Module 4: Buffer, Difference, Clip

Conceptual Overview: The Buffer analysis takes a layer of spatial objects, for example a points layer, and creates a set of polygons with a specified distance radius from each point. The same Buffer tool can be used to create a buffer polygon for polylines, at a specified distance perpendicular to the line on both sides of the original polyline. Once the buffers are available, they can be used to make spatial selections of overlapping features, or they can be used for other geoprocessing tasks. The difference process will take two layers of spatial features and trim any overlapping parts of those features so that only the "difference" remains. The clip process will trim a polygon area to the outer perimeter of another polygon or set of polygons in a polygon layer.

Exercise: In this example we will create a buffer areas at a distance 10 km from power plants (points) in Taiwan, and then create buffers areas that are five km to either side of the railway lines in Taiwan. The buffers will be compared using the "difference" analysis, which essentially will subtract all the areas that are overlapping between the two buffer layers. This difference layer will then be clipped to edge match the coastline of Taiwan, to remove the buffer areas which extend outside of the land area. In short, we will be able to answer the question, which areas in Taiwan are at least 10km away from a power plant, but still within 5km of a railway line.

[Note: spatial operations depending on linear distances can only be run on layers that are first projected in CRS that have defined distance units, such as m, km, mi]

1. We'll begin with the district map that we used in Module 3 as a reference map

1.1 Open the tw_XIAN80 layer, noting the projection units (in this case Xi'an 1980 is in units of meters)

1.2 next open our points layer of Power Plants, called: Taiwan_CARMA_Xian80

1.3 also add the railways, (set encoding to UTF8), TW_Railways

2. Check Projection before running any geoprocessing

2.1 right click on each of the layers and check Properties | General

2.2 we want all three layers to be in the same projection, in this case EPSG 2333, Xian 1980 Zone 19

2.3 click on the SELECT CRS button (looks like a little Globe) to view the details of the current Projection

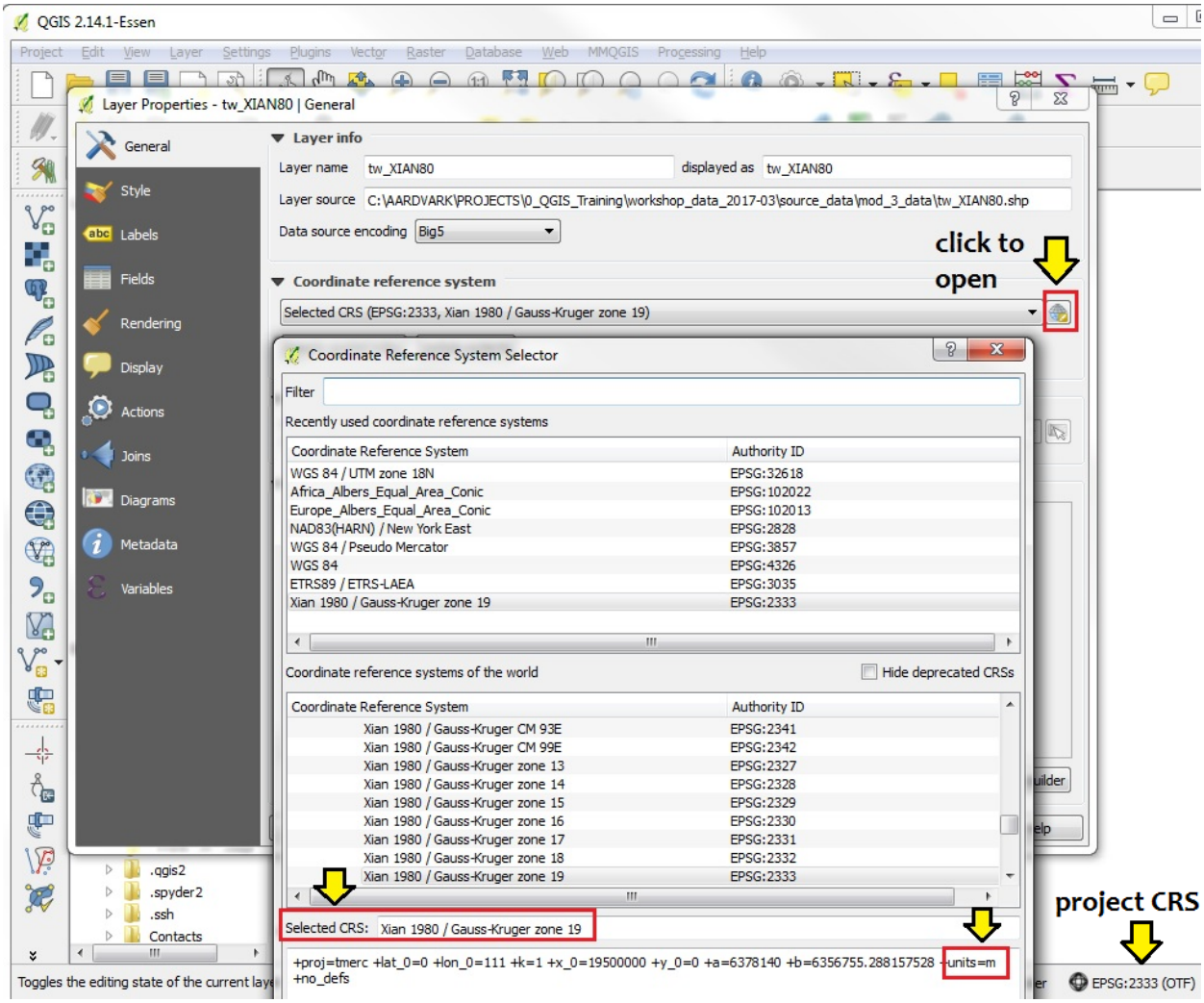
2.4 There are three places we want to check:

