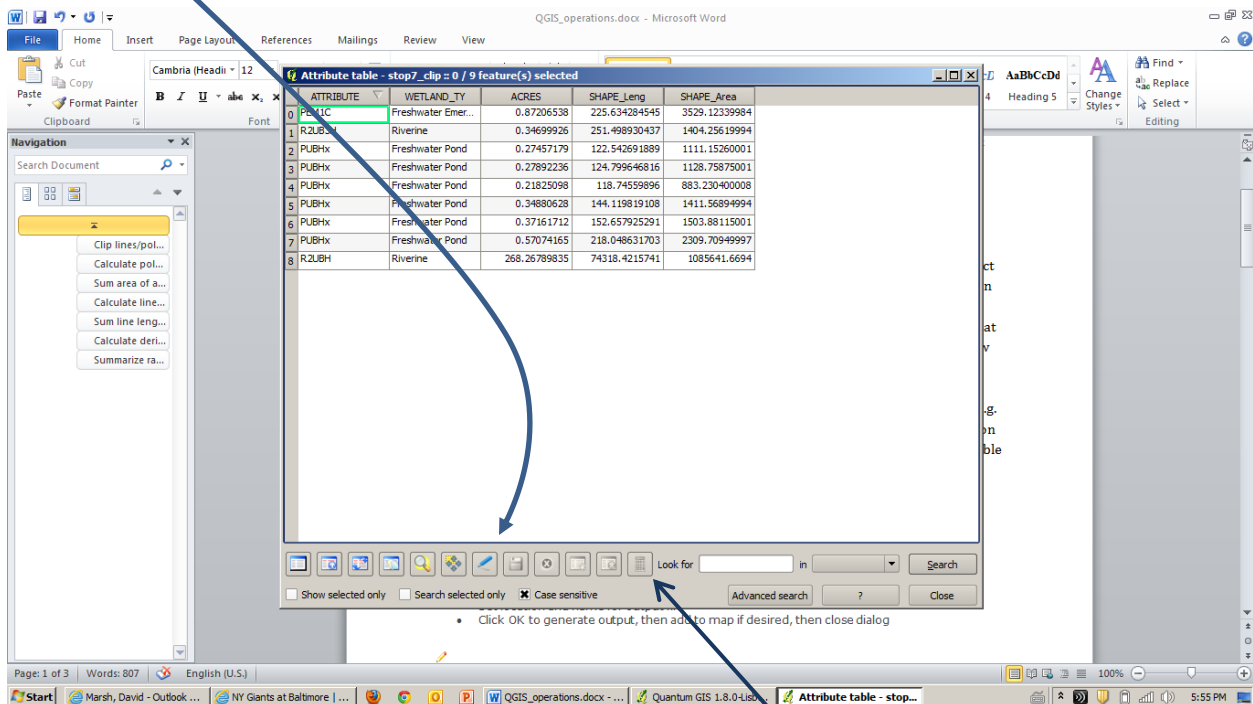


Calculating wetland area within 1000 m of wetlands

Calculating wetland area requires three steps. The first step is to create a new layer that includes only wetlands (and parts of wetlands) within 1000m of the stop (this is called a “clip”). The second step is to calculate the area of all the wetlands within the clip layer. And the third step is to sum up the areas.

To create the clipped layer, go to the top menu and click on Vector then Geoprocessing Tools then Clip. For *Input vector layer*, select the nwi wetlands layer. For *Clip layer*, select the 1000m buffer for the stop (e.g. stop7_1000). Use Browse to set the name and location for the output file (something like stop7_clip, in the same folder with the data for the route). Then click OK to generate the output and add it to the table of contents. Note that any wetlands within the 1000m buffer have now changed color, as your new layer is now showing on the map.

