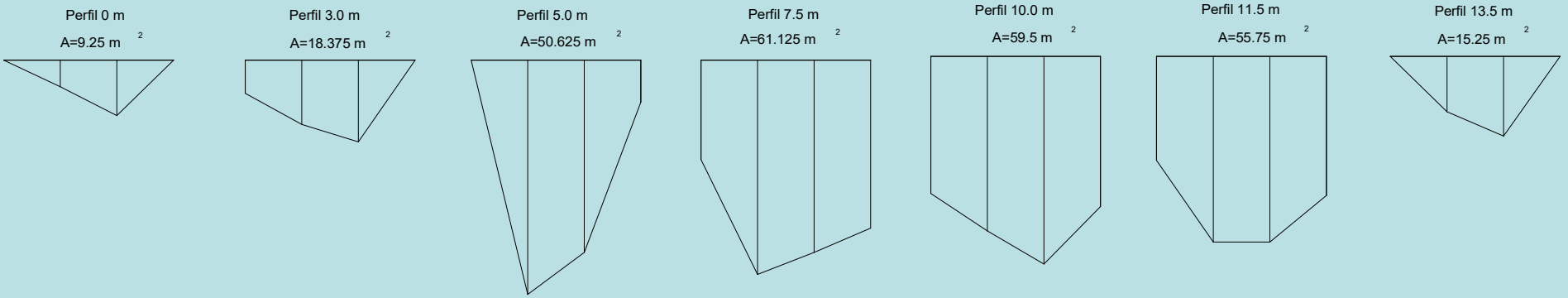
Exemplo: em planta, uma vala para irrigação mede 7.5 m de largura por 13.5 m de comprimento. Utilizando a tabela seguinte, que traduz a profundidade, em metros, nos pontos indicados, estime o volume de escavação que foi necessário efectuar (supondo naturalmente o terreno original horizontal).

m/m	0	3.0	5.0	7.5	10.0	11.5	13.5
0	0.0	1.5	0.0	4.5	6.2	4.7	0.0
2.5	1.2	2.9	10.6	9.7	7.9	8.4	2.5
5.0	2.5	3.7	8.7	8.7	9.4	8.4	3.6
7.5	0.0	0.0	1.9	7.6	6.8	6.3	0.0

Topografia Aplicada – movimento de terras

Considerando os 7 perfis transversais seguintes, tem-se:



$$A_1 = \frac{1}{2}\left[\frac{0}{0}\ \frac{2.5}{0}\ \frac{5.0}{0}\ \frac{7.5}{0}\ \frac{5.0}{2.5}\ \frac{2.5}{1.2}\ \frac{0}{0}\right] = 9.25\ \text{m}^2$$

$$A_2 = \frac{1}{2}\left[\frac{0}{0}\ \frac{2.5}{0}\ \frac{5.0}{0}\ \frac{7.5}{0}\ \frac{5.0}{3.7}\ \frac{2.5}{2.9}\ \frac{0}{1.5}\ \frac{0}{0}\right] = 18.375\ \text{m}^2$$

$$A_3 = \frac{1}{2}\left[\frac{0}{0}\ \frac{2.5}{0}\ \frac{5.0}{0}\ \frac{7.5}{0}\ \frac{7.5}{1.9}\ \frac{5.0}{8.7}\ \frac{2.5}{10.6}\ \frac{0}{0}\right] = 50.625\ \text{m}^2$$

$$A_4 = \frac{1}{2}\left[\frac{0}{0}\ \frac{2.5}{0}\ \frac{5.0}{0}\ \frac{7.5}{0}\ \frac{7.5}{7.6}\ \frac{5.0}{8.7}\ \frac{2.5}{9.7}\ \frac{0}{4.5}\ \frac{0}{0}\right] = 61.125\ \text{m}^2$$

$$A_5 = \frac{1}{2}\left[\frac{0}{0}\ \frac{2.5}{0}\ \frac{5.0}{0}\ \frac{7.5}{0}\ \frac{7.5}{6.8}\ \frac{5.0}{9.4}\ \frac{2.5}{7.9}\ \frac{0}{6.2}\ \frac{0}{0}\right] = 59.5\ \text{m}^2$$

$$A_6 = \frac{1}{2}\left[\frac{0}{0}\ \frac{2.5}{0}\ \frac{5.0}{0}\ \frac{7.5}{0}\ \frac{7.5}{6.3}\ \frac{5.0}{8.4}\ \frac{2.5}{8.4}\ \frac{0}{4.7}\ \frac{0}{0}\right] = 55.75\ \text{m}^2$$

$$A_7 = \frac{1}{2}\left[\frac{0}{0}\ \frac{2.5}{0}\ \frac{5.0}{0}\ \frac{7.5}{0}\ \frac{5.0}{3.6}\ \frac{2.5}{2.5}\ \frac{0}{0}\right] = 15.25\ \text{m}^2$$

$$V_1 = \frac{1}{2}(A_1 + A_2) \times 3 = 41.4375\ \text{m}^3$$

$$V_2 = \frac{1}{2}(A_2 + A_3) \times 2 = 69.0\ \text{m}^3$$

$$V_3 = \frac{1}{2}(A_3 + A_4) \times 2.5 = 139.6875\ \text{m}^3$$

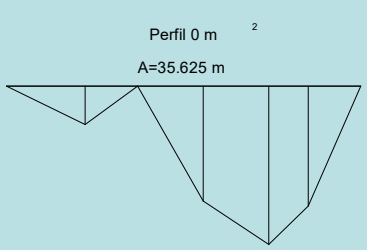
$$V_4 = \frac{1}{2}(A_4 + A_5) \times 2.5 = 150.78125\ \text{m}^3$$

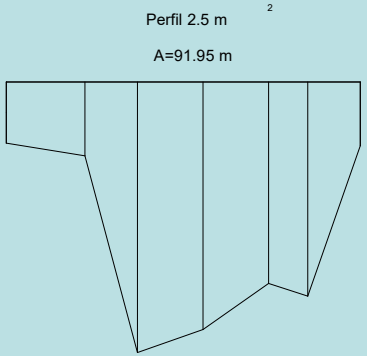
$$V_5 = \frac{1}{2}(A_5 + A_6) \times 1.5 = 86.4375\ \text{m}^3$$

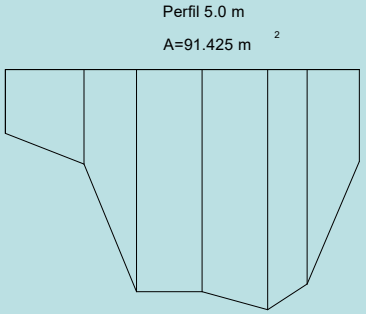
$$V_6 = \frac{1}{2}(A_6 + A_7) \times 2 = 71.0\ \text{m}^3$$