Selected CRS: is the currently selected CRS for this layer.

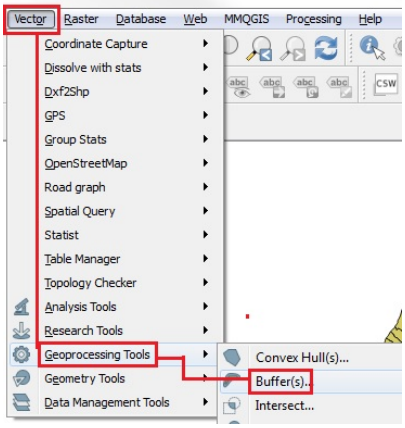
Units of the selected CRS: in this case units=m (meters)

Project CRS: shown in the bottom right of status bar

2.5 If our layers to be buffered are all in the same projection and match the Project CRS, close the CRS dialog and proceed to the buffering



3. Go to the main menu and find VECTOR | GEOPROCESSING | BUFFER item

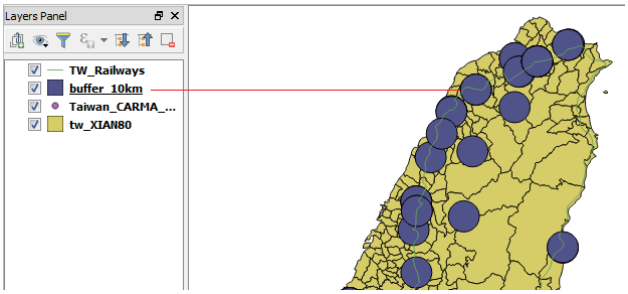


3.1 for the Input Vector Layer, select Taiwan_CARMA_Xian80 (our Power Plants)

3.2 for the Buffer Distance enter the distance (in the layer units !), in our case: **10000** (= 10km)

3.3 browse to your working folder where the new buffer layer will be created, and provide a name for the buffer file, for example: buffer_10km

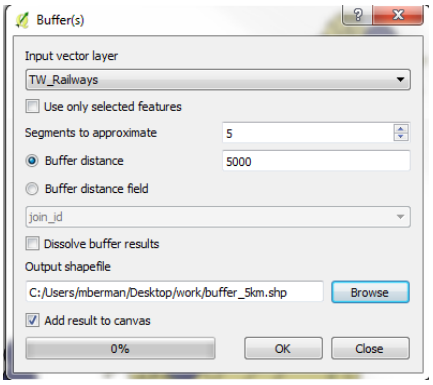
3.4 click OK to run the Buffer process and view the resulting layer



