of the left-hand page for Dec. 2014, showing tides. Note the line for Wed 3rd.

Moon	Day	Time	Ht.	Time	Ht.	Time	Ht.	Time	Ht.
		LOW		HIGH		LOW		HIGH	
	1 Mon	0010	1.0	0708	**6.1**	1335	0.7	1953	4.5
	2 Tue	0107	1.3	0753	**6.4**	1429	0.1	2103	4.6
	3 Wed	0201	1.7	0836	**6.5**	1517	**-0.4**	2204	4.8
	4 Thr	0251	2.0	0918	**6.6**	1601	**-0.8**	2259	4.9

- Low @ 2:01am – 1.7 ft.
- High @ 8:36 am – 6.5 feet
- Low @ 3:17 pm – -0.4 ft.
- High @ 10:04 pm – 4.8 ft.

Unusually high or low tides (above 6 feet or below zero) are marked in bold.

Step 1b: Get the Currents at Golden Gate:

Currents in Knots — Pacific Standard Time

		MAX Current			MAX Current		MAX Current			MAX Current		
Day	Slack	Time H.M.	Vel Knots	Slack	Time H.M.	Vel Knots	Slack	Time H.M.	Vel Knots	Slack	Time H.M.	Vel Knots	Slack
1 Mon	0234	0537	3.4F	0844	1140	4.0E	1537	1831	3.1F	2129			
2 Tue		0000	2.9E	0330	0630	3.3F	0931	1235	4.4F	1632	1933	3.5F	2234
3 Wed		0101	2.7E	0423	0720	3.3F	1016	1326	**4.8E**	1724	2028	3.8F	2333
4 Thr		0157	2.6E	0514	0808	3.2F	1101	1414	**5.1E**	1812	2118	4.0F	

- Slack @ 4:23,
- Max Flood @ 7:20am/3.3 kts.,
- Slack @ 10:16am,
- Ebb @ 1:36pm/4.8 kts.
- Slack @ 5:24 pm
- Max Flood @ 8:28 pm
- Slack @ 11:33 pm

Currents over 4 knots are marked in bold. Plan with special care during these periods.

Step 2: Correct For Location

We know the tides and currents for GG, but we are not rowing at GG. We need to correct our findings to get conditions near the Dolphin Club.

The tide books also provide the "differences" or correction factors to apply to the GG tides to get predicted tides and currents at other locations.

The page at right (Pg 6 in the tide book) shows the correction to "Tide" (water height) information for many locations. Notice the lines for Alcatraz and San Francisco, North Point, Pier 41. These locations are close to the club, and will do for our calculations.

Reading across the columns for both locations...

Alcatraz – High Tide: 14 min later than GG
Low Tide: 18 Min Later than GG

North Point - High Tide: 13 min later than GG
Low Tide: 11 Min Later than GG

Most Dolphins just simplify the correction to +15 min for both. That's close enough for our needs.

The tide height corrections for these locations are zero f very small, and we can ignore them.

