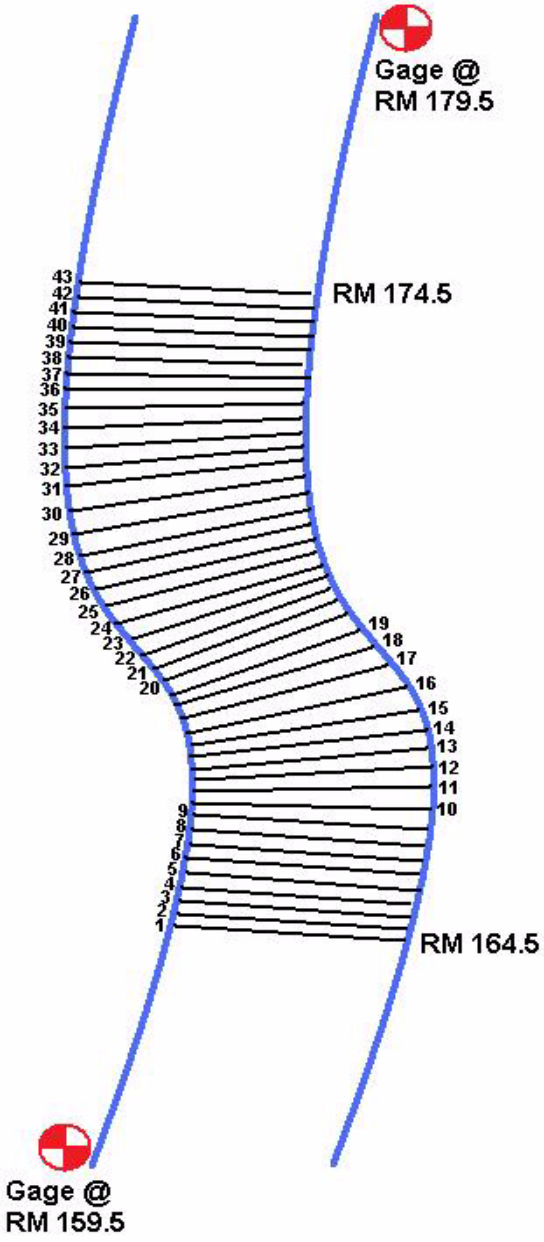
Tides: Elevation and Sloping Rivers

By Joe Burnett

In Continuation with the tides articles, we are now going to look at creating tide files for elevation water surfaces. This can be a little tricky. The main concern is going to be your vessel's location and time within the survey reach.

Assuming that you are able to collect all of your survey data from line 1 to 43, in successive order, then your tide file will be fairly straightforward and easy to setup.

FIGURE 1. *Hypothetical River Project*



A few things have to be taken into consideration:

Scenario #1

1. Boat speed for all lines is the same.
2. Time between lines is the same.
3. No stoppage during entire survey.
4. Lines were collected in successive line number order (from downstream to upstream, or vice versa).

Scenario #2

1. Boat speed for all lines is the same
2. Time between lines is the same
3. Take lunch break of 1 hour at 12:00, between lines 19 & 20.
4. Lines were collected in successive line number order (from downstream to upstream, or vice versa).

Scenario # 3

1. Boat speed for all lines is the same.
2. Time between lines is the same.
3. After collecting lines 1 thru 9, a downstream barge at 10:00, caused you to skip to lines 30 thru 43,from 10:30 until 12:00, before returning to complete lines 10 thru 29, from 12:30 until 17:00.

Scenario # 4

1. Boat speed for all lines is irrelevant.
2. Time between lines is irrelevant.
3. Order that the Lines are collected in, is irrelevant.
4. Lunch Break or Vessel Breakdown, is irrelevant.

First, we need our gage information.

