Transfer of Chart Datums

by Pat Sanders

During my recent overseas training tours, one of the attendees asked a simple question.

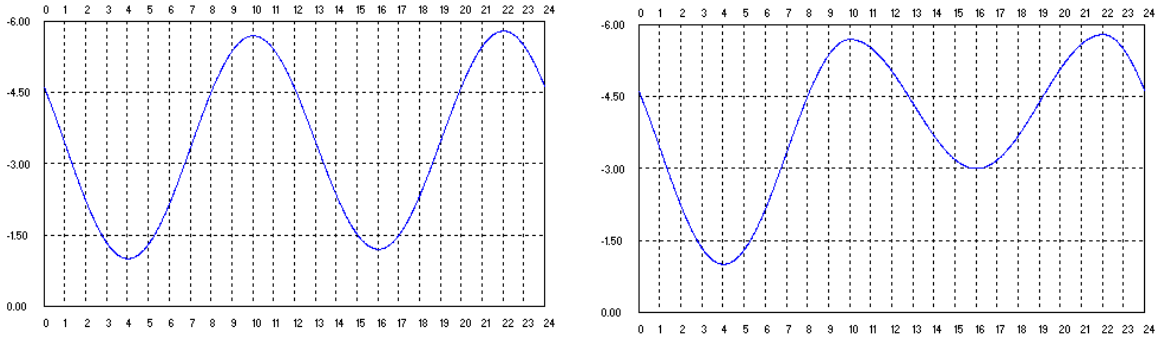
“If I am surveying 20km away from a known tide station, how can I determine the chart datum at my location?”

In the USA, we are a little spoiled, with vertical bench marks located frequently along the coast. Overseas, surveyors aren’t always so lucky. After a sleepless night, I remembered an old British Admiralty publication N.P.122(2), entitled Admiralty Tidal Handbook No. 2, Datums for Hydrographic Surveys. My copy has a “Crown Copyright 1975” date on it. I wasn’t sure it was still available, but found it for sale on the web. One of the providers was: http://www.bookharbour.com/admiralty-publications/np122-2-tidal-handbook-no.2-datums-for-hydrographic-surveys/

I would recommend that you purchase the manual and add it to your hydrographic library! Chapter 6 is entitled “Transferring Datum When Tide is “Semi-Diurnal” and Chapter 7 is entitled “Transferring Datum When Tide is “Diurnal”. All details in this article are taken directly from this publication.

As an example, I would like to demonstrate transferring the datum for a Semi-Diurnal tide.

FIGURE 1. *Semi-diurnal Tide (left), Diurnal Tide (right)*



In Figure 1, the graph on the left shows a “semi-diurnal” tide. The subsequent highs and lows are very similar. The graph on the right shows a “diurnal” tide. There are large differences between subsequent highs and or lows. No tide is completely “semi-diurnal” or “diurnal”, but is a combination of the two. In order to determine the proper method to transfer your chart datum, you will have to make a decision whether your local tide is primarily “semi-diurnal” or “diurnal”.

Transferring the Datum When the Tide is Primarily “Semi-diurnal”

This method requires short period observations at both an established gauge (where the chart datum is known) and your local gauge (where you are trying to establish the chart

datum). You need to record the tide values for four consecutive low waters and the three intervening high waters.

This method works best during spring tides, when the range of differences between high and low waters is the greatest.

