8) Click Editor button, click Save Edits, and click Stop Editing.

9) On ArcToolbox window, click + symbol on 3D Analyst Tools → on Functional Surface, double click Add Surface Information.

10) Next will appear Add Surface Information. On combo box of Input Feature Class, choose layer "sungai_utama_01_dissolve". On combo box of Input Surface, choose layer "dem_10". Check AVG_SLOPE from Output Property. Click OK button.
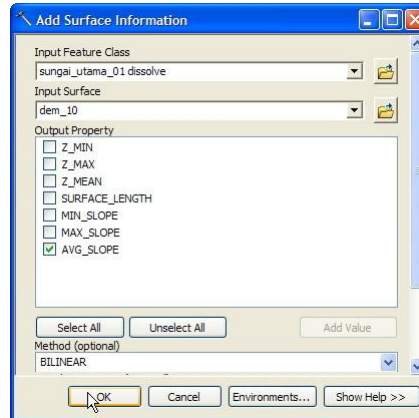

11) According to the theory, the banjir bandang occurred in river sections that have a slope between 2 – 10 degrees. Therefore, we have to determine the river segments that have the criteria.

    Click Selection and click Select By Attributes.

12) Next will Select By Attributes window. On combo box of Layer choose layer "sungai_utama_01_dissolve". Write the formula "Avg_Slope" >=2 AND "Avg_Slope" <11 on formula window. Click OK button.
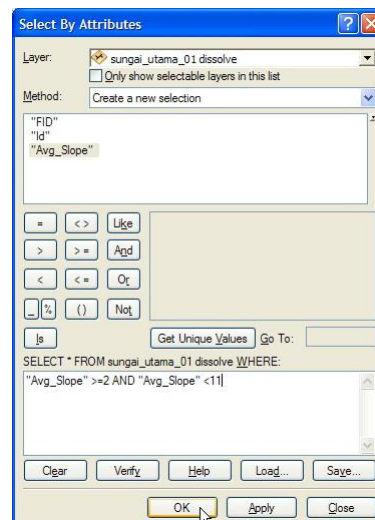

13) Right click layer "sungai_utama_01_dissolve", point the cursor to Data, then click Export Data. Insert data that will be exported into folder: Data source for training\11 Creating banjir bandang hazard area, and give name "sungai utama 01 dissolve edit.shp".

    If there is question whether the exported data will insert into ArcMap workspace, answer Yes. Next will be formed layer "sungai utama 01 dissolve edit" in ArcMap workspace.

14) On this step we will edit the data or objects of layer "sungai utama 01 dissolve edit", according to the slope ranges in step 11 above.

    Click Editor button, on Start Editing window, choose layer "sungai utama 01 dissolve edit".

15) Click ▶ button on Editor toolbar, and select all objects on layer "sungai utama 01 dissolve edit" which are beyond range between the up arrow and down arrow, as shown below.
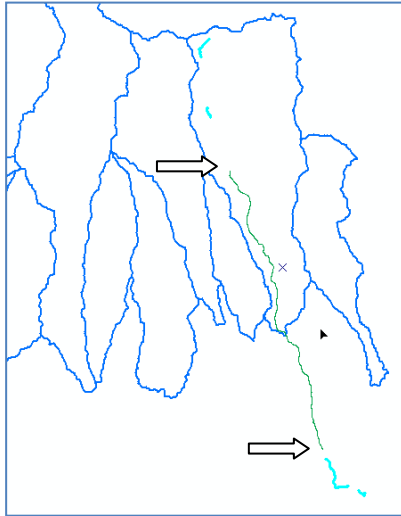

16) After all the objects selected, remove by using the Del key on the computer keyboard.

17) Click Editor button, click Save Edits, and click Stop Editing.

18) On ArcToolbox window, click + symbol on Data Management Tools → Generalization, double click Dissolve. Next will appear Dissolve window.