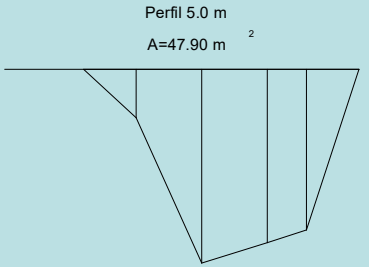
V_{total}=558.34375 m³

Como alternativa, podem utilizar-se os 4 perfis longitudinais seguintes:







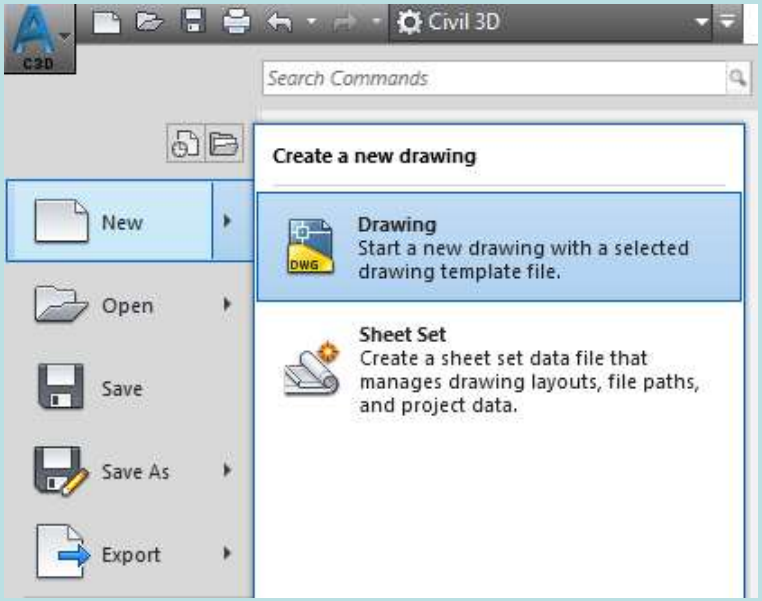


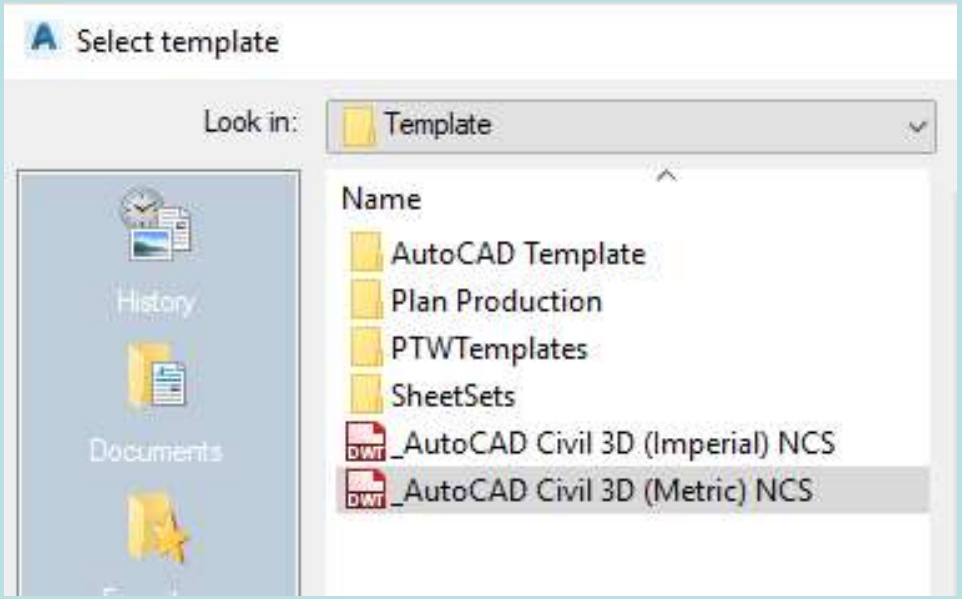
V_{total}=562.84375 m^3

Posicionamento Geoespacial II

Resolução do problema com o Civil3D:

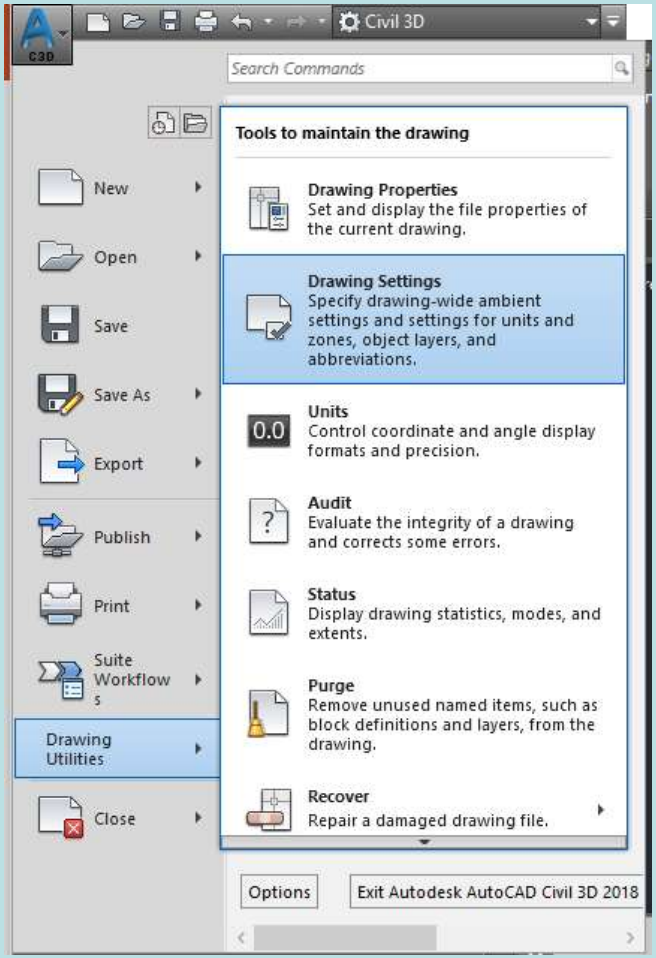
1. **Abrir um ficheiro novo utilizando o template AutoCAD Civil 3D (Metrics) NCS e fazer Save As vala.dwg.**