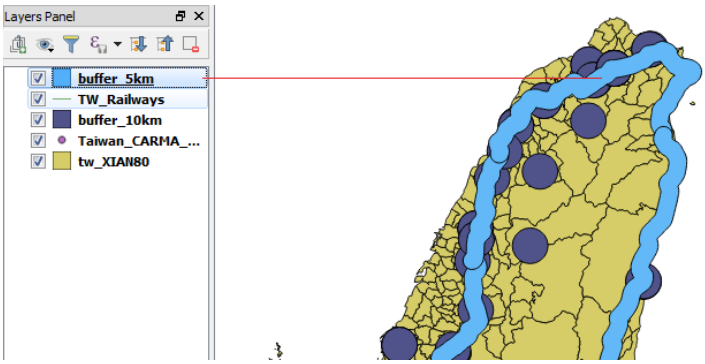
3.5 Now we will repeat the process to buffer the Railways layer

3.6 Go to the main menu and find VECTOR | GEOPROCESSING | BUFFER item

3.7 In the Buffers form, we'll select the TW_Railways layer and enter Buffer distance of 5000 m, the layer name can be buffer_5km



3.8 Click OK and view the resulting layer, buffer_5km



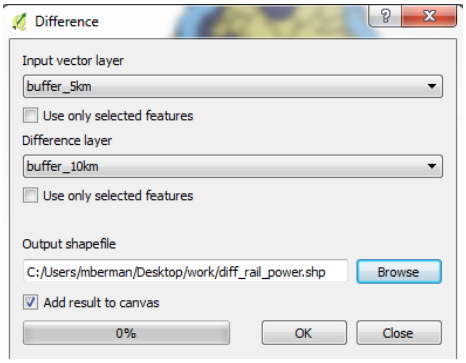
3.9 we now have two polygon layers that can be used for our next analysis, Difference

4. Go to the main menu and find VECTOR | GEOPROCESSING | DIFFERENCE item

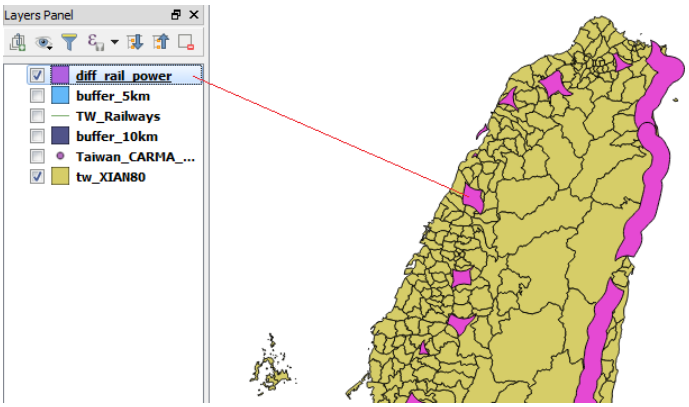
4.1 for the Input Vector Layer select Buffer_5km (the buffer along the railway lines)

4.2 now for the Difference Layer, select Buffer_10km (in order to erase the overlapping power plant areas from the Railway buffer areas)

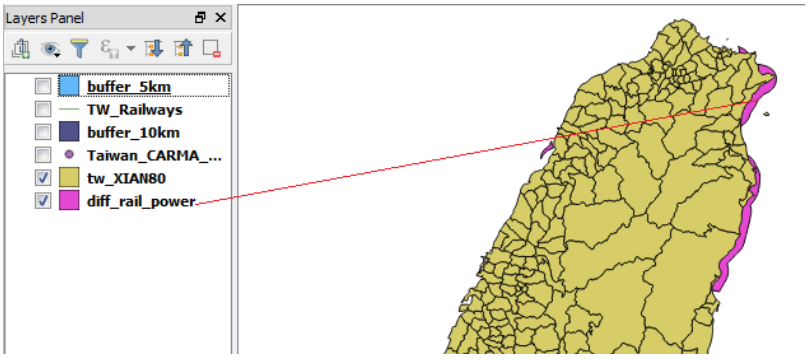
4.3 Browse to the folder to create your shapefile and name it, for example: Diff_rail_power



4.4 view the resulting "difference" or the areas that are within the 5km buffer zone, but NOT within the overlapping 10km radius from each power plant.