19) On combo box Input Features, choose layer "sungai utama 01 dissolve edit". On text box Output Feature Class, save the data into folder: Data source for training\11 Creating banjir bandang hazard area, give name "sungai utama 01 target.shp". Check FID on Dissolve Field(s) window. Click OK button. Next will be formed layer "sungai utama 01 target" in ArcMap workspace.
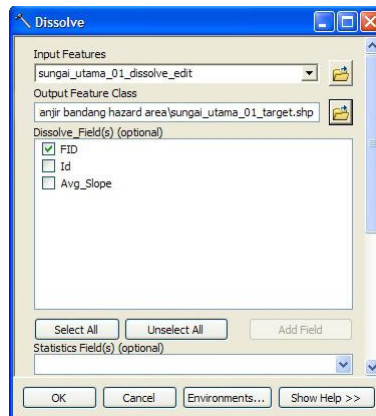
Step 3.   Changing 2D features into 3D features

1)   On this step we would like to make 2D feature into 3D features.
On ArcToolbox window, click + symbol on 3D Analyst Tools → Functional Surface, double click Interpolate Shape.

2)   Next will appear Interpolate Shape window. On combo box Input Surface, choose layer "dem_10". On combo box Input Feature Class, choose layer "sungai utama 01 target". On text box Output Feature Class, save the data into folder: Data source for training\11 Creating banjir bandang hazard area, and give name "sungai utama 01 target 3D.shp". Click OK button.
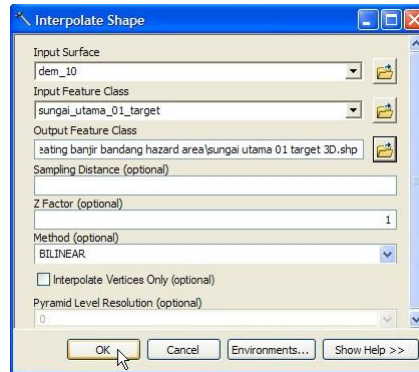

3)   Export data/layer "sungai utama 01 target 3D" into folder: Data source for training\11 Creating banjir bandang hazard area, and give name "sungai utama 01 target 3D p5".
If there is question whether the exported data will insert into ArcMap workspace, answer Yes.

4)   On ArcToolbox window, click + symbol on Data Management Tools → Features, double click Adjust 3D Z. Next will appear Adjust 3D Z window.

5)   On this step we will make an assumption of banjir bandang inundation height. For preliminary assumption, we can use height value as 5 m from river bed.
On combo box Input Features, choose layer "sungai utama 01 target 3D p5". On text box Adjust Z Value, fill with value 5, which means that we will raise the height of feature/object is at 5 meters. Click OK button.
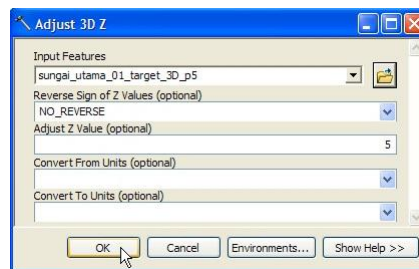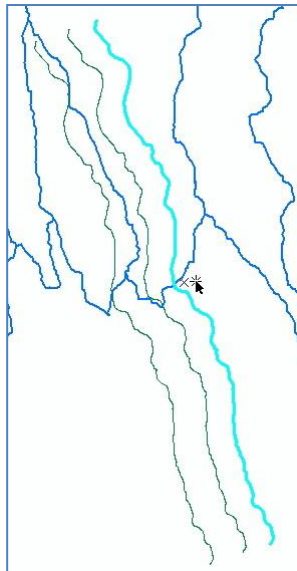
Step 4.   Making banjir bandang hazard area

1)   Right click layer "sungai utama 01 target 3D p5", then export into folder: Data source for training\11 Creating banjir bandang hazard area, and give name "sungai utama 01 target 3D p5 edit.shp". If there is question whether the exported data will insert into ArcMap workspace, answer Yes.

2)   Click Editor button, click Start Editing, choose layer "sungai utama 01 target 3D p5 edit" on Start Editing window, then press OK button.