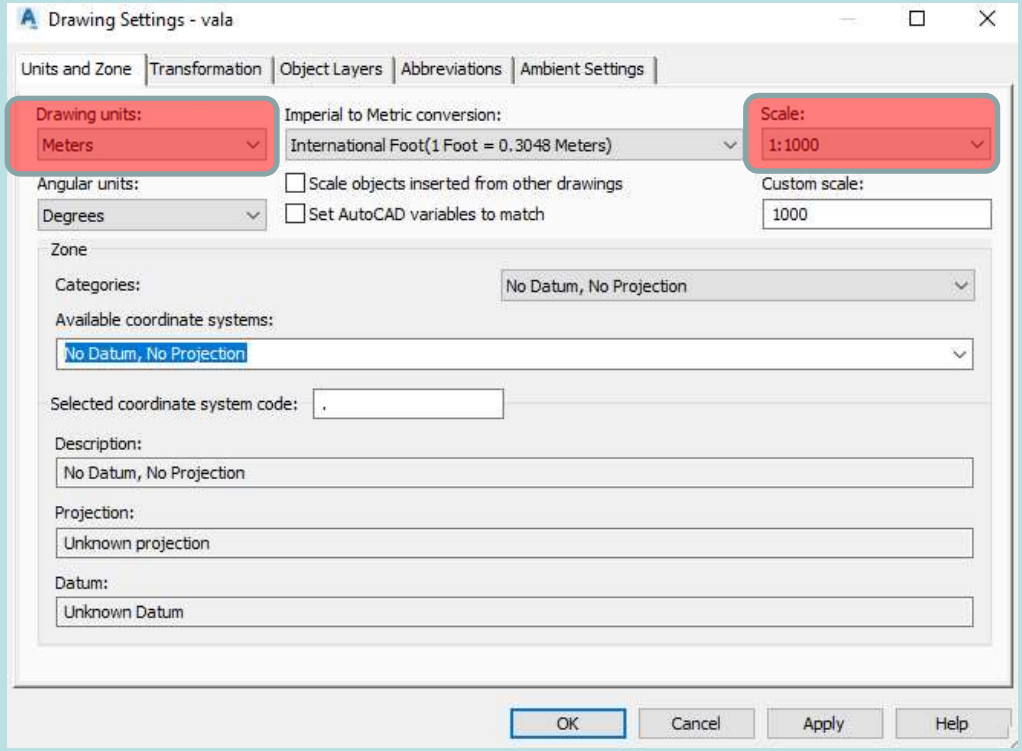




Posicionamento Geoespacial II

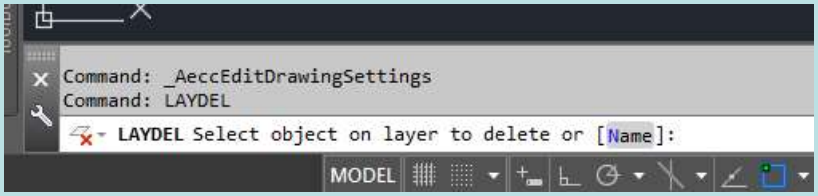
2. Confirmar as unidades e a escala:

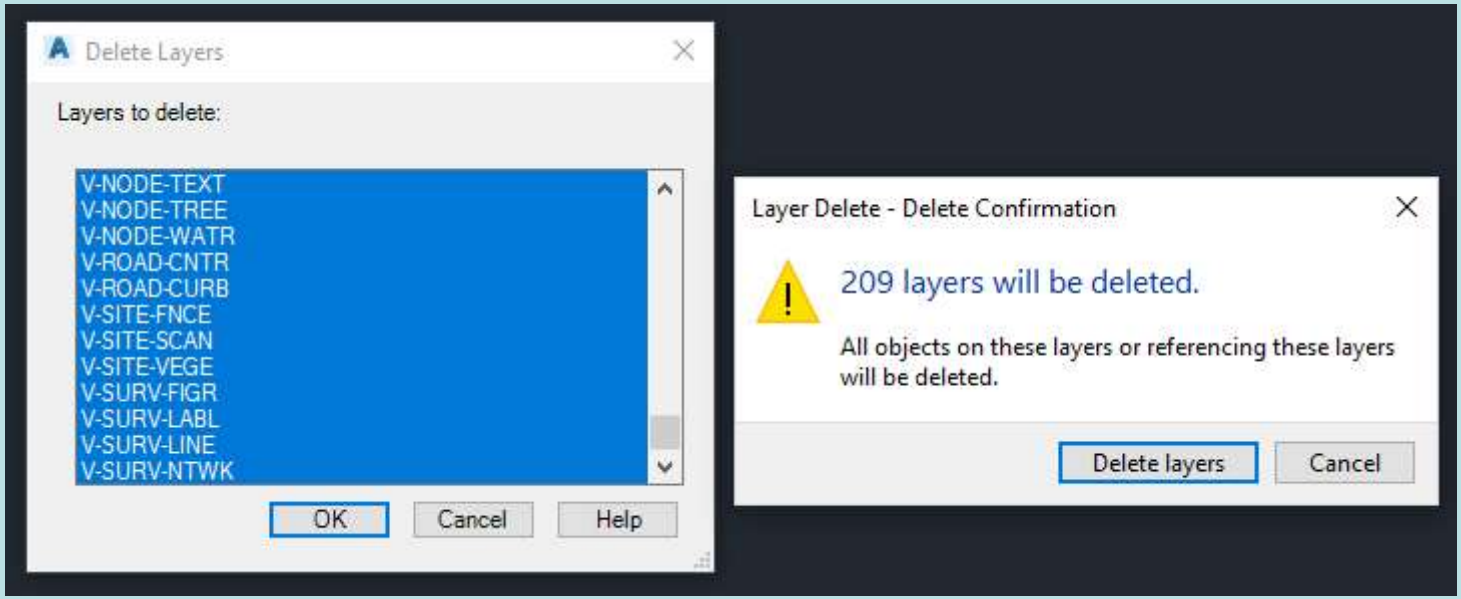




Posicionamento Geoespacial II

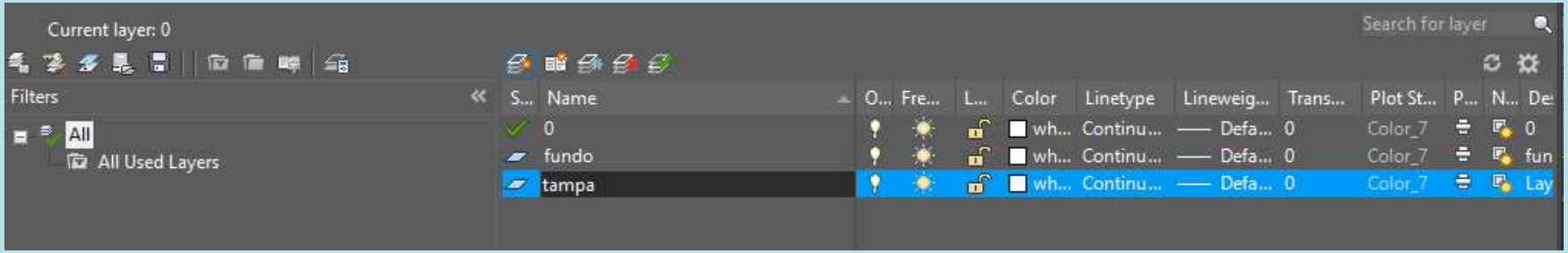
3. Apagar layers pré-definidos:





Posicionamento Geoespacial II

4. Criar os layers fundo e tampa:



Posicionamento Geoespacial II

5. Criar os ficheiros de texto com as coordenadas que definem as 2 superfícies, cuja estrutura é num, M, P, C:

vala_fundo - Notepad

File Edit Format View Help

```
1,0.0,0.0,0.0
2,0.0,3.0,-1.5
3,0.0,5.0,0.0
4,0.0,7.5,-4.5
5,0.0,10.0,-6.2
6,0.0,11.5,-4.7
7,0.0,13.5,0.0
8,2.5,0.0,-1.2
9,2.5,3.0,-2.9
10,2.5,5.0,-10.6
11,2.5,7.5,-9.7
12,2.5,10.0,-7.9
13,2.5,11.5,-8.4
14,2.5,13.5,-2.5
15,5.0,0.0,-2.5
16,5.0,3.0,-3.7
17,5.0,5.0,-8.7
18,5.0,7.5,-8.7
19,5.0,10.0,-9.4
20,5.0,11.5,-8.4
21,5.0,13.5,-3.6
22,7.5,0.0,0.0
23,7.5,3.0, 0.0
24,7.5,5.0,-1.9
25,7.5,7.5,-7.6
26,7.5,10.0,-6.8
27,7.5,11.5,-6.3
28,7.5,13.5,0.0
```

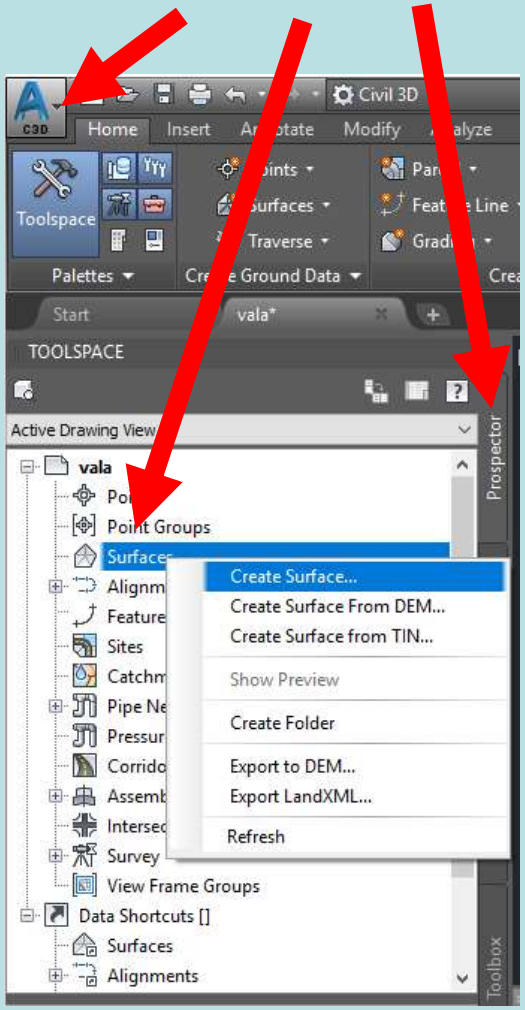
vala_tampa - Notepad

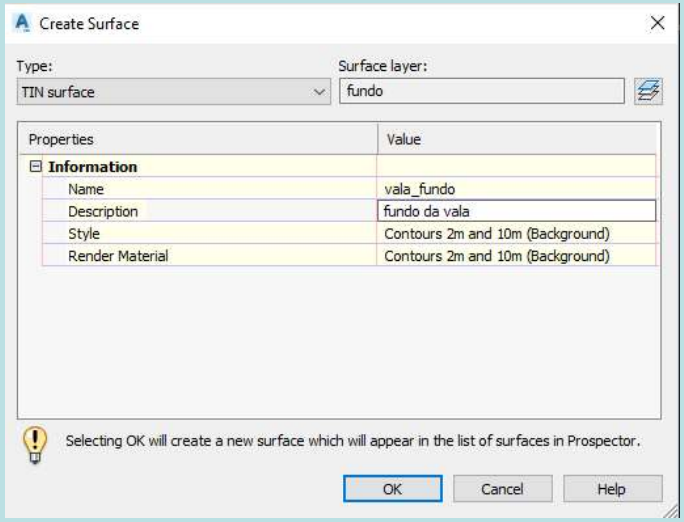
File Edit Format View Help

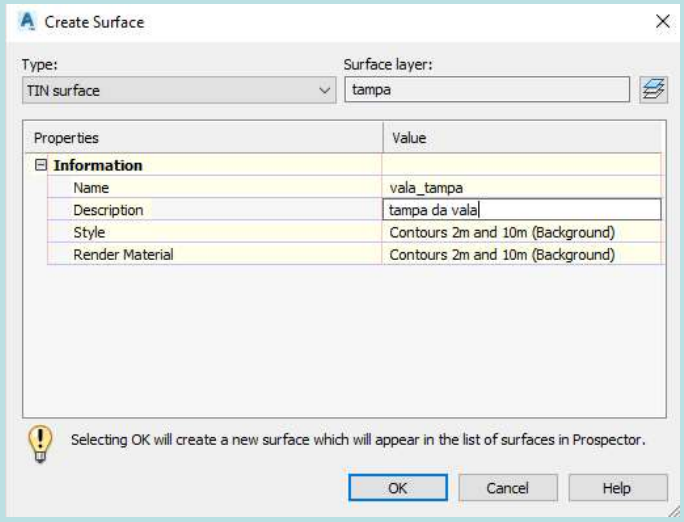
```
1,0.0,0.0,0.0
2,0.0,13.5,0.0
3,7.5,0.0,0.0
4,7.5,13.5,0.0
```