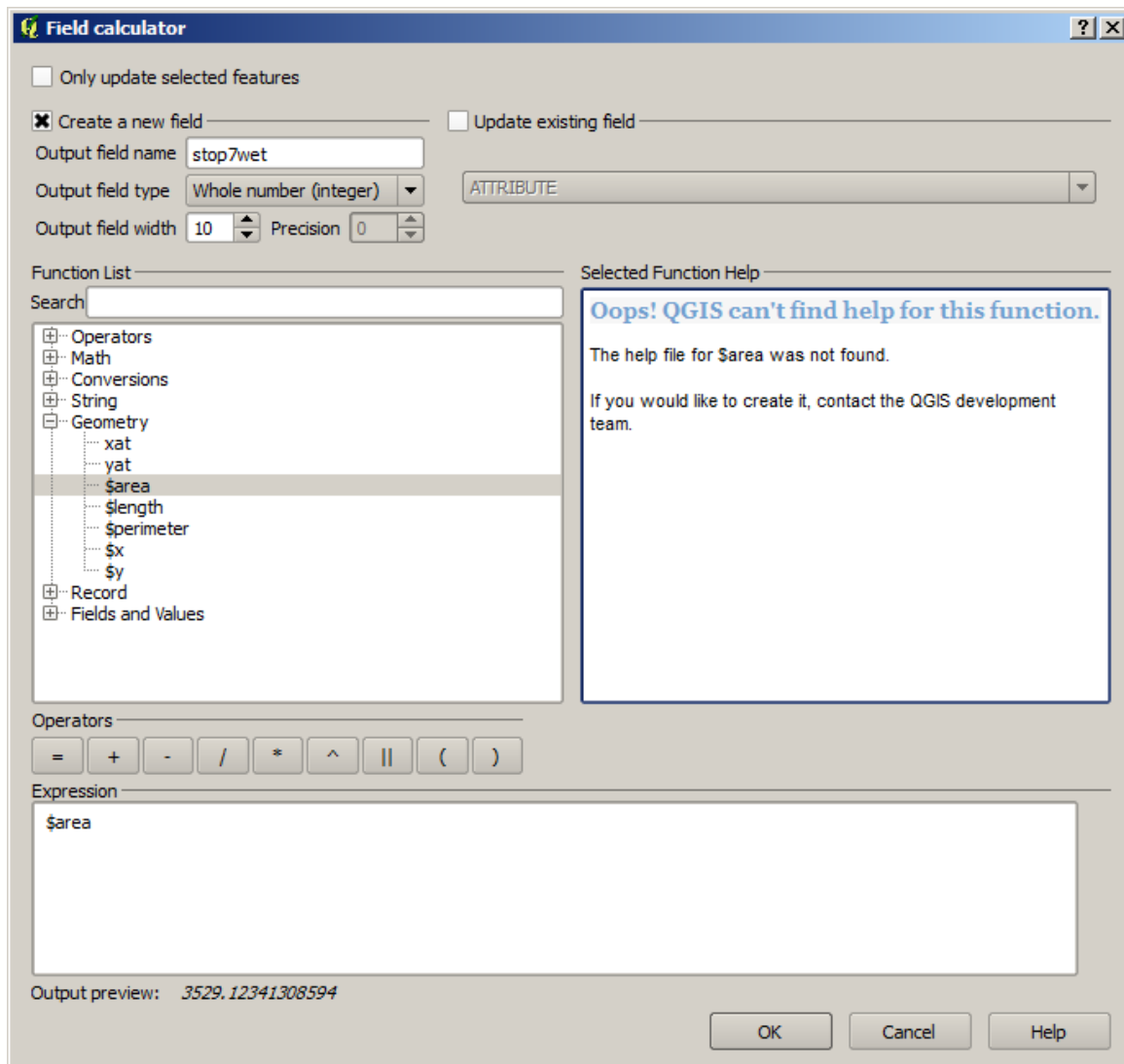
For step two (calculating area of the wetlands within the clip), highlight the new layer (e.g. stop7_clip) in the layer window. Open the attribute table for the clipped layer that you just created and turn on editing by clicking on the pen in the middle of the bottom row of icons in the attribute table window.