4.5 Notice that the 5km buffer extended beyond the actual coastline in a few places



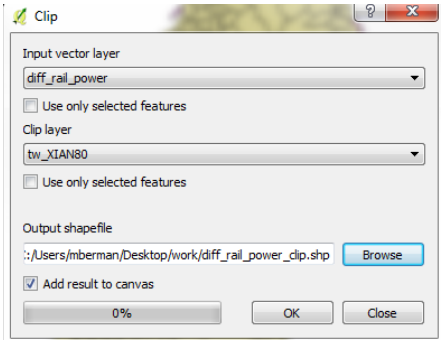
4.6 we can use the CLIP process to trim those areas off the diff_rail_buffer layer.

5. Go to the main menu and find VECTOR | GEOPROCESSING | CLIP item

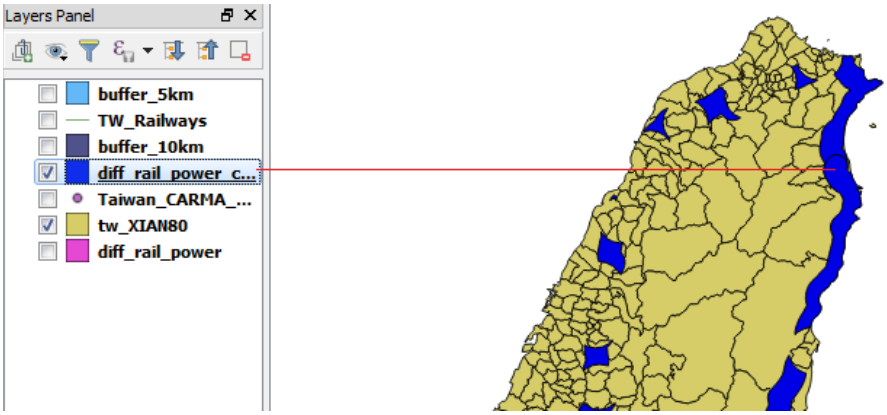
5.1 Set the Input Vector Layer to diff_rail_power (the layer that we want to trim)

5.2 set the Clip Layer to tw_XIAN80 (the layer that we want to use as the template to clip edge)

5.3 select an output folder and output name, such as diff_rail_power_clip



5.4 view the resulting diff_rail_power_clip layer, notice that the edge of the layer now matches the coastline in the tw_XIAN80 layer.



6. Now let's add all the Railway Stations in Taiwan, and use them to find all the areas in the diff_rail_power_clip layer that are WITHIN 500 Meters of a railway station.

6.1 First we add the Vector layer tw_stations

6.2 Go to the main menu and find VECTOR | GEOPROCESSING |BUFFER item

6.3 In the Buffers form, select the tw_stations layer and enter Buffer distance of 500, the layer name can be stations_500m

6.4 click OK and check the results

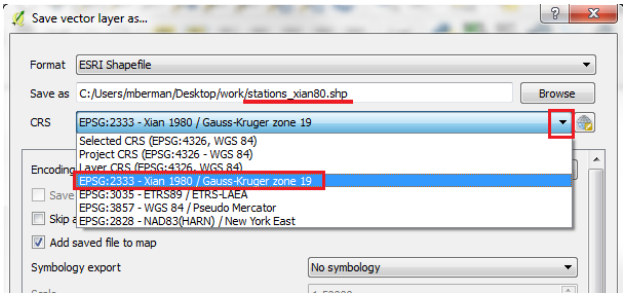
6.5 What happened? The buffers are larger than planet earth… Go back to your tw_stations layer and right-click to check the PROPERTIES | GENERAL | SELECT CRS

6.6 Aha! we were using a buffer distance of 500 but the units were decimal degrees, so we tried to create buffers that were 1000 degrees in diameter.