FIGURE 2. *Trout's Bend Tide Data*

For data in ELEV
For 30 Day STAGE Data

DATE_TIME	VALUE
09-25-2010 00:00	45.86
09-24-2010 23:00	45.78
09-24-2010 22:00	45.69
09-24-2010 21:00	45.61
09-24-2010 20:00	45.57
09-24-2010 19:00	45.46
09-24-2010 18:00	45.34
09-24-2010 17:00	45.27
09-24-2010 16:00	45.16
09-24-2010 15:00	45.04
09-24-2010 14:00	44.96
09-24-2010 13:00	44.87
09-24-2010 12:00	44.76
09-24-2010 11:00	44.73
09-24-2010 10:00	44.60
09-24-2010 09:00	44.50
09-24-2010 08:00	44.38
09-24-2010 07:00	44.25
09-24-2010 06:00	44.05
09-24-2010 05:00	43.92
09-24-2010 04:00	43.79
09-24-2010 03:00	43.61
09-24-2010 02:00	43.52
09-24-2010 01:00	43.37
09-24-2010 00:00	43.19

Trout's Bend -- Atchafalaya River
River Mile 179.5

GAGE ID: ATTP GAGE ZERO: **354.14** ft NGVD 88
LEVEL: STAGE
UNITS: FT

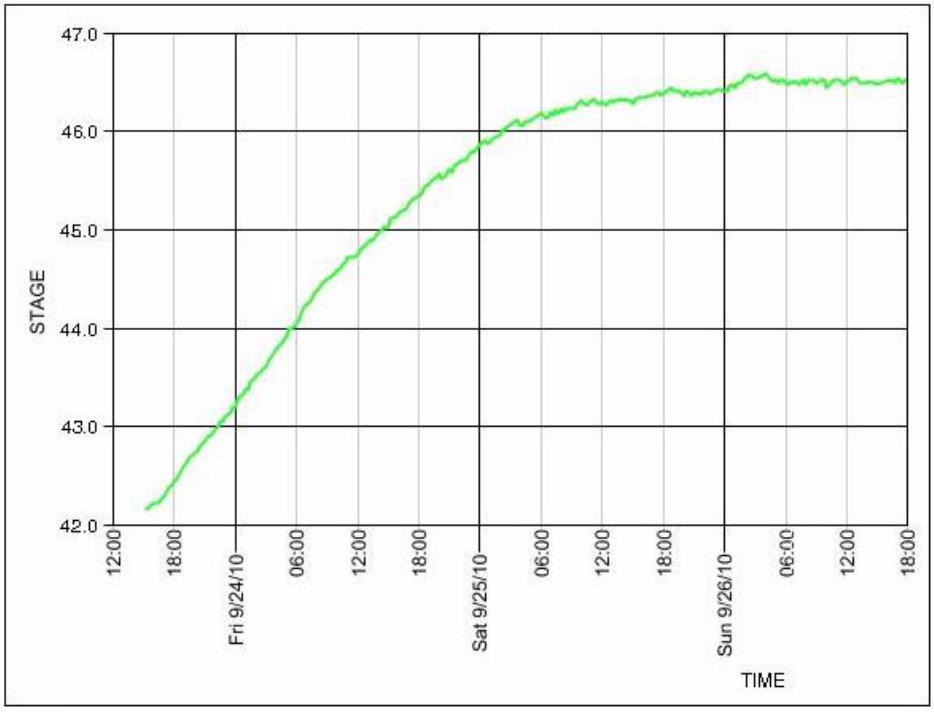
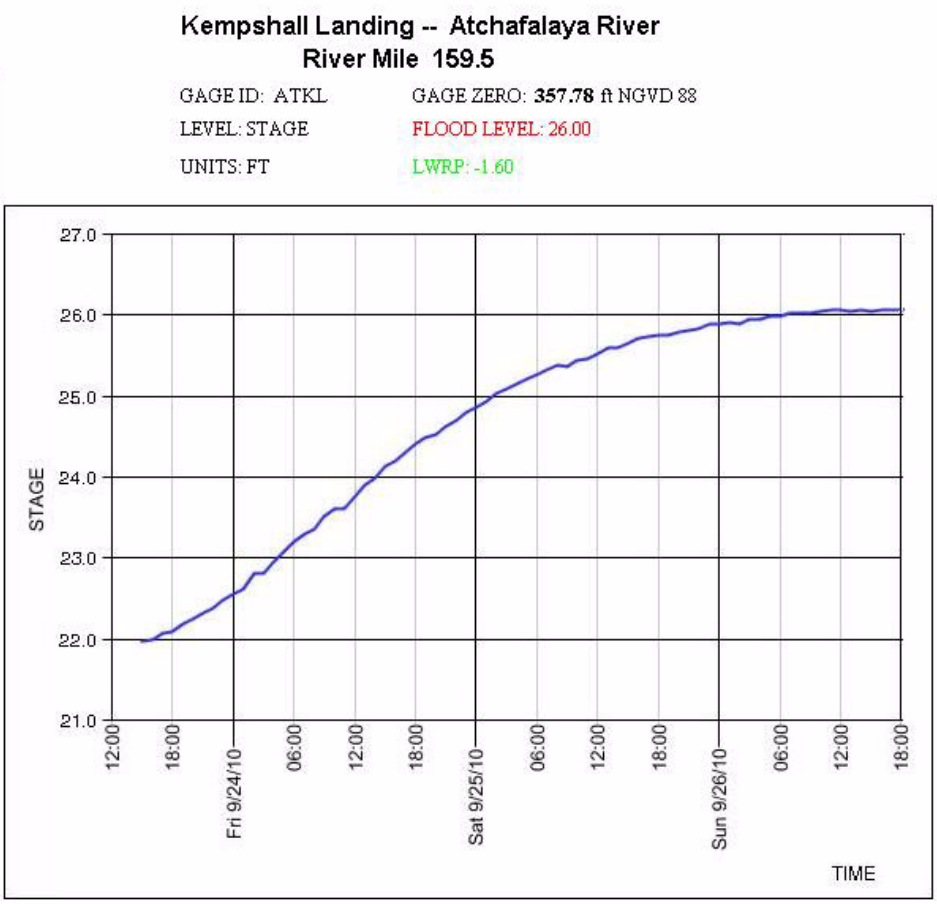