TIDAL DIFFERENCES FROM THE GOLDEN GATE

HIGH WATER TIME	HIGH WATER HEIGHT	LOCATION	LOW WATER TIME	LOW WATER HEIGHT
		OUTER COAST		
–1.08	–0.5	Monterey, Monterey Bay	–0.47	0.0
–1.08	*0.88	General Fish Company Pier	–0.46	*0.94
–1.10	–0.7	Moss Landing, Ocean Pier	–0.48	–0.1
–1.06	*0.87	Elkhorn Slough, Highway 1 Bridge	–0.49	*0.91
–0.54	–0.5	Pacific Mariculture Dock	–0.40	0.0
–0.43	–0.4	Kirby Park, Elkhorn Slough	–0.39	–0.1
–1.15	–0.6	Santa Cruz, Monterey Bay	–0.58	0.0
–1.06	–0.3	Princeton, Half Moon Bay	–0.50	0.0
–0.49	+0.1	Ocean Beach, outer coast	–0.35	0.0
–0.11	*0.70	Bolinas Lagoon	+0.37	*0.61
–0.50	–0.1	Point Reyes	–0.26	0.0
–0.12	*0.87	Tomales Bay Entrance	+0.20	*0.91
+0.32	*0.86	Blakes Landing, Tomales Bay	+1.15	*0.79
+0.38	–0.6	Marshall, Tomales Bay	+1.16	–0.1
+0.40	–0.6	Inverness, Tomales Bay	+1.24	–0.2
–0.38	–0.2	Bodega Harbor Entrance	–0.16	+0.1
–0.51	*0.96	Fort Ross	–0.30	*0.96
–0.40	*1.00	Arena Cove	–0.17	*1.04
–0.42	–0.1	Point Arena	–0.21	0.0
		NORTH COAST		
–0.38	–0.1	Mendocino, Mendocino Bay	–0.21	0.0
–0.30	*1.00	Fort Bragg Landing	–0.20	*1.00
–0.31	+0.1	Noyo River	–0.12	+0.1
–0.31	–0.1	Westport	–0.22	0.0
–0.39	+0.2	Shelter Cove	+0.01	0.0
–0.28	–0.1	Cape Mendocino	+0.01	0.0
+0.05	+0.5	Humboldt Bay North Spit	+0.20	–0.5
+0.06	+0.5	Fields Landing, Humboldt Bay	+0.20	–0.5
+0.15	+0.6	Eureka, Humboldt Bay, Outer Coast	+0.20	+0.4
+0.10	+0.6	Trinidad Harbor, Outer Coast	+0.00	+0.5
+0.40	+0.3	Crescent City, Outer Coast	+0.10	+0.5
		SAN FRANCISCO BAY (Central)		
–0.17	+0.3	Point Bonita, Bonita Cove	–0.10	0.0
+0.14	0.0	Alcatraz Island	+0.18	0.0
+0.13	+0.2	San Francisco, North Point, Pier #41	+0.11	0.0
+0.23	+0.4	Rincon Point, Pier #22½	+0.25	0.0
+0.25	*1.06	Yerba Buena Island	+0.33	*0.99
+0.28	+0.3	Oakland, Matson Wharf	+0.36	0.0
+0.33	+0.2	Oakland Pier	+0.48	0.0
+0.37	+0.5	Oakland Inner Harbor	+0.41	0.0
+0.32	*1.12	Alameda	+0.41	*0.98
+0.33	+0.4	Oakland Inner Harbor, Grove Street	+0.42	0.0
+0.38	+0.6	Oakland Harbor, Park Street Bridge	+0.44	0.0

NOTE: When an asterisk (*) precedes a difference, that difference given is a ratio, and the height of high or low water at the Golden Gate is multiplied by the ratio to determine the height at the station.

At left is the list of adjustments to Currents (Pg 9). The best location to use for our rowing area is the "Alcatraz Is. S" location. That is a point between the cove and the south end of Alcatraz.

The left-hand column tell us that the time of the Low Slack, the slack water that follows an ebb, will be 29 minutes *earlier* than at Golden Gate (that's correct, *earlier*. It seems odd but that's how it works). Continuing across the page...