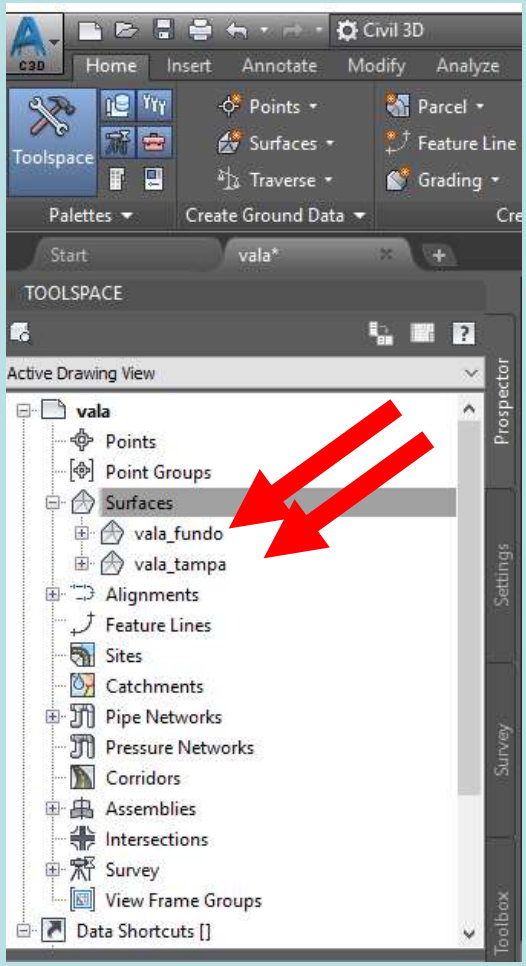
Posicionamento Geoespacial II

6. Criar as superfícies fundo e tampa:



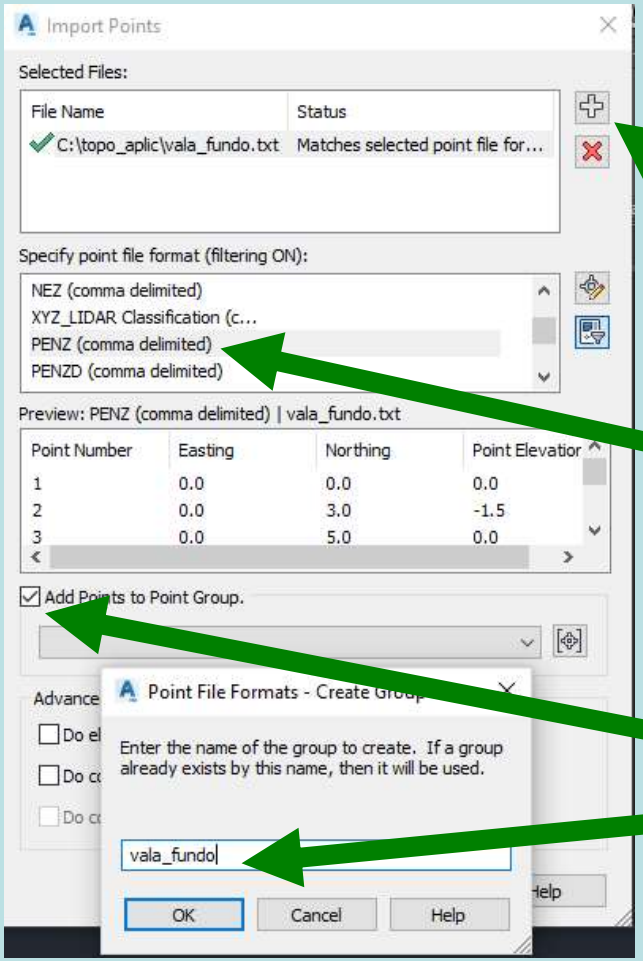


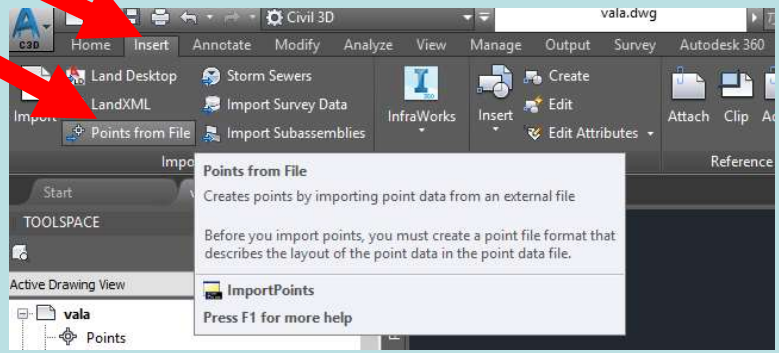




Posicionamento Geoespacial II

7. Importar os ficheiros de pontos que definem a superfície fundo:





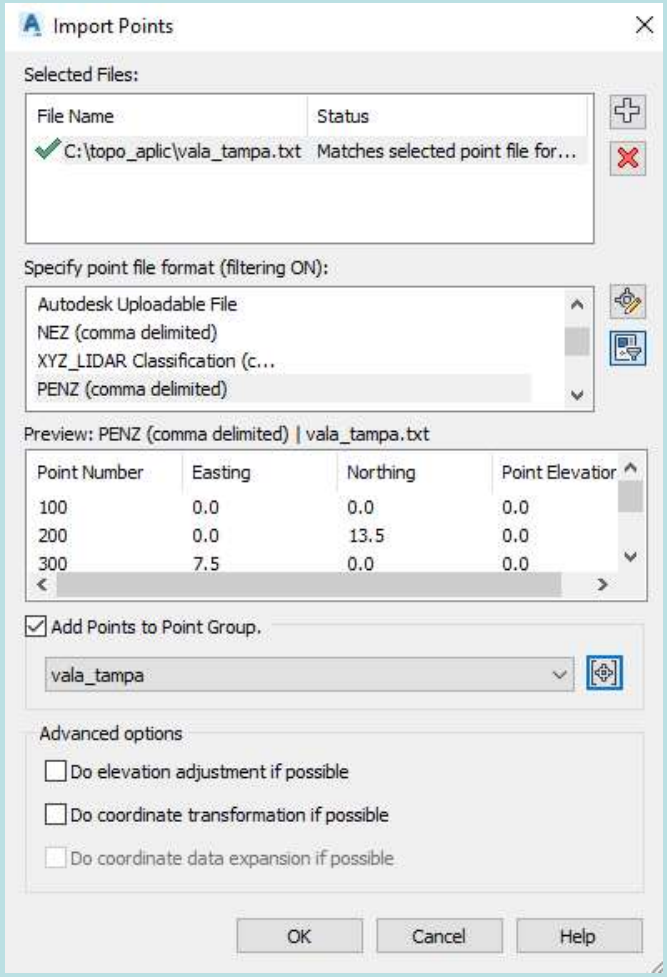
Indicar a localização do ficheiro de coordenadas