3)   Select entire objects on layer "sungai utama 01 target 3D p5 edit" using ⬚ button on Editor toolbar.

4)   Open or view the Advanced Editing toolbar by right click on any empty space on ArcMap workspace, then click Advanced Editing.
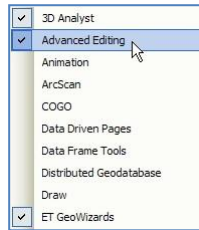


5)   Next will appear Advanced Editing toolbar as below.

6)   Press Copy Features Tool ⬚ button on Advanced Editing toolbar.

7)   By using reference of the selected object position in the form of "X" sign, copy and paste the selected object to the left and right in parallel, approximately as far as 750 meters.


8)   Click Editor button, click Save Edits, and click Stop Editing.

9)   On ArcToolbox window, click + symbol on 3D Analyst Tools → TIN Management, double click Create TIN. Next will appear Create TIN window.
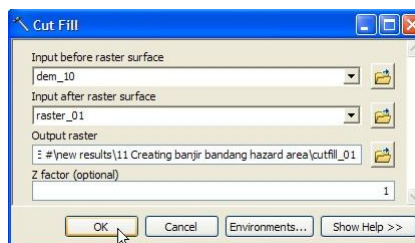
10) On text box Output TIN, insert the resulted data into folder: Data source for training\11 Creating banjir bandang hazard area, give name "tin_01". On text box of Spatial Reference, choose "WGS_1984_UTM_Zone_49S". Choose layer "sungai utama 01 target 3D p5 edit", on combo box Input Feature Class. Press OK button.
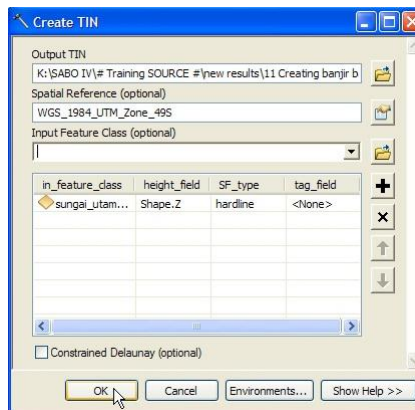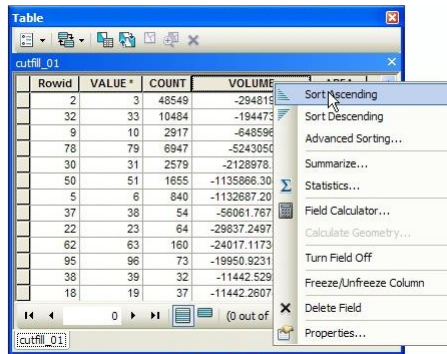
11) On ArcToolbox window, click + sign on 3D Analyst Tools → Conversion → From TIN, double click TIN to Raster.

12) Next will appear TIN to Raster window. On combo box of Input TIN, choose layer "tin_01". On text box of Output Raster, insert the resulted data into folder: Data source for training\11 Creating banjir bandang hazard area, and give name "raster_01". On combo box Sampling Distance, choose "CELLSIZE 10". Click OK butoon.
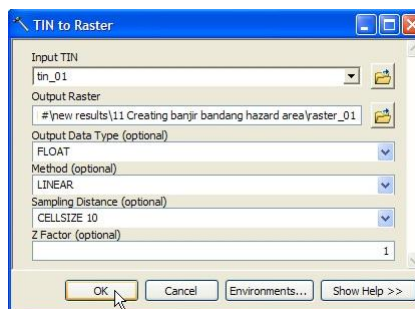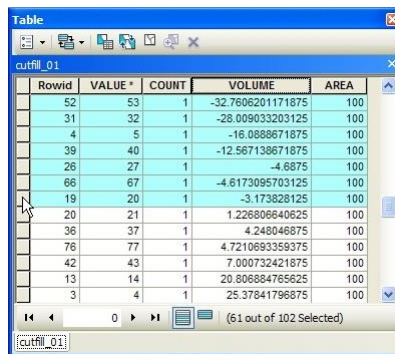
13) On ArcToolbox window, click + sign on 3D Analyst Tools → Raster Surface, double click Cut Fill. Next will appear Cut Fill window.

