- Maximum length (l) – distance on the lake surface between the two most distant point on the lake shore

- Maximum width (b) – distance on the lake surface at a right angle to the line of maximum length on a lake

- Mean width (b) is equal to the area divided by the maximum length
  \[ b = \frac{A_o}{l} \]
- **Area** – planar area of the surface or any given contour within the lake (A)

- **Volume** (V) – water volume of a lake

- **Integral of the areas of each stratum at successive depths from the surface to the point of maximum depth**
Volume can be estimated by summation of the frustra of a series of truncated cones of the strata

\[ V = \frac{h}{3}(A_1 + A_2 + \sqrt{A_1A_2}) \]

- \( h \) = vertical depth of stratum
- \( A_1 \) = area of upper surface
- \( A_2 \) = area of lower surface
Volume of a particular stratum of a lake can be calculated by the following formula:

\[ V_{z_1-z_0} = \left( \frac{z_1-z_0}{3} \right) (A_{z_0} + A_{z_1} + \sqrt{A_{z_0}A_{z_1}}) \]
Hypsographic curves are plots of stratum surface area versus depth.

Volume of a lake can be calculated by integrating the area beneath a hypsographic curve.
Volumes of particular strata can be calculated by integrating the area beneath the portion of the curve bounded by the upper and lower depths of the stratum.

Hypsographic curves can also be represented as the percent of the total lake volume lying above a particular depth.
- Maximum depth ($z_m$) – the greatest depth of a lake ($z_m$)
- Mean depth ($z$) – average depth of a lake

$$z = \frac{V}{A_0}$$
Relative depth \( (z_r) \) – ratio of the maximum depth as a percentage of the mean diameter of the lake at the surface

\[
50 \ z_m \sqrt{\pi} \\
\]

\[
z_r = \frac{50 \ z_m \sqrt{\pi}}{\sqrt{A_0}}
\]

Most lakes have \( z_r \) of less than 2%  
Deep lakes have \( z_r \) of greater than 4%  
Crater Lake has a \( z_r \) of 7.5%
Shore line (L) – perimeter of the lake
Shore line (L) – perimeter of the lake
Shoreline development ($D_L$) – ratio of the length of the shore line to the circumference of a circle of area equal to that of the lake

$$D_L = \frac{L}{2\sqrt{\pi A_0}}$$

- Very circular lakes, such as crater lakes and kettle lakes, approach $D_L$ of unity
- Most lakes have $D_L$ around 2
- $D_L$ increases as lakes become more elongated
Volume development (DV) – ratio of volume of a lake to the volume of a perfect cone with the same surface area and maximum depth

\[ D_v = \frac{z A_0}{(0.33 z_m)A_0} \]
\[ D_v = 3(z/z_m) \]

- \( D_v \) is around 1.3 for most lakes
- \( D_v \) ranges from 1-1.5 in lakes in easily eroded geology
- \( D_v \) exceeds 1.5 in caldera, graben, and fjord lakes
Examples

- Crater Lake – 1.65
- Lake Tahoe – 1.87
- Lake Baikal – 1.29
- Finger Lakes, NY – 1.23
- Lake Winnipeg, Canada – 2.07
- Demming Lake, MN (kettle lake) – 0.65 (typical of lakes with a more or less uniform bottom with the exception of an anomalous deep hole)
Morphoedaphic index (MEI) is a combination of morphologic and edaphic factors to indicate potential lake productivity.

Uses mean depth (in meters) as a general physical descriptor and total dissolved solids (TDS, in milligrams per liter) as a rough indicator of physical and chemical factors that influence production.

Originally applied to commercial fish yields in north temperate lakes.

Productive lakes had MEI in the range of 10 – 30.
In northern lakes, mean depth may be important because of winter kill in shallow lakes or great volume in deeper lakes; therefore MEI may be useful.

In tropical lakes, mean depth may not strongly influence productivity because of overriding influence of climate.

Extremely high or extremely low nutrient concentrations may override morphologic influences on production.
TDS is not an accurate predictor of concentration of a limiting nutrient

MEI becomes relatively meaningless in comparing lakes in different regions