Alcatraz S.: Low Slack – 29 min. earlier than GG

Peak Flood – 15 min. earlier than GG

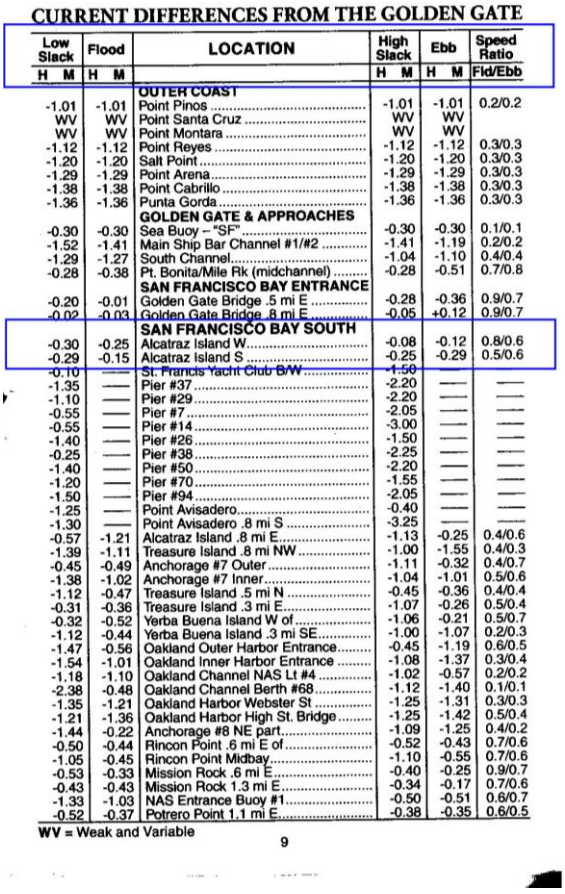
High Slack – 25 min earlier than GG

Peak Ebb – 29 min earlier than GG

Peak Flood Speed – 0.5 times GG

Peak Ebb Speed – 0.6 times GG

Most Dolphin rowers simplify the correction to say that the times of current events are 20 to 30 minutes *before* GG and the speeds are halved. That's usually close enough for our purposes.



CURRENT DIFFERENCES FROM THE GOLDEN GATE

Low Slack H M	Flood H M	LOCATION	High Slack H M	Ebb H M	Speed Ratio Fld/Ebb
		OUTER COAST			
-1.01	-1.01	Point Pinos	-1.01	-1.01	0.2/0.2
WV	WV	Point Santa Cruz	WV	WV	
WV	WV	Point Montara	WV	WV	
-1.12	-1.12	Point Reyes	-1.12	-1.12	0.3/0.3
-1.20	-1.20	Salt Point	-1.20	-1.20	0.3/0.3
-1.29	-1.29	Point Arena	-1.29	-1.29	0.3/0.3
-1.38	-1.38	Point Cabrillo	-1.38	-1.38	0.3/0.3
-1.36	-1.36	Punta Gorda	-1.36	-1.36	0.3/0.3
		GOLDEN GATE & APPROACHES			
-0.30	-0.30	Sea Buoy – "SF"	-0.30	-0.30	0.1/0.1
-1.52	-1.41	Main Ship Bar Channel #1/#2	-1.41	-1.19	0.2/0.2
-1.29	-1.27	South Channel	-1.04	-1.10	0.4/0.4
-0.28	-0.38	Pt. Bonita/Mile Rk (midchannel)	-0.28	-0.51	0.7/0.8
		SAN FRANCISCO BAY ENTRANCE			
-0.20	-0.01	Golden Gate Bridge .5 mi E	-0.28	-0.36	0.9/0.7
-0.02	-0.03	Golden Gate Bridge .8 mi E	-0.05	+0.12	0.9/0.7
		SAN FRANCISCO BAY SOUTH			
-0.30	-0.25	Alcatraz Island W	-0.08	-0.12	0.8/0.6
-0.29	-0.15	Alcatraz Island S	-0.25	-0.29	0.5/0.6
-0.10	——	St. Francis Yacht Club B/W	-1.50	——	——
-1.35	——	Pier #37	-2.20	——	——
-1.10	——	Pier #29	-2.20	——	——
-0.55	——	Pier #7	-2.05	——	——
-0.55	——	Pier #14	-3.00	——	——
-1.40	——	Pier #26	-1.50	——	——
-0.25	——	Pier #38	-2.25	——	——
-1.40	——	Pier #50	-2.20	——	——
-1.20	——	Pier #70	-1.55	——	——
-1.50	——	Pier #94	-2.05	——	——
-1.25	——	Point Avisadero	-0.40	——	——
-1.30	——	Point Avisadero .8 mi S	-3.25	——	——
-0.57	-1.21	Alcatraz Island .8 mi E	-1.13	-0.25	0.4/0.6
-1.39	-1.11	Treasure Island .8 mi NW	-1.00	-1.55	0.4/0.3
-0.45	-0.49	Anchorage #7 Outer	-1.11	-0.32	0.4/0.7
-1.38	-1.02	Anchorage #7 Inner	-1.04	-1.01	0.5/0.6
-1.12	-0.47	Treasure Island .5 mi N	-0.45	-0.36	0.4/0.4
-0.31	-0.36	Treasure Island .3 mi E	-1.07	-0.26	0.5/0.4
-0.32	-0.52	Yerba Buena Island W of	-1.06	-0.21	0.5/0.7
-1.12	-0.44	Yerba Buena Island .3 mi SE	-1.00	-1.07	0.2/0.3
-1.47	-0.56	Oakland Outer Harbor Entrance	-0.45	-1.19	0.6/0.5
-1.54	-1.01	Oakland Inner Harbor Entrance	-1.08	-1.37	0.3/0.4
-1.18	-1.10	Oakland Channel NAS Lt #4	-1.02	-0.57	0.2/0.2
-2.38	-0.48	Oakland Channel Berth #68	-1.12	-1.40	0.1/0.1
-1.35	-1.21	Oakland Harbor Webster St	-1.25	-1.31	0.3/0.3
-1.21	-1.36	Oakland Harbor High St. Bridge	-1.25	-1.42	0.5/0.4
-1.44	-0.22	Anchorage #8 NE part	-1.09	-1.25	0.4/0.2
-0.50	-0.44	Rincon Point .6 mi E of	-0.52	-0.43	0.7/0.6
-1.05	-0.45	Rincon Point Midbay	-1.10	-0.55	0.7/0.6
-0.53	-0.33	Mission Rock .6 mi E	-0.40	-0.25	0.9/0.7
-0.43	-0.43	Mission Rock 1.3 mi E	-0.34	-0.17	0.7/0.6
-1.33	-1.03	NAS Entrance Buoy #1	-0.50	-0.51	0.6/0.7
-0.52	-0.37	Potrero Point 1.1 mi E	-0.38	-0.35	0.6/0.5