14) On combo box of Input before raster surface, choose layer "dem_10". On combo box of Input after raster surface, choose layer "raster_01". On text box of Output raster, insert the resulted data yang into folder: Data source for training\11 Creating banjir bandang hazard area, and give name "cutfill_01". Click OK button.

15) Right click layer "cutfill_01", and open the attribute table.

16) Right click column "VOLUME" and click Sort Ascending.

17) Select entire row that have negative value of VOLUME.

18) On ArcToolbox window, click + sign on Conversion Tools → From Raster, double click Raster to Polygon.

19) Next will appear Raster to Polygon window. On combo box of Input raster, choose layer "cutfill_01". On combo box Field, choose VALUE. On text box Output polygon features, save the resulted data into folder: Data source for training\11 Creating banjir bandang hazard area, and give name "cutfill_01.shp". Check Simplify polygons (optional). Click OK button.
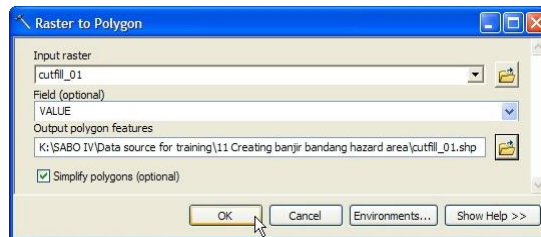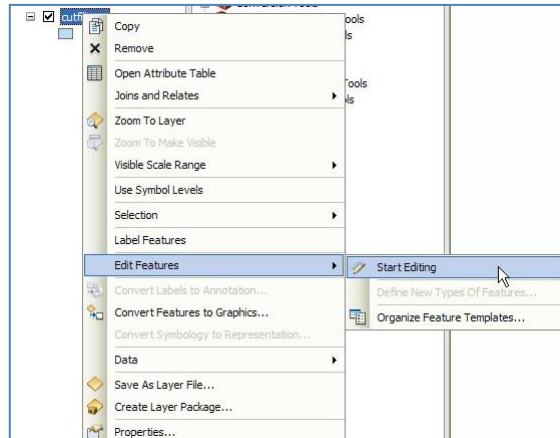

20) Click Clear Selected Features button.

Step 5.   Editing banjir bandang hazard area

1)   Banjir bandang hazard area need editing as there are hazard areas that are outside of the river flow and there are hazard areas that do not fit the logic or reality on the field.
Right click layer "cutfill_01" → Edit Features, and double click Start Editing.

2)   Right click layer "cutfill_01" → Selection → Make This Only Selectable Layer.

3)   By using ▶ button on Editor toolbar, select polygon object on layer "cutfill_01" that on the river flow.

4)   Delete the objects by press Del button on computer keyboard.

5)   For polygon object that should be edited by changes its shape, the first is select the object by using ▶ button on Editor toolbar.

6)   On Editor toolbar, click Cut Polygon Tools ⊕ button.

7)   Cut the polygon objects that assume the inundation is not fitted with the actual condition in the field.
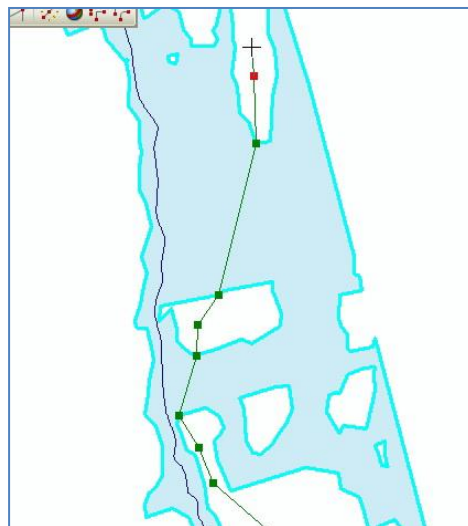
8)   After all of polygon objects has finished editing, click Editor button, click Save Edits, and click Stop Editing.
Next we will use "area rawan banjir bandang ref.shp" that contained in folder: Ref.

