**Multi-criteria Site Selection in QGIS**

The purpose of multi-criteria site selection is to identify areas on your map that meet a specified set of criteria. For example, you might be trying to identify sites that:

1. are at least 100m from a road
2. are in a recreation area and
3. are relatively flat.

You will recall that we did spatial queries in the first Block. Multi-criteria analysis can be done simply by combining the results of several spatial queries.

The first step is to create layers that contain the results for each of the separate criteria, and then the second step is to combine those layers to get the multicriteria result.

**Step 1: Creating Layers for Each Individual Criteria**

The method for creating layers for each individual criteria depends on what the criteria is. Some common methods include:

**Buffering**

This is used to cater for criteria that involve being some specified distance from a specific feature, or not being closer than a distance to a specific feature. We create a buffer around those features of the specified distance. So in criteria 1 above, we would create a 100m buffer around the road geometries. The layer that contains all the road geometries is an input data set, we specify 100m and the function creates a new data set that contains the buffer geometry. This function can be found at Processing > Toolbox > Vector Geometry > Buffer. There is a good explanation of buffering here:

<https://docs.qgis.org/2.8/en/docs/gentle_gis_introduction/vector_spatial_analysis_buffers.html>

and this video gives a tutorial if you would like one:

<https://www.youtube.com/watch?v=LAGQIrPHncA>

**Spatial Query**

GIS software offers a range of spatial query options, as you saw in the tutorial in Block 1. The following function in QGIS allows you to find objects that are within, touching, overlapping, inside or disjoint from (not touching or overlapping in any way):

Processing > Toolbox > Vector Selection > Select by Location function.

So for example, for criteria 2 above, we need first to have a layer that contains recreation areas. Since ‘in’ is relatively simple spatial query, we can just use the layer itself to indicate areas within recreation areas, but if we want to find out whether specific points (e.g. candidate locations for a picnic) are within a recreation area, we would use the Select by Location function with ‘Select features from’ being set to the candidate picnic locations data set, ticking the box ‘are within’ and ‘By comparing features from’ being set to the recreation areas data set. This will return those candidate picnic spots that are within recreation areas.

Spatial queries are very powerful and can be used to perform many calculations between different data sets to meet specific criteria. For example, we could find:

* land parcels touching a road (which means they share a boundary, and are thus on that road);
* roads that go through a particular administrative region (cross)
* post offices within areas of low economic status.

Select by location returns a layer that contains the geometries from the first layer that have the specified spatial relationship with those from the second layer. If you only want to find those that have the spatial relation with a subset of those in the second layer (for example, for one particular administrative region), you would first do a filter to create a layer for only that administrative area.

**Attribute Filter**

We often want to include only those geometries that have particular characteristics (e.g. only those administrative areas that are of low socio economic status, only those areas that have a low gradient (are flat). To do this, we need a layer that has the required information as an attribute, and can then select the attribute values that we are interested in.

There are a few ways to do this in QGIS, including Processing > Toolbox > Vector Selection > Select by Attribute, in which you simple select the layer, the attribute that you want to restrict the value of, the operator and the value. So if you only want geometries that have a gradient of less than 2%, and you have a layer that stores the average gradient for each geometry (which may be created using slope analysis for example), you would specify the name of the attribute that contains the gradient, select < as the operator, and enter 2 as the value.

You can use Processing > Toolbox > Vector Selection > Select by Expression to build more complex attribute queries. Here is an example: <http://www.patrickrickles.com/tutorial/?p=423&page=2>

**Step 2: Combining the Layers for Multicriteria Analysis**

Once you have created layers for all the individual criteria, you need to combine these to find the features for which all of the criteria are true. You can do this using spatial queries (as described above) with pairs of layers, and then progressively add each new layer (each new criteria) until you have found areas that meet all criteria.

You can also use Vector > Geoprocessing Tools > Intersection, which will simply create the intersection of pairs of data sets, but differs from the spatial query in that it creates a new data set with the parts of the input geometries that overlap, and with the attribute values that you specify. In contrast, the spatial query using overlaps keeps the entire features from the first data set specified in the dialog box that overlap with the second data set specified in the dialog box, in their original form (not only the overlapping part, but the whole geometry, and with all its original attributes).