Field calculator

You'll see that the attribute table already includes a column for shape area (the last column). However, this is the area of the entire wetland, not just the part that's within the 1000m clip. To calculate the clipped area, open the Field Calculator, which is the last icon before the "Look for" space along the bottom row of icons in the attribute table.

Under Geometry, double click on \$area so that it appears in the Expression window at the lower left. Name the output field (this will not be a layer on the map but rather a column in the attribute table), something like "stop7wet". Set Output field type to decimal number (real), though you can leave precision (i.e. number of decimal places) at 0. Click OK, then click on the editing pen again to turn off editing. Save the changes to the attribute table. (Note 1: if you forget to turn off editing, changes will not save properly). (Note 2: Don't worry about the "Oops!..." message in the Function Help window below – the function works fine, they just don't have a help file for it)



Your new attribute table should look like this:

	ATTRIBUTE	WETLAND_TY	ACRES	SHAPE_Leng	SHAPE_Area	stop7wet
0	PEM1C	Freshwater Emer...	0.87206538	225.634284545	3529.12339984	3529
1	R2UB3H	Riverine	0.34699926	251.498930437	1404.25619994	1404
2	PUBHx	Freshwater Pond	0.27457179	122.542691889	1111.15260001	1111
3	PUBHx	Freshwater Pond	0.27892236	124.799646816	1128.75875001	705
4	PUBHx	Freshwater Pond	0.21825098	118.74559896	883.230400008	883
5	PUBHx	Freshwater Pond	0.34880628	144.119819108	1411.56894994	1412
6	PUBHx	Freshwater Pond	0.37161712	152.657925291	1503.88115001	1504
7	PUBHx	Freshwater Pond	0.57074165	218.048631703	2309.70949997	2310
8	R2UBH	Riverine	268.26789835	74318.4215741	1085641.6694	76850

Note that in the new column the wetlands are the same area as in the SHAPE_Area column if they are contained entirely within the buffer. If only part of the wetland is inside the buffer (as with the river flowing through the site), the clipped area is much smaller. If you ever find the clipped wetlands in your new column to be larger than the whole wetlands in the default column (i.e. SHAPE_Area), then you've almost certainly done something wrong.

We could just type the new areas into a calculator, but qGIS will actually add them up for us. Go to Vector in the top menu, then Analysis Tools, then Basic Statistics. Choose the clipped layer (e.g. stop7_clip) for the Input Vector Layer and the new area column (e.g. stop7wet) for the Target Field. Then click OK.

Parameter	Value
StdDev	23660.2831255
Sum	89708.0
Min	705.0
Max	76850.0
N	9.0
CV	2.37372974684

The third value down (**Sum = 89708**) gives you the total wetland area in square meters.

Always ask yourself if your answer seems reasonable. The total area of the buffer is $\pi * 1000^2 = 3,142,000$, so the wetland area is $89708 / 3142000 = 2.8\%$ of the total area. Looking at the map, that looks about right. If the percentage were 28% (or 280%!), you would suspect that a mistake occurred along the way.

Calculating Road Length Within 1000 m of a stop

Calculating road length is really similar to calculating wetland area. Since you're working with vector data, you need to carry out the same three steps: 1) create a clip of roads within 1000m of a stop, 2) calculate the length of each road within the 1000 m buffer, 3) add up the road lengths.

With stop 7 still selected, go to Vector, then Geoprocessing Tools, then Clip. This time, select the OSM roads layer under *Input vector layer*. As before, enter the 1000m buffer under *Clip layer*. Browse to your data folder and give the layer a name (e.g. stop7_roads).

Go the attribute table for your new layer (right click on the layer name and click on attribute table). Click on the pen icon to turn editing on, and then click on the Field Calculator. This time, double-click on \$length so that it appears in the Expression window. Type a name for the new column (e.g. stop7length) in the output field, and set Output field type to decimal number(real). *Note: if your column name is too long, you may get a "NULL" result when you try to perform the calculations below.*

You might be thinking that road area could be more important than road length in terms of effects on frogs – after all, a highway may have the same length as a small secondary road but it would surely be much worse for frogs. Unfortunately, most road data are linear, so we don't have the option of using area.

