



Volumes, volumes, volumes!

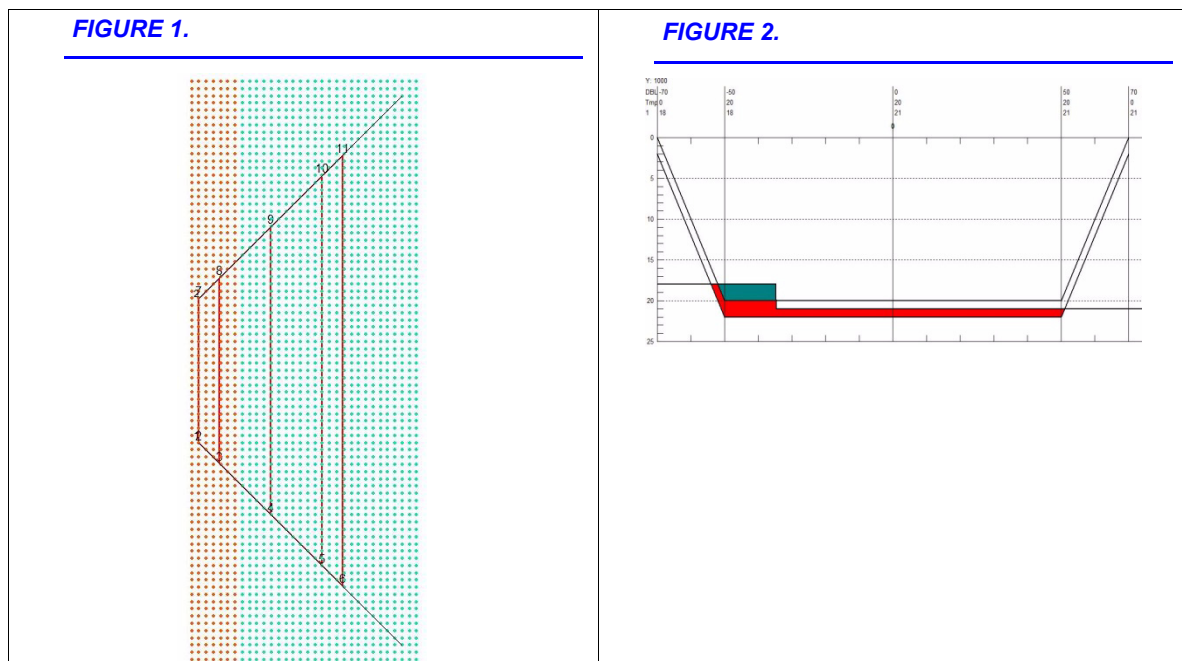
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As we all know, there are several different ways to calculate volumes. There is no one 'correct' method for calculating volumes, and everyone has their preferred way of going about this task, depending on individual experience and what is in the contract specifications. For every method there are both advantages and disadvantages to its use.

On occasion, within the same survey, and even within the same cross section, the different methods can produce very different results. No need to panic! Let's take a look at a few common Volumes Methods and explore some of the reasons behind this volume enigma.

Let's look at the following example.

Figures 1 & 2 demonstrate two non-parallel survey lines. Material is stacked up along the left-side of channel.



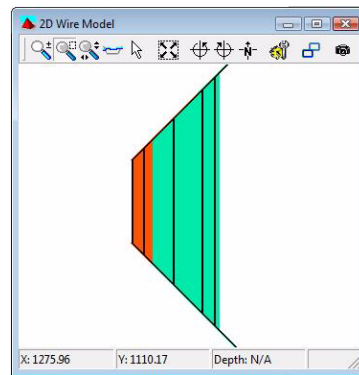
Computing the volumes in the four different methods result in the following total material above design:

TIN	Standard HYPACK	Philadelphia Method	Average End Area 1
3181	3180	3692 (!)	4454 (!!)