FIGURE 2. *Comparing Observed Water Levels at Two Tide Gauges*

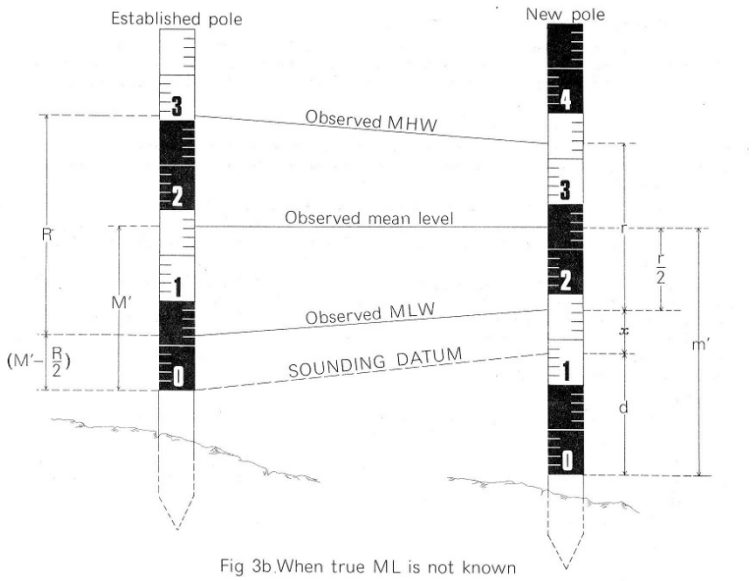


Figure 2 is taken directly from the N.P.122(2) publication. It demonstrates what we are trying to do by comparing the simultaneous observations. Based on our observations, we will calculate the Observed Mean Level, the Observed Mean High Water and the Observed Mean Low Water at both gauges. We will then make the assumption that the relative ratios of these values can also be used to determine the Sounding Datum at the new gauge.

I spent about 15 minutes in Excel to make a spreadsheet that contained the functions provided in Figure 4 from N.P.122(2). Figure 3 shows the results.

FIGURE 3. *Functions Provided in Figure 4 from N.P.122(2)*

Transfer of Sounding Datum

(where tide is mainly semi-diurnal)

	At Established Gauge					At New Gauge				
	Heights Above Chart Datum			Contribution For		Heights Above Chart Datum			Contribution For	
	H.W.	L.W	Factor	H.W.s	L.W.s	H.W.	L.W	Factor	H.W.s	L.W.s
a		1.20	1.00		1.20		1.40	1.00		1.40
b	5.50		1.00	5.50		3.55		1.00	3.55	
c		0.85	3.00		2.55		1.32	3.00		3.96
d	4.62		2.00	9.24		3.02		2.00	6.04	
e		1.15	3.00		3.45		1.38	3.00		4.14
f	5.40		1.00	5.40		3.40		1.00	3.40	
g		0.90	1.00		0.90		1.34	1.00		1.34
	Sums of Contributions			20.14	8.10	Sums of Contributions			12.99	10.84
	Observed MHW and MLW			5.035	1.0125	Observed MHW and MLW			3.25	1.36

Observed Mean Range (R)	4.02	Observed Mean Range (r)	1.89
Observed Mean Level (M')	3.02	Observed Mean Level (m')	2.30

Where 'True Level M.L.' at Established Gauge is Known		Where 'True Level M.L.' at Established Gauge is not known
d = m' - (M' - M) - [M * (r/R)]		d = m' - (M' * r)/R
M.H.W.S.	5.05	
M.L.W.S.	0.95	d: 0.88
M	3.00	
d:	0.87	

The heights of the Low Waters and High Waters are observed at each gauge and entered as shown. They are then multiplied by the weighting factors to compute the total contribution of each observation. Those are summed and then divided by the sum of the factors to get the Observed Mean High Water (MHW) and Observed Mean Low Water (MLW) for each gauge.

The Observed Mean Range (R and r) is then calculated for each gauge:

Obs. Mean Range = Obs. MHW – Obs. MLW **(EQ 1)**

The Observed Mean Level (M’ and m’) is calculated for each gauge:

Obs. Mean Level = [Obs. MHW + Obs. MLW]/2 **(EQ 2)**

If you know the position of MHWS and MLWS on the established gauge, you can use the process on the left-hand side. If those items are not known, you can use the method on the left.

Based on the sample numbers, the level of the Chart Datum at our New Gauge is at 0.88 on the gauge.

Transferring the Datum when the tide is primarily "diurnal"

Ha! Buy the book!

I urge all of you to try to locate and purchase a copy of NP122(2). Seriously, you'll learn a lot!