6.7 Let's close this dialog box and right-click on the tw_stations layer, then SAVE AS a new Shapefile.

6.8 Save to your work folder as: stations_xian80

6.9 in the CRS drop down menu, set to the recently used EPSG 2333 Xian 1980 item

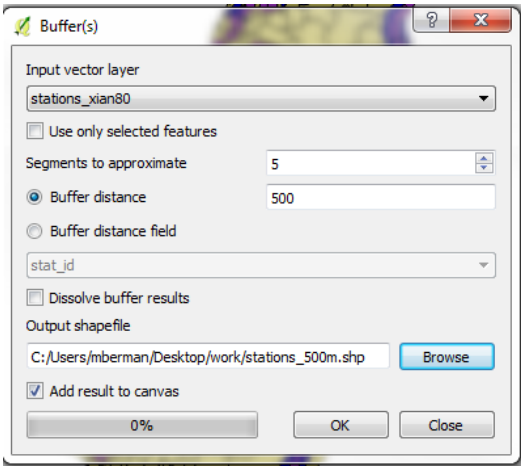


6.10 Click OK and the new layer stations_xian80 should be added to the project

7 We will now run the Buffer process again

7.1 Go to the main menu and find VECTOR | GEOPROCESSING |BUFFER item

7.2 Input Vector Layer is the stations_xian80 layer, buffer distance = 500, output shapefile = stations_500m



7.3 You will be prompted to OVERWRITE the existing stations_500m layer, click YES

7.4 now click OK to run the buffer process

7.5 View the results, this time the stations_500km look like tiny dots on the tw_stations symbols

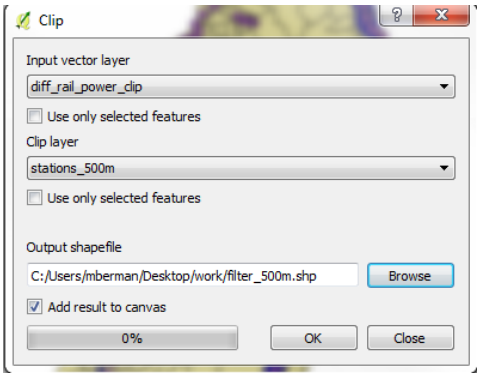
8 Finally, we can run another CLIP process to find all the areas of the diff_rail_power_clip layer, that are contained within the 500m radius of any Railway Station

8.1 Go to the main menu and find VECTOR | GEOPROCESSING | CLIP item

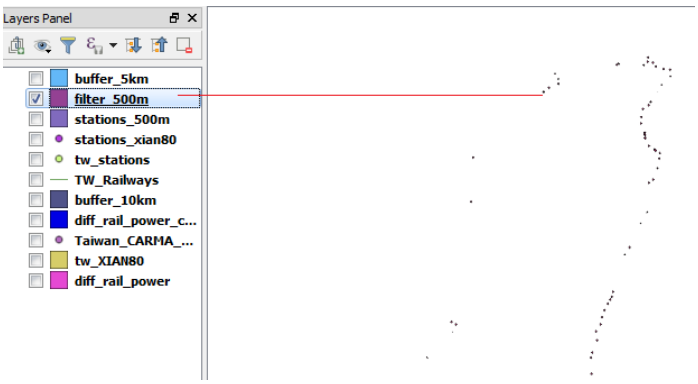
8.2 the Input Vector Layer will be diff_rail_power_clip

8.3 the Clip Layer will be stations_500m

8.4 the output Shapefile can be: filter_500m



8.5 Click OK to run the buffer process and then view the results by turning off ALL other layers besides the filter_500m layer. You should see just some tiny dots and slivers.