FIGURE 3. *Kempshall Landing Tide Data*

For data in ELEV
For 30 Day STAGE Data

DATE_TIME	VALUE
09-25-2010 00:00	24.86
09-24-2010 23:00	24.79
09-24-2010 22:00	24.71
09-24-2010 21:00	24.62
09-24-2010 20:00	24.53
09-24-2010 19:00	24.49
09-24-2010 18:00	24.41
09-24-2010 17:00	24.31
09-24-2010 16:00	24.20
09-24-2010 15:00	24.13
09-24-2010 14:00	23.98
09-24-2010 13:00	23.91
09-24-2010 12:00	23.76
09-24-2010 11:00	23.62
09-24-2010 10:00	23.62
09-24-2010 09:00	23.52
09-24-2010 08:00	23.36
09-24-2010 07:00	23.30
09-24-2010 06:00	23.20
09-24-2010 05:00	23.08
09-24-2010 04:00	22.95
09-24-2010 03:00	22.82
09-24-2010 02:00	22.82
09-24-2010 01:00	22.62
09-24-2010 00:00	22.56



For all four (4) Scenarios, the following parameters will be the same:

- The survey data collection started at 08:00 a.m., on line # 1, at river mile 164.5
- The survey data collection ended at 17:00 p.m., on line # 43, at river mile 174.5
- Distance between each line is 1250 feet.

Elevation water surface (on a river system) is usually calculated by linearly interpolating between the gage just downstream of the beginning of the survey reach to the gage just upstream of the end of the survey reach.

This linear interpolation must also take into consideration whether the river is rising, falling, or staying on an unchanging slope. It must also consider the time of day at which the survey data was collected, in order to correlate the correct gage information to it.

The following equation is used to calculate the water surface at a particular location and time:

FIGURE 4. *Calculating Interpolated Tide*

$$\text{Water Surface @ River Mile "A" @ XX:XX Time} = \left(\frac{\text{River Mile "A"} - \text{Downstream Gage River Mile}}{\text{Upstream Gage River Mile} - \text{Downstream Gage River Mile}}\right)\left(\text{Upstream Gage Reading @ XX:XX Time} - \text{Downstream Gage Reading @ XX:XX Time}\right) + \left(\text{Downstream Gage Reading @ XX:XX Time}\right)$$

Using the gage information in Figure 2 and Figure 3, the values for the beginning of the survey will be as follows:

FIGURE 5. *Calculating Tide at Start of Survey*

$$\text{Water Surface @ River Mile } 164.5 \text{ @ } 08{:}00 = \left(\frac{164.5 - 159.5}{179.5 - 159.5}\right)\left((44.38+354.14) - (23.36+357.78)\right) + \left((23.36+357.78)\right) = 385.485 \text{ (NGVD 88)}$$

The same will be calculated for the location and time at the end of the survey:

FIGURE 6. *Calculating Tide at End of Survey*

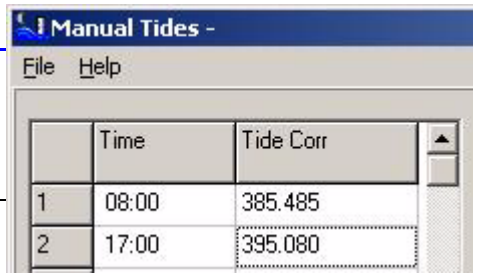
$$\text{Water Surface @ River Mile } 174.5 \text{ @ } 17{:}00 = \left(\frac{174.5 - 159.5}{179.5 - 159.5}\right)\left((45.27+354.14) - (24.31+357.78)\right) + \left((24.31+357.78)\right) = 395.08 \text{ (NGVD 88)}$$

SCENARIO #1

1. Boat speed for all lines is the same.
2. Time between lines is the same.
3. No stoppage during entire survey.
4. Lines were collected in successive line number order (from downstream to upstream, or vice versa).

This Scenario is straightforward. Simply "plug in" the time and water surface elevations into the MANUAL TIDES program, and you are done.

FIGURE 7. *Entering Start and End Tides in MANUAL TIDES*



Save the Tide File with this information and apply it to the collected survey data during processing.

Note: This assumed that all conditions would take place. This is rarely the case.

SCENARIO #2

1. Boat speed for all lines is the same
2. Time between lines is the same
3. Take lunch break of 1 hour at 12:00, between lines 19 & 20.
4. Lines were collected in successive line number order (from downstream to upstream, or vice versa).

This scenario is also straightforward. The only difference from Scenario #1, is that you are going to add two times and tides (elevations) that coincide with the time that lunch began and ended, at the location that you stopped for lunch.

Since you stopped after running Line # 19, we need to figure out where that is.

Line spacing is 1250 feet x 19 = 23750' or 4.5 miles.

Therefore, you stopped at River Mile 169.0 at 12:00.

FIGURE 8. *Calculating Tide at Lunch Time*

$$\text{Water Surface @ River Mile } 169.0 \text{ @ } 12{:}00 = \left(\frac{169.0 - 159.5}{179.5 - 159.5}\right)\left((44.76+354.14) - (23.76+357.78)\right) + \left((23.76+357.78)\right) = 389.786 \text{ (NGVD 88)}$$

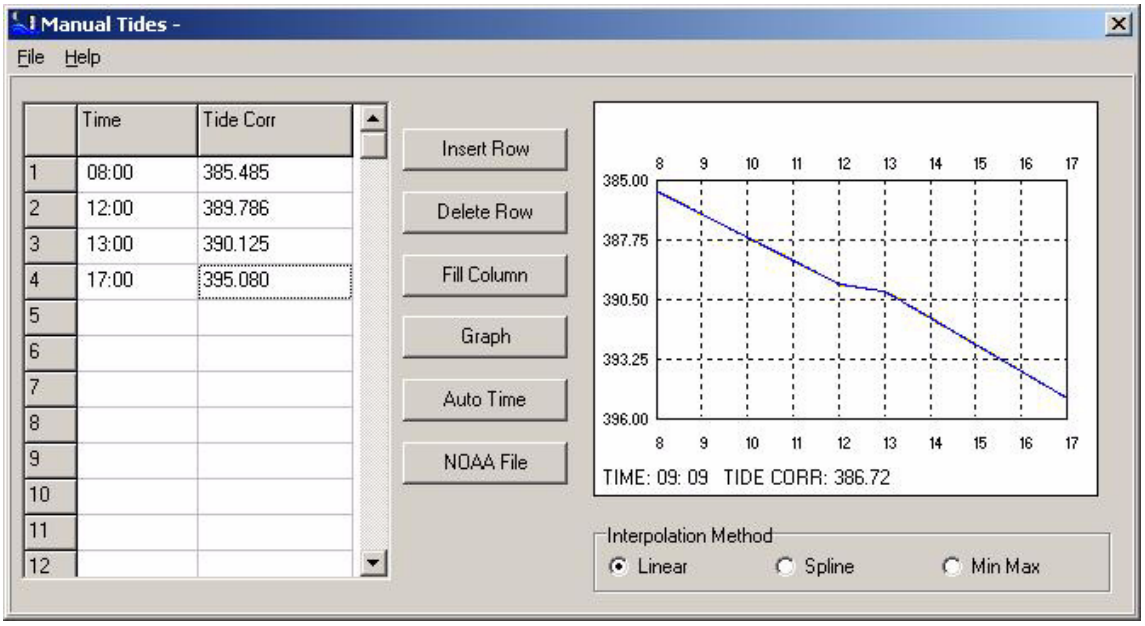
You started again on Line # 20, 1250' x 20 = 25000' or 4.74 miles.