WV = Weak and Variable

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Summary: Corrections for Dolphin Club rowing area

Tide: Add 15 min to GG

Current: Subtract 20-30 min from GG and halve the speed

Let's perform Step 2 for the morning of Dec 3rd:

Tides at Golden Gate (from table)	**Correction to Dolphin Club**	**Tides at Dolphin Club**
Low @ 2:01 am	Add 15 min to GG	Low @ 2:16 am
High @ 8:36 am	Add 15 min to GG	High @ 8:41 am

Currents at Golden Gate (from table)	**Correction to Dolphin Club**	**Currents at Dolphin Club**
Slack Water @ 4:23 am	Subtract 20-30 min & 1/2 speed	Slack Water @ 4 am
Max Flood @ 7:20 am / 3.3 kts	Subtract 20-30 min & 1/2 speed	Max Flood @ 7 am / 1.6 kts
Slack Water @ 10:16 am	Subtract 20-30 min & 1/2 speed	Slack Water @ 9:50 am
Max Ebb at 1:36pm / 4.8 kts	Subtract 20-30 min & 1/2 speed	Max Ebb @1:10 pm / 2.4 kts.

NOTE: Yes… we've rounded and done some "rough estimating" on the current figures. We could have used the exact difference figures to get exact times and speeds, but that level of accuracy is neither required nor what we really experience on the bay (more on that later). Don't be afraid to use rough calculations in order to get a general feeling for the conditions.

Step 3: Correct for Current Time:

Now we know the times of the important tide events at Aquatic Park, but we are interested in the state of the current *now*. Unless we are, by chance, rowing at the time of slack or peak current, we will need to make one further correction.

Let's imagine that we are at the club, preparing to leave the dock at 8:30 am on the day discussed above, Dec. 3. We found that the time of Max Flood current near the DC was at 7 am. There is about 3 hours between a peak current and slack water, so, since we are 1.5 hours after the peak, we are about ½ of the way from peak to slack.

For an 8:30 am departure....

- Current at 7 am (peak flood): 1.6 kts
- Current 1.5 hrs later (½ way to slack): About 0.8 kts. and dropping

If we were leaving at 7:30 we would know that that the flood would be only a bit below the peak of 1.6 kts, perhaps 1.4 kts.

If, on the other hand, we slept late and are at the dock between 9:30 and 10 am, we would know that we are leaving close to slack, and that a strong ebb was coming. By noon the ebb will be close to 2 kts (heading towards a peak of 2.4 kts near 1 pm. We would plan our row around the expectation of an ebb current.