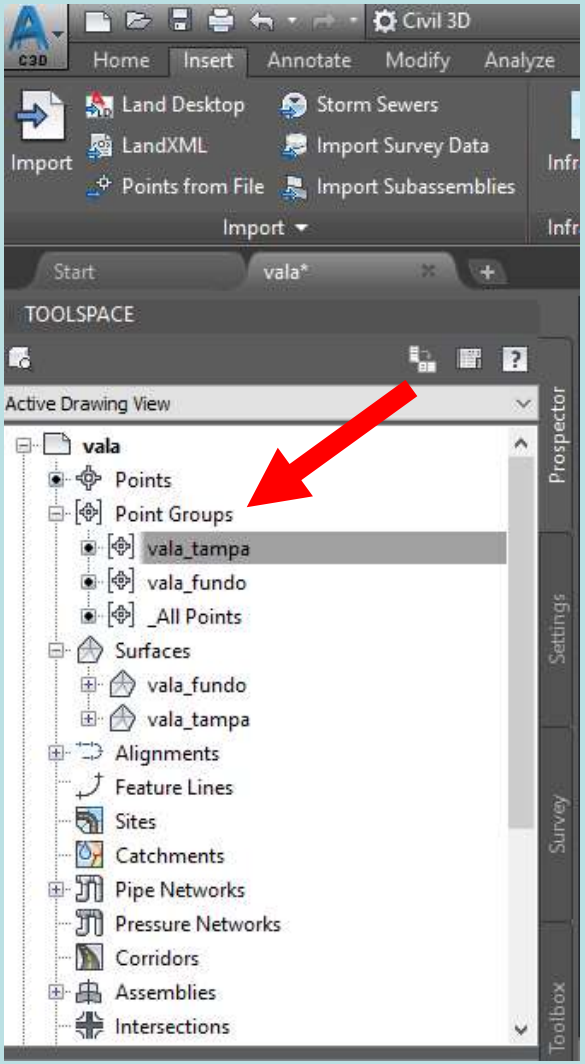
Seleccionar a estrutura do ficheiro de coordenadas

Seleccionar esta opção para ser possível manipular os pontos de uma superfície ao mesmo tempo e indicar um nome para esse grupo

Posicionamento Geoespacial II

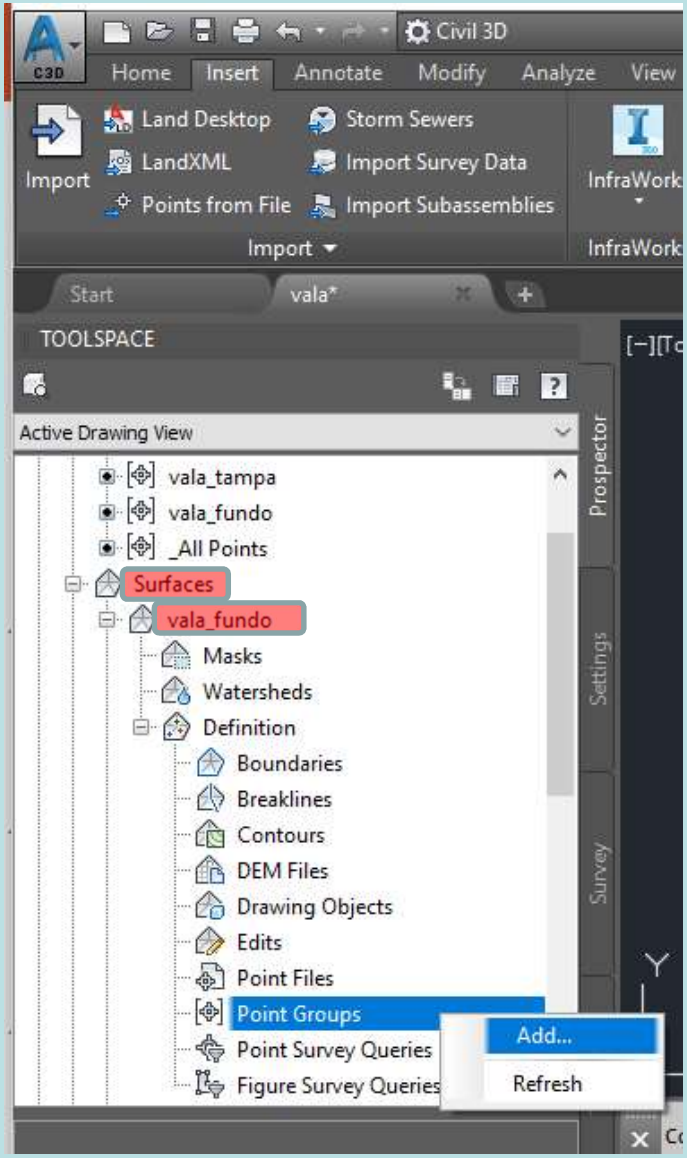
Repetir a importação para os pontos que definem a superfície tampa:

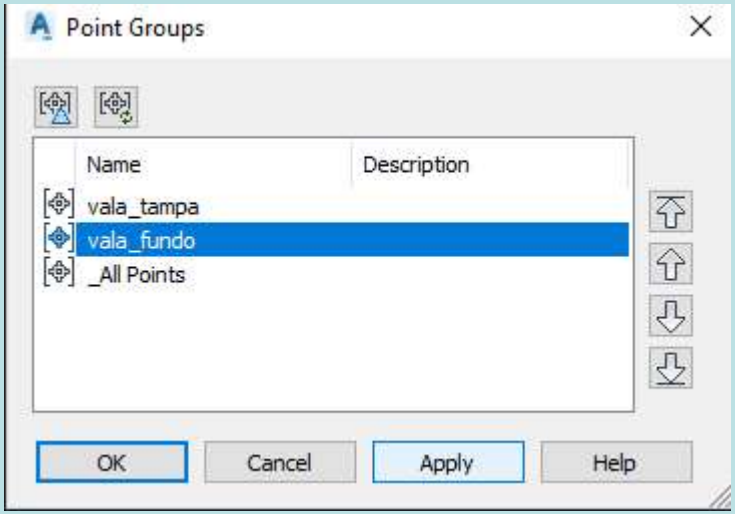




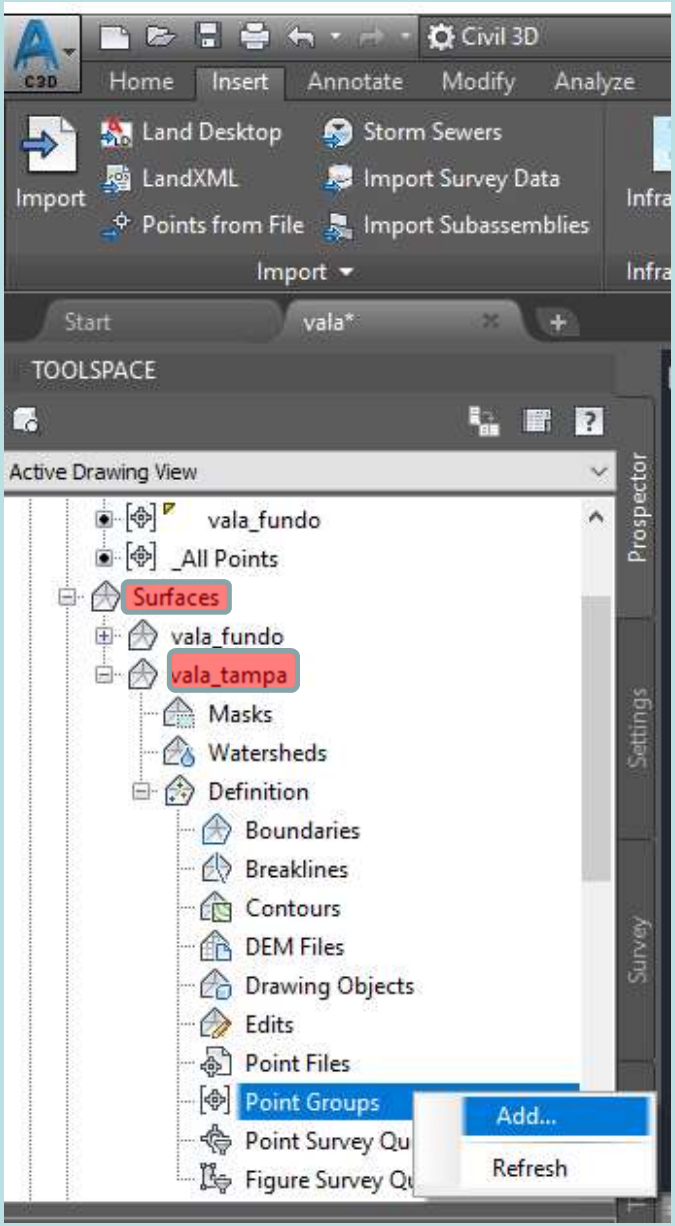
Posicionamento Geoespacial II

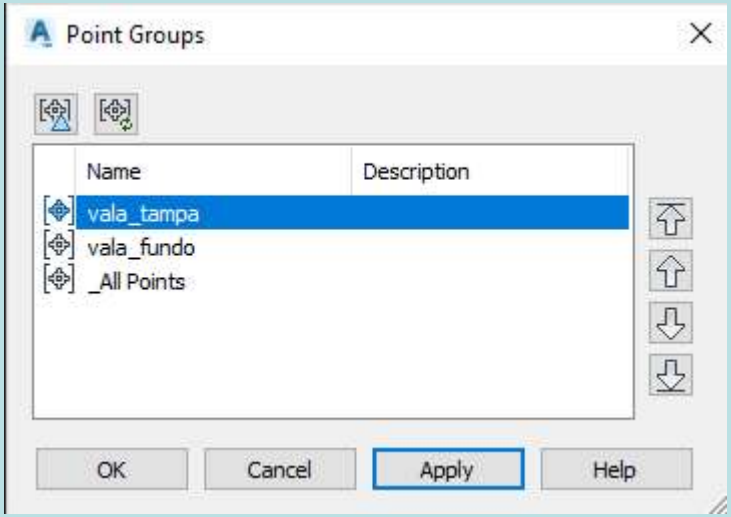
8. Gerar DTM's das 2 superfícies:



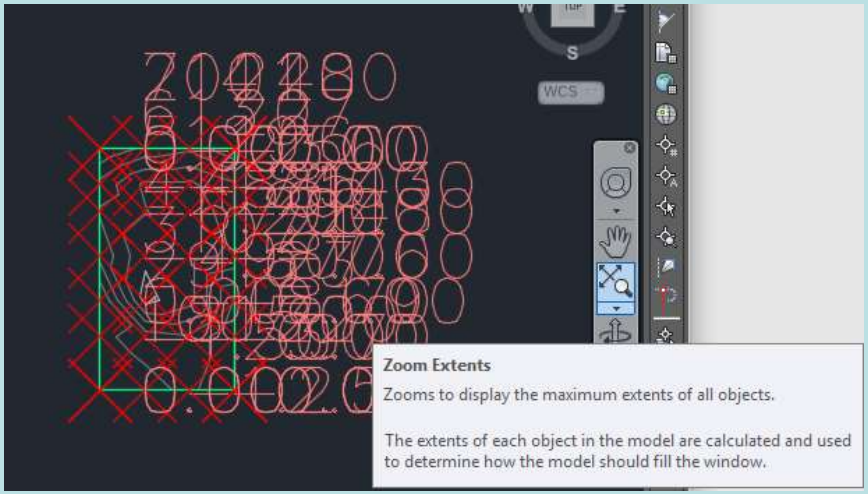


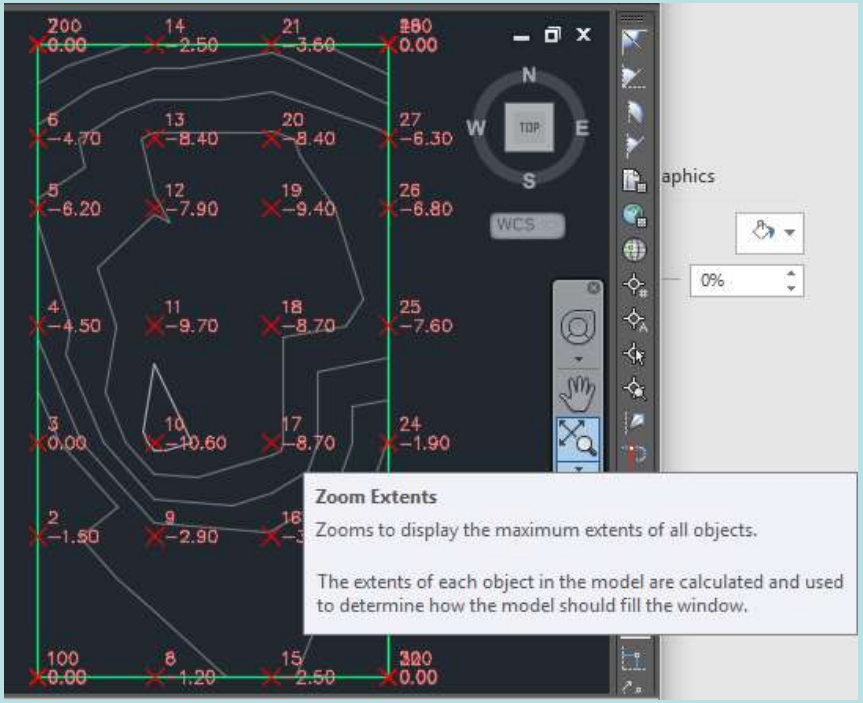
Posicionamento Geoespacial II



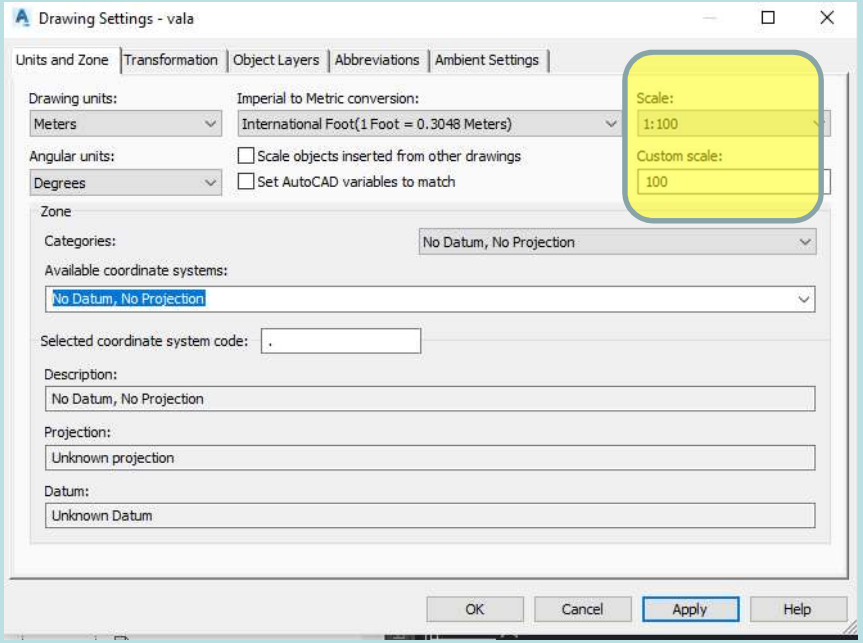


Posicionamento Geoespacial II



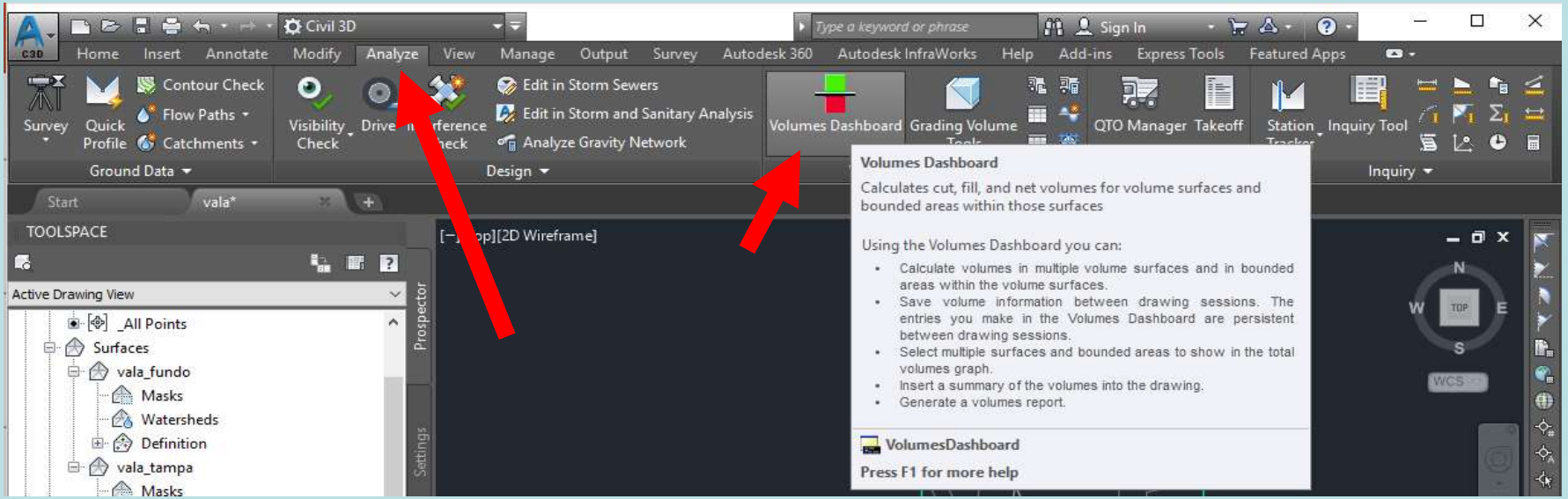


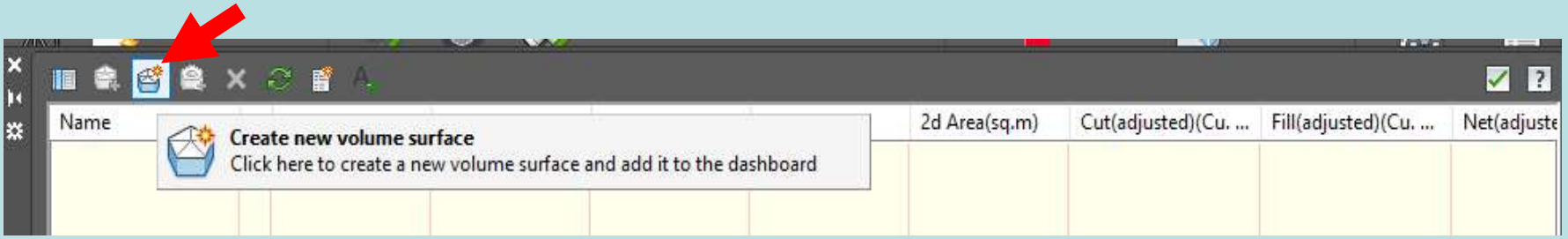
9. Ao fazer Zoom os textos e os pontos aparecem muito grandes: alterar a escala.



Posicionamento Geoespacial II

10. Calcular o volume envolvido na escavação da vala:





Posicionamento Geoespacial II