VII. Making Landslide Potential Map and Banjir Bandang Hazard Map

1) Open/run ArcMap, choose Blank Map.

2) Insert data "citra satelit.tif" that derived from folder: Data source for training\01 Satellite image.

3) Insert data "das ref.shp" and "area rawan banjir bandang ref.shp" that derived from folder: Ref.

4) Insert file layer of "Potensi longsor berdasarkan faktor gabungan.lyr" that derived from folder: Data source for training\10 Landslide potential by combine factor.

5) Change the transparency layer of "Potensi longsor berdasarkan faktor gabungan" and layer "area rawan banjir bandang ref", become 35%.

6) Click layout view button, located at the bottom of the ArcMap workspace.

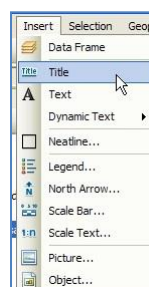7) Right click on any empty space ArcMap workspace, and choose Layout to display Layout toolbar.
   Layout Toolbar is like the figure below.

8) Click Change Layout ⏸ button on Layout toolbar.

9) Next will appear Select Template window. Click tab ISO (A) Page Size, choose ISO A3 Portrait.mxd. Click Finish button.
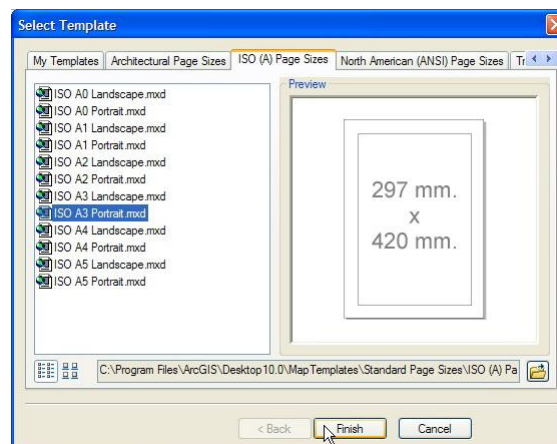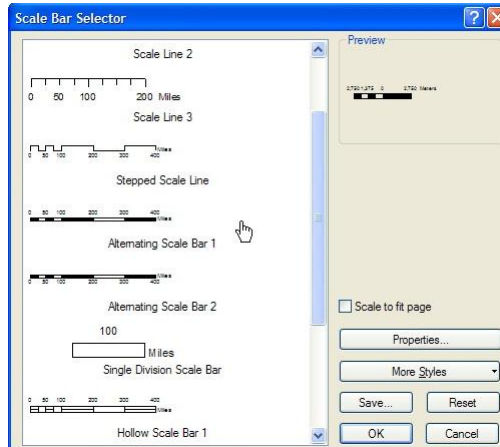

10) Click Insert on ArcMap main menu, then click Title.

11) Next will appear Insert Title window. Write the title as "Peta potensi longsor dan rawan banjir bandang". Click OK button.
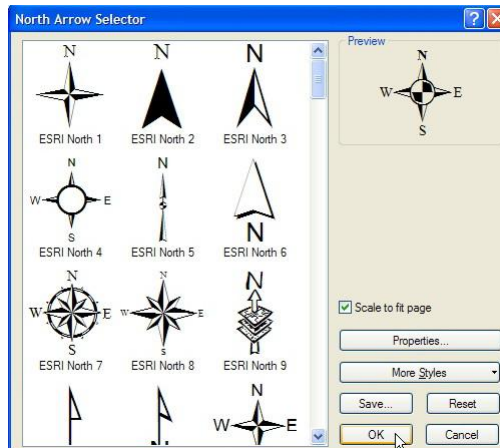

Set type, font size and its position on the map.

12) Click Insert on ArcMap main menu, then click Scale Bar.

13) Next will appear Scale Bar Selector window.