So, you started collecting data again at River Mile 169.24 at 13:00.

FIGURE 9. *Calculating Tide After Lunch*

$$\text{Water Surface @ River Mile } 169.24 \text{ @ } 13{:}00 = \left(\frac{169.24 - 159.5}{179.5 - 159.5}\right)\left((44.87+354.14) - (23.91+357.78)\right) + \left((23.91+357.78)\right) = 390.125 \text{ (NGVD 88)}$$

FIGURE 10. *Entering Your Calculated Tides in MANUAL TIDES*



SCENARIO #3

Scenario #3 is very similar to Scenario #2, but you now have to move to different areas within the Survey Area due to Vessel Traffic, and this will require a little more complex Tide (Elevation) File.

1. Boat speed for all lines is the same.
2. Time between lines is the same.

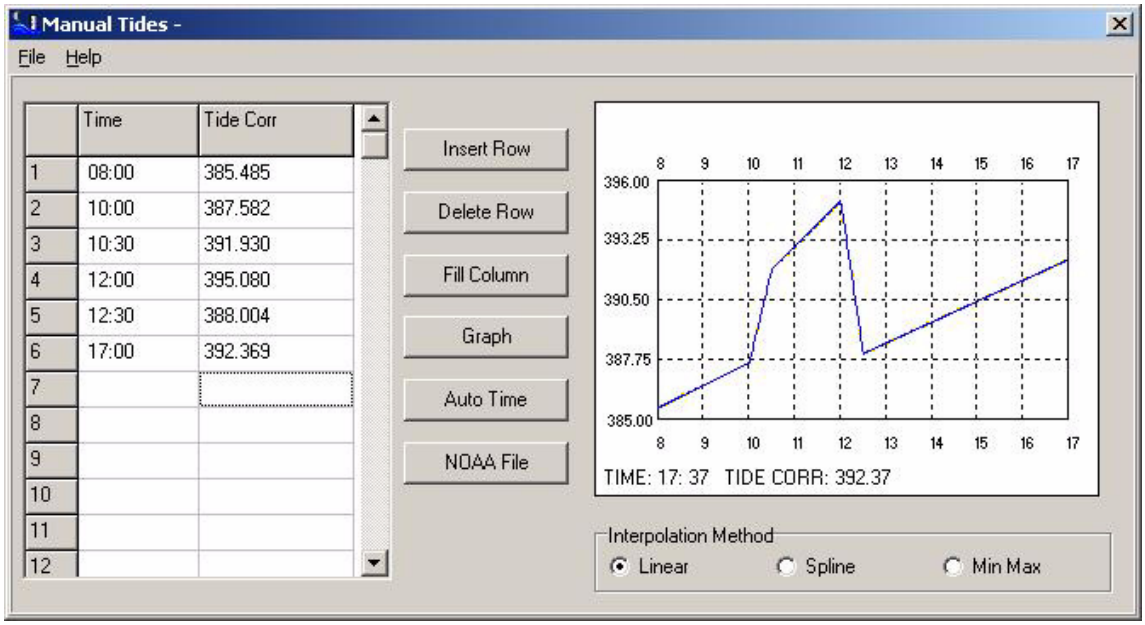
3. After collecting lines 1 thru 9, a downstream barge at 10:00, caused you to skip to lines 30 thru 43,from 10:30 until 12:00, before returning to complete lines 10 thru 29, from 12:30 until 17:00.

FIGURE 11. *Times and Elevations for each set of Lines*

Line #	River Mile	Time	Elevation
1	164.5	**8:00**	**385.485**
9	166.63	**10:00**	**387.582**
30	171.6	**10:30**	**391.930**
43	174.5	**12:00**	**395.080**
10	166.87	**12:30**	**388.004**
29	171.37	**17:00**	**392.369**

Using the same equations as above, we can create a table to be used for filling in the tide program:

FIGURE 12. *Entering the Calculated Tide Data in MANUAL TIDES*



In these first three (3) scenarios, we have used the MANUAL TIDES program to create a tide (elevation) file to be applied during the editing process, whether it be used for single beam or multibeam.