Next, turn editing off (click on the pen icon again) and save your changes. Now, if you scroll to the end of the attribute table, you should see your new column. As before, go to Vector then Analysis tools then Basic statistics. Use your clipped roads layer (e.g. stop7_roads) as your *Input Vector Layer* and the new length column (e.g. stop7length) as the *Target field*. Once again, the sum (11349) gives you the total road length in meters.

Does this value seem reasonable? Given that the buffer is 2000 m wide, this is equivalent to 5 or 6 roads passing straight through the buffer. Looking at the map, that seems reasonable. If you had the equivalent of 1/10 of a road or 100 roads (e.g. 200 m or 200000 m), you might be suspicious.

Calculating the proportion of surrounding land (< 1000m) that is developed, forested, or agricultural

Since the land use (nlcd) layer is raster data (i.e. color-coded cells), this calculation is a bit different from the calculations above. Recall that the landcover classifications (http://www.mrlc.gov/nlcd06_leg.php) are more specific than just "forested" or "developed". Rather, there are 3 different codes for forest (Deciduous, Evergreen, and Mixed), and 4 different codes for Developed (from Developed, Open Space to Developed, High Intensity). So, to calculate proportion developed (or forested, or agricultural) you first have to create a new raster layer that classifies cells as to whether they fall into any of the developed codes or not (using 1 for developed and 0 for not developed).

Once you have this new layer, you then calculate the mean value of the cells within the buffer, which will give us the proportion of cells that are developed. You may have to think about this for a minute to understand why it works. If say half the cells are developed then the mean of half 1s and half 0s will be 0.5. If $\frac{1}{4}$ of the cells developed then the mean of cells ($\frac{1}{4}$ of which are scored as 1 and $\frac{3}{4}$ of which are scored as 0), will be 0.25.

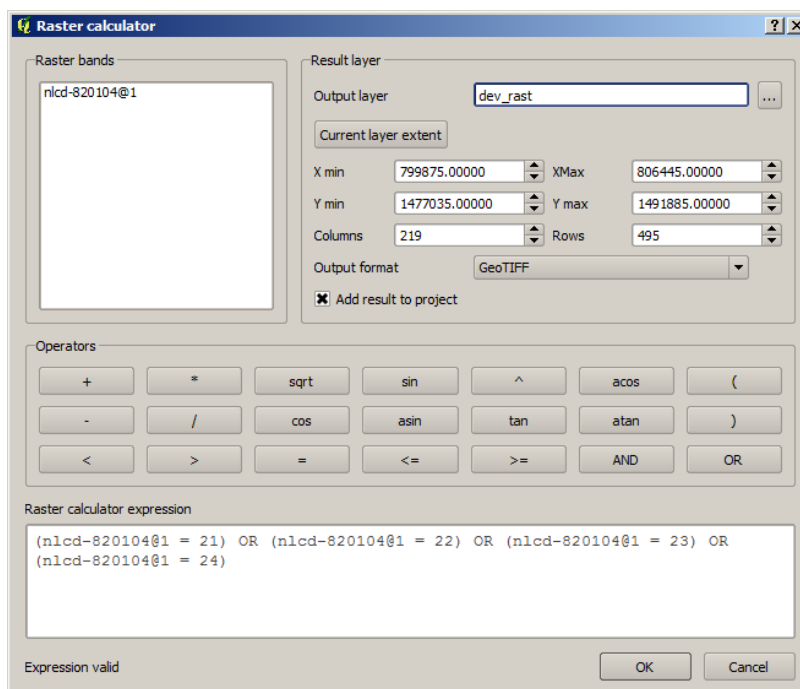
For these raster calculations, you'll need to enable a Plug-In called "Zonal Statistics." Go to Plugins, then Manage Plugins. Scroll down to the bottom from the list. Around third from the bottom is "Zonal Statistics." You'll need to click the box next to this item and click OK.