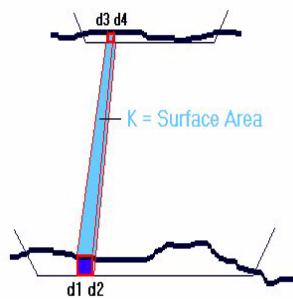
Why did this happen? What's the deal?

TIN MODEL utilizes all of the survey data by creating a series of triangles between sounding data that calculates the volume values individually within these connecting triangles for all the data points on each line. This coverage is so complete it sometimes creates a solid fill and in our opinion, gives the most accurate representation of your channel bottom. This means that the TIN computes the volume **for what the channel bottom is literally doing**, reflecting total channel material, and does not miscalculate volume amounts by missing them in its computations.

FIGURE 3. Volumes calculated in TIN Model



Standard HYPACK (SH) method is not an Average End Area (AEA) method. SH utilizes a Prismatic Method to calculate volumes. This makes SH very similar to a TIN in accuracy. The Prismatic Method creates prisms between soundings and computes the volume across the lines, computing and creating a complete detail of what your design is doing and thus not missing material in these non-parallel survey areas.



The Philadelphia Method is also an AEA but as demonstrated in the above example, it gives a very different result than the AEA1. Philadelphia Method is more precise than the AEA1 in non-parallel survey areas because it breaks the channel into Left of Center and Right of Center and calculates the distance between lines for each 4 zones separately. Philadelphia is more accurate than AEA1 because its required computations include measurements within Left of Center and Right of Center that break the areas into smaller zones and thus minimizing the error in comparison to an AEA1 method.

FIGURE 4. Philadelphia Predredge Cross Section

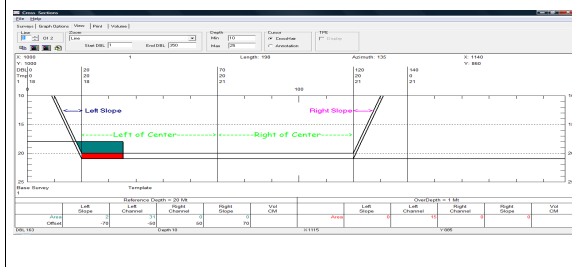
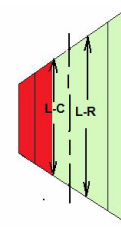


FIGURE 5. Method measures line distances separately



Average End Area 1 (AEA1) is the most common method because of its simplicity but also the least precise method of calculating actual volumes in non-parallel areas because it does not recognize where the material is actually located. AEA1 breaks the channel into 3 areas and measures the distance between lines at the center of the channel and at the channel toe lines. This method of calculation can create errors by underestimating on the outside or over-estimating on the inside material amounts on turns because it basically generates an 'all or nothing' value relative to where the lines fall.

FIGURE 6. Figure 5: Average End Area 1 Cross Section

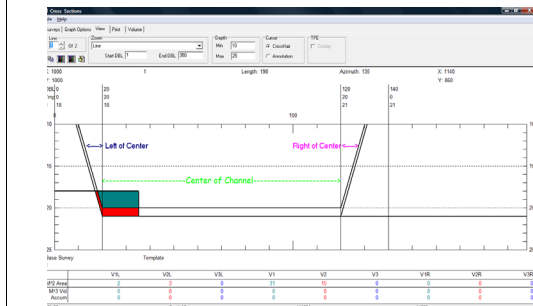
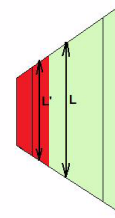


FIGURE 7. Figure 6: AEA does not figure Channel Geometry



All AEA methods calculate their volumes by utilizing the values for their specific areas and line distances. This means that AEA methods can sometimes substantially over- or underestimate material accumulations because they do not take into consideration where the material is located, and so can create gross differences in volume data.

All of these methods are correct, used daily, and not violating any mathematical rules. They all calculate exactly what they are being asked but because of the measurement methods behind the actual formulas, they can produce very different volume results, even within the same cross section.