SCENARIO #4

The last Scenario, #4, is a somewhat unique situation, but probably more common than you might think. And you will probably find that it will be the easiest one to set up and use.

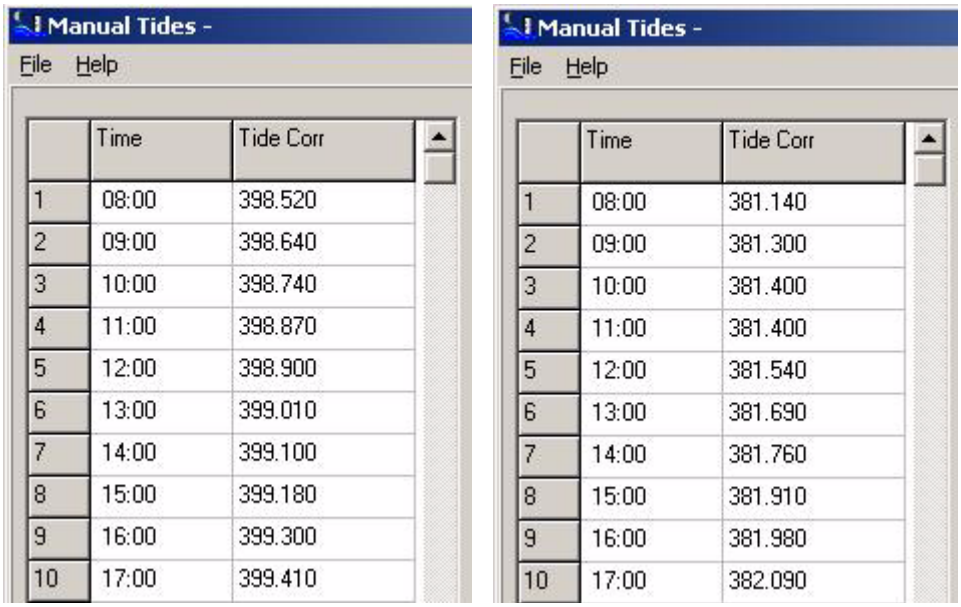
1. Boat speed for all lines is irrelevant.

2. Time between lines is irrelevant.
3. Order that the Lines are collected in, is irrelevant.
4. Lunch Break or Vessel Breakdown, is irrelevant.

Which makes you wonder "Is my Survey irrelevant ??". Not at All !!

The first thing we are going to do, is simply create 2 tide (elevation) files, directly from the tide gage readings.

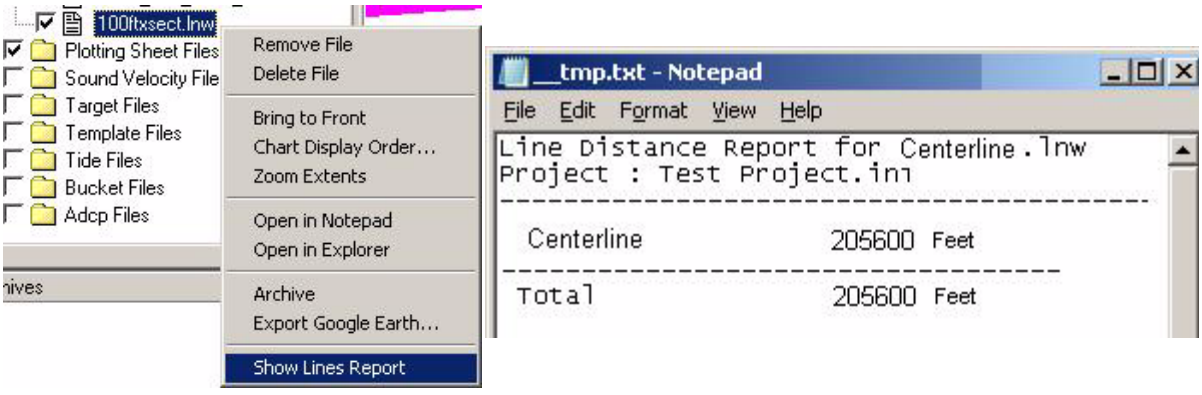
FIGURE 13. *Kempshall Landing Gage, River Mile 159.5 (left), Trout's Bend Gage, River Mile 179.5 (right)*



Next, we need to create a Planned Line File (LNW), that has one line in it—the centerline from the downstream gage to the upstream gage.