Now, go to Raster at the top menu, then Raster Calculator. The Calculator window should open. Click the "..." (i.e. browse) button and then type in a name for the output layer (I called mine dev_rast for developed raster). *Note: for some reason if you just type directly into the output layer window without first browsing to the desired folder (i.e. without hitting the "..." button), your raster layer will not be created.* Anyway, once you have the name entered, type (or copy and paste) the following expression into the Raster calculator expression window:

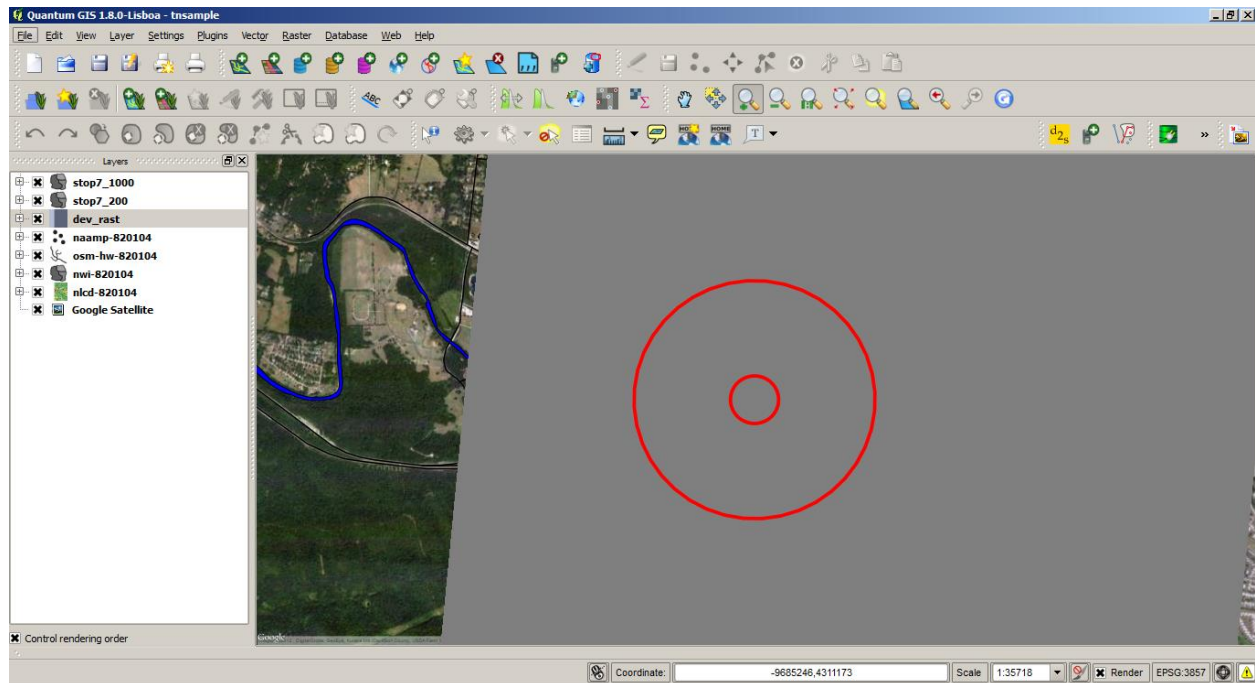
```
(nlcd-820104@1 = 21) OR (nlcd-820104@1 = 22) OR (nlcd-820104@1 = 23) OR  
(nlcd-820104@1 = 24)
```

The 820104 refers to the route number (so this would change for a different route), the @1 assigns a value of 1 to each relevant cell and the =21, = 22, etc refer to the color codes for developed on the nlcd raster. So, this expression assigns a "1" to any cell that falls into any of the four developed classes. By default, other cells are assigned the value zero.

