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INTEROFFICE CORRESPONDENCE

To: File Project Number 0284-319 **Date:** March 10, 2005

From: Anthony Trani, Hartford

Re: Fill Volume Calculations
Non-Public Properties Study Area, Hamden, CT

This memo provides a description of how fill volumes were calculated for contiguous fill and isolated fill. The contiguous fill volumes were calculated differently than the isolated fill volume and will be discussed separately. Note that the calculations are for in-situ volume and do not include any fluff factor that might increase the volume if the material is excavated. The calculations do include fill under roadways and any space now occupied by overlying building basements.

Contiguous Fill

Volumes in the contiguous fill areas are based on contour lines of the fill because borings in the contiguous fill area were not evenly distributed. Contour lines of these fill areas were drawn in CAD and later imported to ArcGIS where areas (ft^2) were calculated using the "Field Calculator". The attached figure depicts the delineated fill areas and the corresponding spreadsheet shows the formulas used in calculating volumes.

Calculating volumes in contiguous fill can best be explained through the following example, using the simplified illustration. In this example, there are three contours; 10 feet below grade (fbg), 4 fgb, and 0 fbg (edge of fill). The depths used in the calculations are averages of depths between contours except at the bottom where 0.5 ft was added to the lowest contour value. The following average depths were used between contours:

1) Depth $_{0\text{-}4}$ = (4-0) / 2 = 2 ft
2) Depth $_{4\text{-}10}$ = (10-4) / 2 + 4 =7 ft
3) Depth $_{>10}$ = 10 + 0.5 = 10.5 ft (this is the bottom)

To calculate volumes first the area between the contours (intercontour area) was calculated except at the deepest contour where the reported area was used. The internal area of circle C is 100 ft^2, B is 300 ft^2, and A is 600 ft^2. Areas between the contours were calculated in the following way:

1) Area $_{0\text{-}4}$ = Area of Circle A –Area of Circle B = 600 ft^2- 300 ft^2 = 300 ft^2
2) Area $_{4\text{-}10}$ = Area of Circle B – Area of Circle C = 300 ft^2 - 100 ft^2 = 200 ft^2
3) Area $_{>10}$ = Area Circle C = 100 ft^2

Applying the depths to these areas, the intercontour volumes were calculated in the following way:

1) Volume $_{0\text{-}4}$ = ((Area A – Area B) x Depth 0-4 / 27 ft^3 =

((600 ft - 300 ft) x 2 ft) / 27 ft^3 = 22 yd^3

2) Volume $_{4\text{-}10}$ = ((Area B – Area C) x Depth 4-10) / 27 ft^3 =
((300 ft - 100 ft) x 7 ft) / 27 ft^3 = 52 yd^3

3) Volume $_{>10}$ = (Area C x Depth >10) / 27 ft^3 =
(100 ft x 10.5 ft) / 27 ft^3 = 39 yd^3

The total fill volume for the example was then calculated by adding up the three intercontour volume components: 39 + 52 + 22 = 113 yd^3.

For the Southwest Satellite Area, which has fill contours of 10, 15 and 20 fbg, additional areas between these contours were calculated in a similar manner and using the corresponding average depths of 12.5, 17.5, and 20.5 fbg.

Special case, fill volume <4 feet deep only

Calculating the fraction of the volume of fill in this illustration that is less than four feet deep throughout the fill area is done in a similar way except that the area within all of circle B is given a depth of 4 feet and the other areas inside circle B are ignored.

Volume (yd^3) = [(Area B x 4) + ((Area A – Area B) x 2)]/ 27 ft^3 =
[(300 ft x 4 ft) + ((600 ft - 300 ft) x 2 ft)] / 27 ft^3 = 67 $yards^3$

Isolated Fill

Borings in the isolated fill locations are typically evenly distributed within a given isolated fill area and fully penetrate the fill. These areas are generally very thin. Outlines of these fill areas were drawn in CAD and later imported to ArcGIS where areas (ft^2) were calculated using the "Field Calculator". The attached figure depicts the delineated fill areas and the corresponding spreadsheet shows the formulas used in calculating volumes.

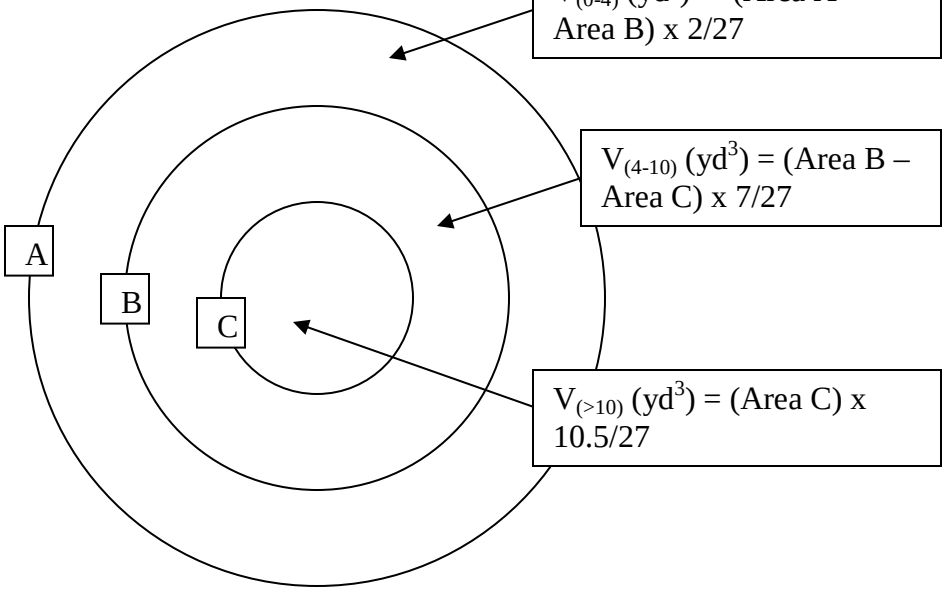
Isolated fill volume estimates were calculated by simply multiplying the internal area given by ArcGIS by the average depth of fill actually penetrated by the borings. This approach was used because, unlike the contiguous fill, the isolated fill borings are generally evenly distributed within a particular isolated fill area. The average depth was calculated by summing the total fill depths of all the boring inside a particular isolated fill area and dividing by the total number of borings inside that isolated fill area.

Volume (yd^3) = (Area x average depth) / 27 ft^3

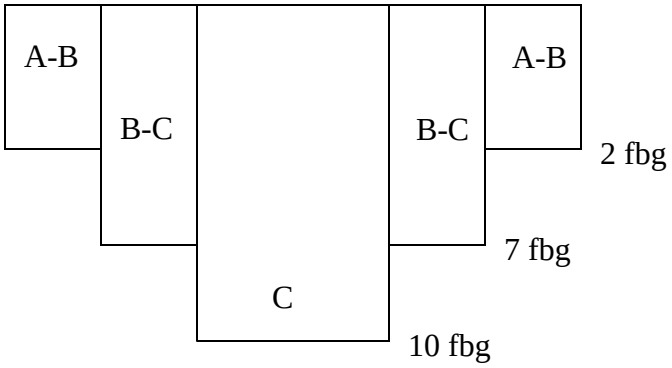
Volumes of isolated fill that are defined by one boring are usually poorly constrained by surrounding borings, so no volume was calculated for these area.

AJT
Attachments

Illustration for above example



Plan View



Cross-Section View