Once you have created the LNW file with the centerline, you will need to know the distance from one end to the other, and more specifically, the distance between each gage along the centerline. If you have only two gages—one at the beginning and the other at the end of the centerline—right-click on the line file in the HYPACK® shell and select "Show Lines Report". In the "Show Lines Report", we can find the distance of each line in the LNW file.

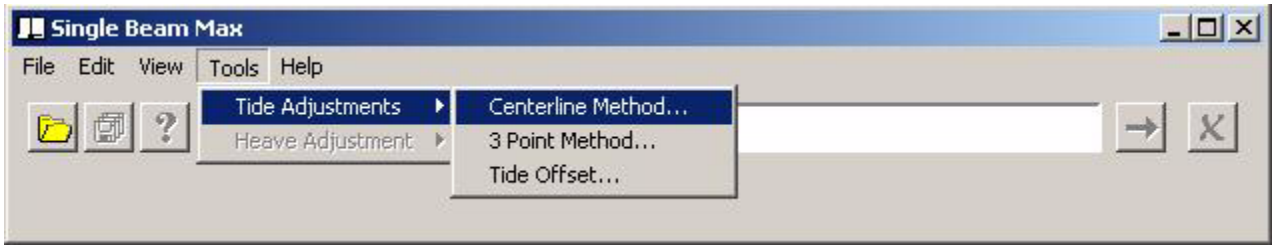
FIGURE 14. *Accessing the Show Lines Report*



We are now ready to begin the editing process.

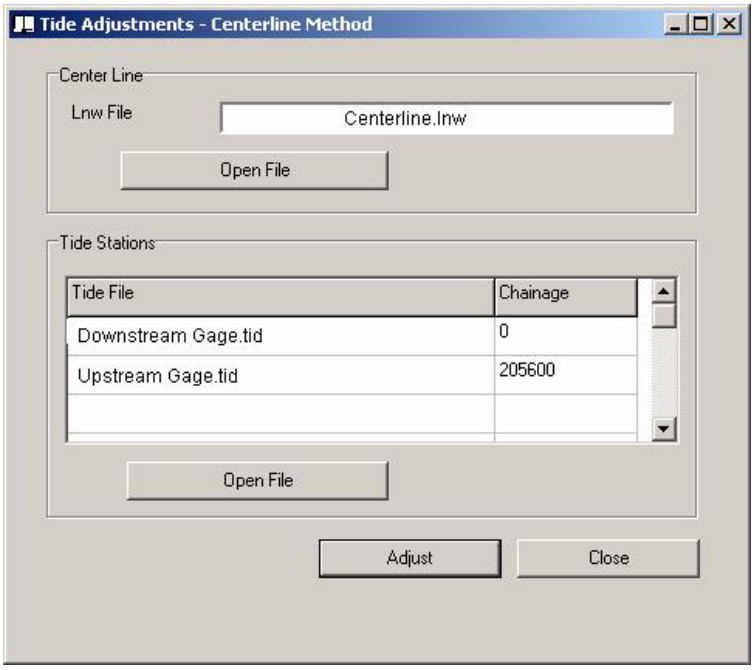
1. Open either the SINGLE BEAM EDITOR (SBMax) or the HYSWEEP® EDITOR (MBMax) and load the raw data into the editor.
2. Select TOOLS-TIDE ADJUSTMENTS-CENTERLINE METHOD.

FIGURE 15. *Accessing Tide Adjustments*



3. **Under Centerline, open your LNW file** with the centerline in it.
4. **Open your two tide (elevation) files and enter the chainage (stationing) of each gage**, in their respective boxes.

FIGURE 16. *Calculating Tide Adjusments*



5. **Click on the Adjust button,** and all the soundings will be "adjusted", with respect to the water surface calculated, based on time and position and the data from the tide gages.

TIDE ADJUSTMENTS

The Centerline Method looks at each sounding, reads the time and position of the sounding, then creates a "perpendicular offset" to the nearest segment of the centerline file. This gives the TIDE ADJUSTMENTS a station (chainage) along the centerline. The program then

calculates the water surface based on the sounding position along your centerline and time that the sounding was collected relative to the data from your two tide gages.

The Centerline Method could be applied to any of the four (4) Scenarios presented in this article.

Like the old saying goes, "Save the Best for Last".