Here's what the raster calculator window should look like:

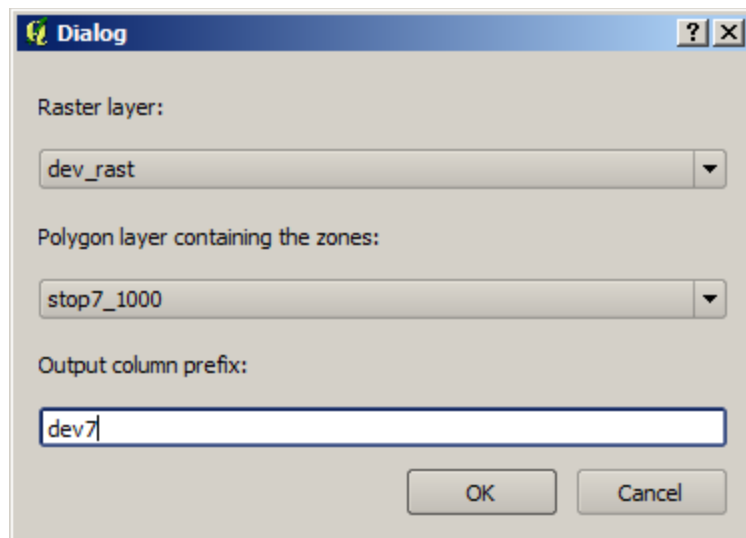


When you click OK, the new layer will eat your map:



The new raster covers the old raster (i.e. the whole strip containing all the stops). But, no worries, just move the new raster to the bottom of the layer list. You'll need it for calculations, but there's no reason to look at it.

Now go to Raster (at the top menu) and then Zonal Statistics. A Dialog box should open.



Use your newly created raster layer as the *Raster layer* (e.g. dev_rast) and specify the 1000m buffer (e.g. stop7_1000) as the *Polygon layer containing the zones*.

Also, give the Output column a short (5 characters or less!) prefix (I used dev7 for developed, stop 7). Click OK. Note, output column names longer than 5 characters will just give you "NULL" for the output columns.

Almost done. The last step is to open the attribute table for the 1000 m buffer (i.e. highlight and right-click stop7_1000 in the layer window). Magically, three new columns have appeared:

Attribute table - stop7_1000 :: 0 / 1 feature(s) selected								
	stopnum	routenum	lat	lon	dev7count	dev7sum	dev7mean	
0	21398	7	820104	36.082	-86.9968	3473	383	0.110279297437...

</

“dev7mean” is the proportion of the buffer that falls into one of the four developed classes. That number is 0.1103, and if you look back at the map, that indeed looks reasonable.

What about proportion forested or proportion agricultural? Here you follow exactly the same set of steps: first, create a new raster to represent whether the cells are forested (or agricultural) or not; then, use the Raster calculator to figure out the mean value of these cells within the 1000m buffer. The only thing that’s different for forested or agricultural is the expression that goes into the Raster calculator, since the land use codes are different.

So, for proportion forest, instead of the expression for developed:

```
(nlcd-820104@1 = 21) OR (nlcd-820104@1 = 22) OR (nlcd-820104@1 = 23) OR
(nlcd-820104@1 = 24)
```

You, would use:

```
(nlcd-820104@1 = 41) OR (nlcd-820104@1 = 42) OR (nlcd-820104@1 = 43)
```

Since 41,42, and 43 are the codes for the 3 forest types.

Similarly, for proportion agriculture, you would use:

`(nlcd-820104@1 = 81) OR (nlcd-820104@1 = 82)`

Since 81 and 82 are the codes for agricultural (cultivated)

A few important points about these raster calculations:

- Always look back at the map to make sure your entry looks reasonable. You probably won't be able to tell 0.20 from 0.25, but you should be able to distinguish 0.20 from 0.02.
- When you go to do a different route (i.e., not 820104), you'll need to change the text in the expressions within the Raster Calculator to reflect the new route number. Forgetting to do this (or mistyping the route number!) are some of the more common mistakes with this section.
- When you go to the next stop on the same route (1, 4, or 10), you will need to make a new 1000m buffer for that stop. But the rasters you created for developed, forested, and agricultural cells apply to the whole route. So, you will only have to carry out this step once for each route -your next set of Zonal Statistics will use the same raster with a new buffer.