Choose "Alternating Scale Bar 1", then click OK button. Set type, font size and its position on the map.

14) Click Insert ArcMap main menu, then click "North Arrow".

15) Next will appear North Arrow Selector window.

Choose the north symbol as you wish, then click OK button. Set type, font size and its position on the map.

16)   Click Insert ArcMap main menu, then click "Legend".

17)   Next will appear Legend Wizard window.

On Legend item are, remove satellite image by choosing layer "citra satelit.tif" on part of Legend Items, and by clicking [<] button. Click Next button.

18)   On Legend Wizard part-2 window, we can change the legend title and change the view color and font character. Click Next button.

19)   On Legend Wizard part-3 window, we can change the view of legend frame. Click Next button.
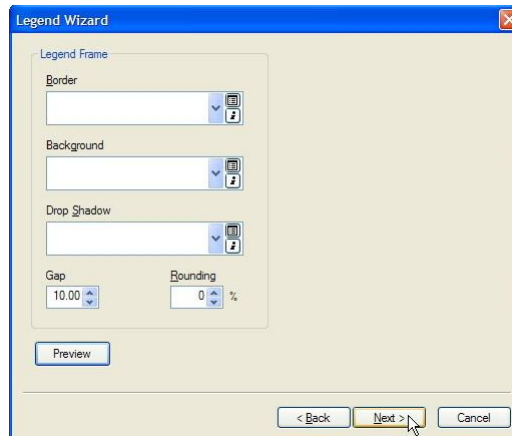
20) On Legend Wizard part-4 window, we can change the view character of legend symbol for each layer. Click Next button.
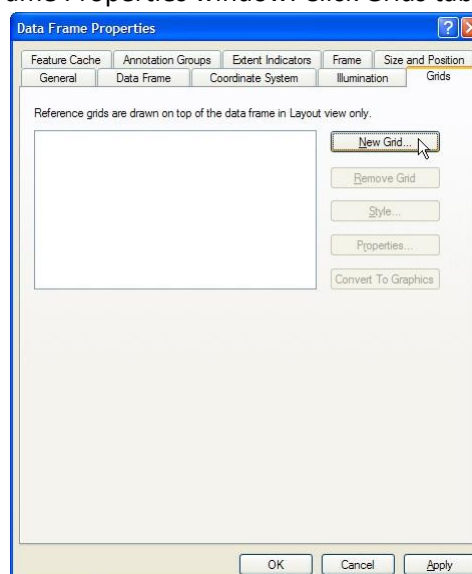
21) On Legend Wizard part-5 window, we can change the spacing between each layers in the legend.

Click Finish button. Set the size and its position on the map.

22) To insert the coordinate information on the map layout, right click Layer on the Table of Contents and click Properties.

23) Next will appear Data Frame Properties window. Click Grids tab.

24) Click New Grid button.

25) Next will appear Grids and Graticules Wizard window. There are 3 radio button for different coordinated system. Choose Graticule, click Next button.
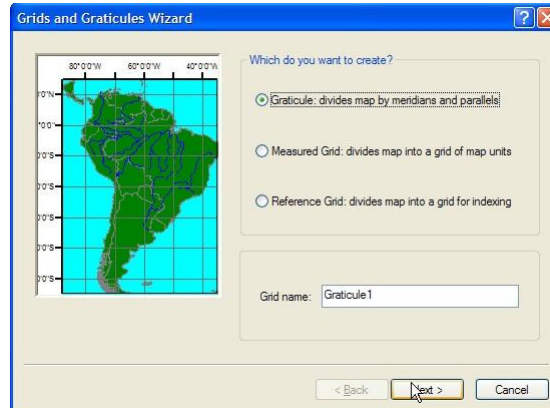
26) Next will appear Create a graticule window. Fill in the Intervals part, the coordinate interval that we want to show. For example, on parallel line and meridians line, we fill with value 3'. Click Next button.

27) Next will appear Axes and labels window. Choose character of line and label that we want to show. Click Next button.