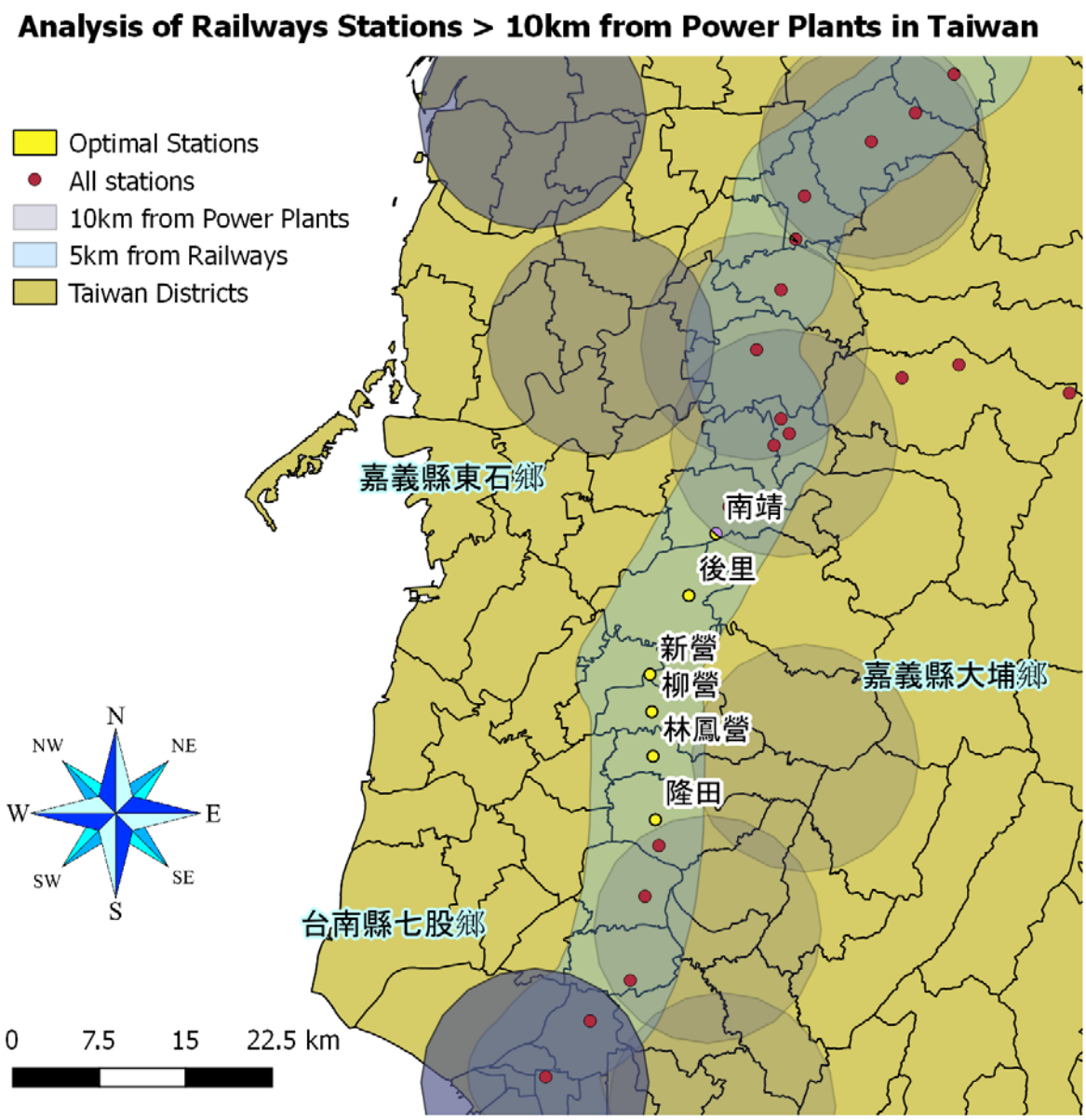


8.6 zoom in to a few of the filter_500m objects to take a closer look, then turn on the tw_XIAN80 basemap again for some context

8.7 turn on the stations_xian80 layer and drag it ABOVE the filter_500m layer in the drawing order

8.8 now right click on the stations_xian80 layer and go to PROPERTIES | LABELS (label field = name_utf)

8.9 Now we can see which areas of Taiwan are MORE than 10km from a Power Plant, and within 500m of a railway station. Indeed, we did not even need the railway buffer line of 5km, except we could add it for visual interest to the final map.



Data Sources

Taiwan Ministry of Education, Taiwan Ministry of Transporation

CARMA Power Plants http://www.carma.org/plant