Planning Your Row:

You've learned how to calculate the tides and currents near the club; how does that effect your row planning?

Where to Row:

The rule of thumb is... "do the hard part first", which means row up-current (into the current) and then turn around and ride the current home to the club. In a flood current, row west toward the GG Bridge. On an ebb current row east along the piers towards the Bay Bridge.

An Example:

Rowing the boat at 3 knots (a comfortable pace in our wooden singles), in a 1 knot *ebb current*

The right way:

- Row *east* making 2 knots net speed (3 knots rowing minus 1 knot of current).
- Get to Ferry Building (2 nm) in one hour.
- Return at 4 knots net (3 kts in the water plus one kt current), getting safely to DC in ½ hour

If you are over-tired, feeling an injury, or suffer an the current will help bring you home.

The wrong way:

- Row *west* making 4 kts net speed
- Get to far end of Crissy Field in only 30 min. Feeling a bit tired….
- Turn into current (up to 2 knots close to GGB) and make only 1 knot net speed toward home.
- Stagger back to DC in 1/5 to 2 hours (if your muscles hold out).

Summary... "Row Uphill"

Starting your row up-current is like traveling uphill; you have the safety factor in an easier row home, assisted by the current. Conversely rowing down-current is risky, you need to be sure you have the strength to get home.

Special Case: Getting Close to Slack.

If you leave the dock close to the next slack water, a different approach might be best.

For example: You depart into a flood tide about 45 minutes before the expected slack. If you decide, "it's flooding, I should go west", you will fight the flood current heading west, turn around at slack water, and then fight the growing ebb current on your return. You are being hindered by the current in both directions.

Be sure to consider the implications of the new, growing current after the slack. In the scenario described above, you can ride the flood current east to the Bay Bridge or beyond, and then pick-up the new ebb current for the ride home, an excellent strategy!

Also, the period around the slack is a good time to row cross-current, perhaps to Alcatraz or Angel Island.

Special Case: "Big Ebbs": In SF Bay the ebb current is generally more challenging than the flood:

1. Ebbs are stronger. More water leaves the bay than comes in (California's major rivers empty out through the bay)
2. Ebbs generate more rough water and tidal rips and often oppose the wind, further increasing the waves
3. Ebbs become faster and more violent as they approach the constriction at the GG Bridge
4. Ebbs are carrying you out to the ocean

… so ebb currents are a greater concern than flood currents. Pay attention to the "big ebbs", marked in bold in the tide book, and plan cautiously before you row. Have a "bail-out plan" ready if the current overwhelms you.

Our more ordinary ebbs and floods are unlikely to cause serious risk, but the occasional big ebb current can be trouble. If you are not confident of your strength and rowing abilities, stay off the water in these times and wait for better conditions.

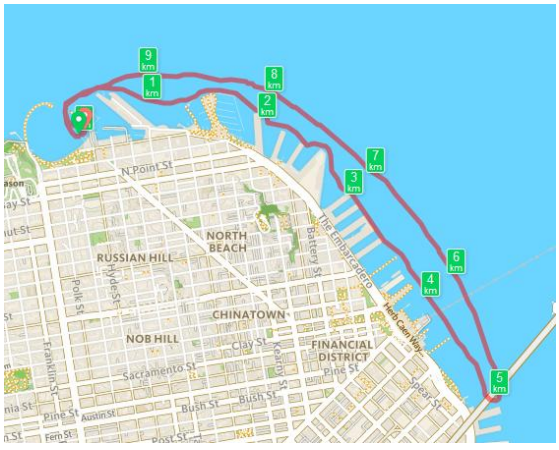
Managing the Current

When rowing against a current, usually on the outbound leg of your row, you need not stay out in the flow and fight it, there are ways to hide from it and take advantages of the local variations in current.

Tip 1: Stay Close going against the current: In general the currents are slower close to shore, and obstacles will impede the flow and create pockets of quiet water we can exploit. A typical route hugs the shoreline going outbound, then swings out several hundred meters to find a faster current for the "ride" home.