28) Next will appear Create a graticule window. Determine the character types of coordinate boundary lines, and determine wheter we want to display Neatline (line edge map). Click Finish button.

Automatically, ArcMap will show the label of coordinates label on the map frame. This coordinate value will automatically change if we change or pan the data/object position.

29) To adjust the position of objects on the map layout to be more neat and pleasant to look at, we can set the margin of a certain size according to our wishes.
The trick, click and drag the mouse cursor on the bar layout to produce a certain margin size. Automatically, the dashed line in blue will be formed. Objects that exist in the layout can be snap to the line.
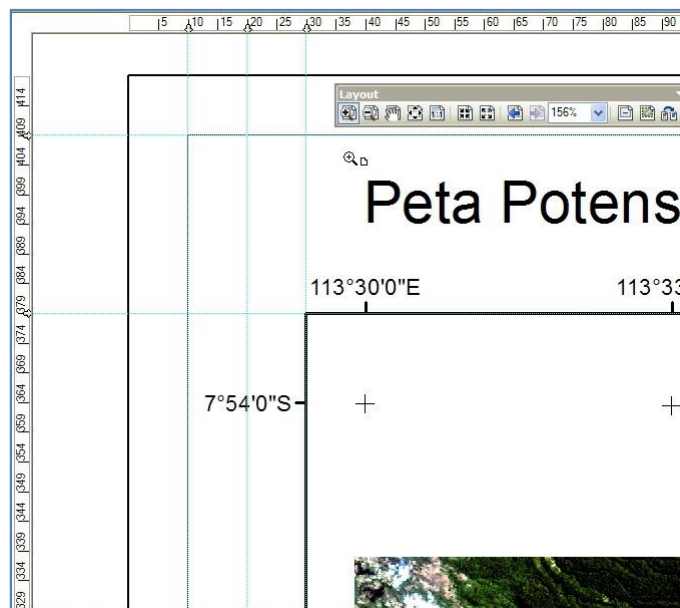
30) Here are some tips that provide information about the tool differences between Tools toolbar and Layout toolbars.

From both toolbar, we can see that there are some tools that have image/icon similarity that are the tool of Zoom In, Zoom Out, Panning, Full Extent / Zoom Whole Page. When we use the tool from the Tools toolbar in the Layout workspace, then the change is object data or the contents of the map. Whereas if we use the tool from Layout toolbar, then the contents of the object data will not change but just the view of the layout only.

As an example we can use the Zoom In tool on the Layout toolbar to zoom in the corners of the map frame when we want to set the size of the margin.

31) To make/export the map into PDF format, click File and click Export Map.

32) Next will appear Export Map window. Choose the type of file that we want to save that is PDF.
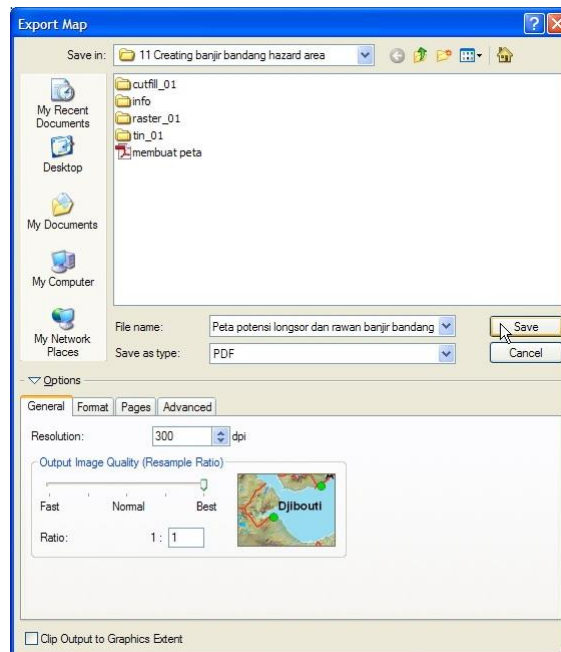
On part of Options, set the Resolution = 300 dpi and Output Image Quality = Best. Click Save button.

33) Here is a map the resulting.