Tip 2: Hide behind obstacles that slow the current:

Going east along the piers, rowers will "pier-hop" their way through the current. An ebb current flows fast along the city-front, but the piers create pockets of still water between them. Row hard to get around each pier (stay close!) and then tuck into the space between the piers to escape the flow, and row easily to the next pier. Then pull out into the current, and round that pier. Repeat at each pier. Be careful to look for departing ferries as you clear each pier.



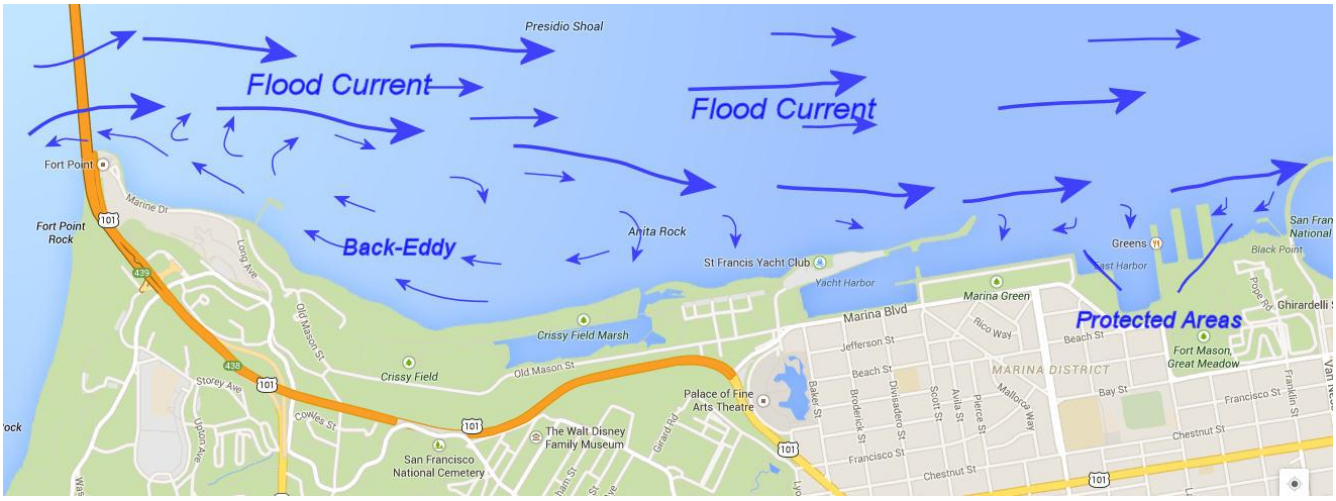
At right is a GPS track from a row to the "Alpha" tower of the Bay Bridge, hugging the piers on the way out and running free in the current on the way back. According to the GPS the row back took almost exactly half the time of the row out.

Going west one can use the Ft. Mason piers and the rock breakwater at the yacht harbor to escape a flood current for part of the distance.

Tip 3: Exploit Local Variations: Water does not flow into or out of the bay in one smooth stream. It swirls and

eddies in response to the shape of the bay and the contour of the bottom. This introduces small-scale local variations that rowers learn and use. The most useful is the back-eddy at Crissy Field.

A strong flood current, pouring under the GG Bridge, creates a “back-eddy” that rotates along the beach of Crissy Field. Rowers heading west against a flood will feel the current easing as they pass the Yacht Club, and will be helped by a small westward current close to the beach. This back-current will often extend a short distance out, past the bridge, beyond Ft. Point.



Smaller local current variations are helpful rounding Angel Island or Alcatraz. Local tidal rips can have the reverse effect, making for rough water and adverse currents that you hadn’t planned on. You will learn this important local lore of the bay by staying observant during your rows, carefully exploring the bay in different conditions, and by speaking to experienced rowers in the club.

Tip 4:Angle into a current when rowing across the flow:

- Point your boat into the current to keep your actual track headed where you want to go.
- Don’t let a current push you below (down current) from your goal. Hard rowing getting back upstream!

In the example at right, one rower points his boat straight at Alcatraz, but doesn't get there, as the current pushes his course further east.

The smarter rower aims a bit to the west, into the current. Her boat tracks directly to the island.