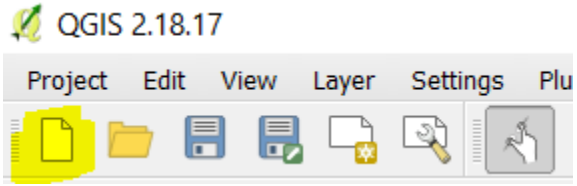
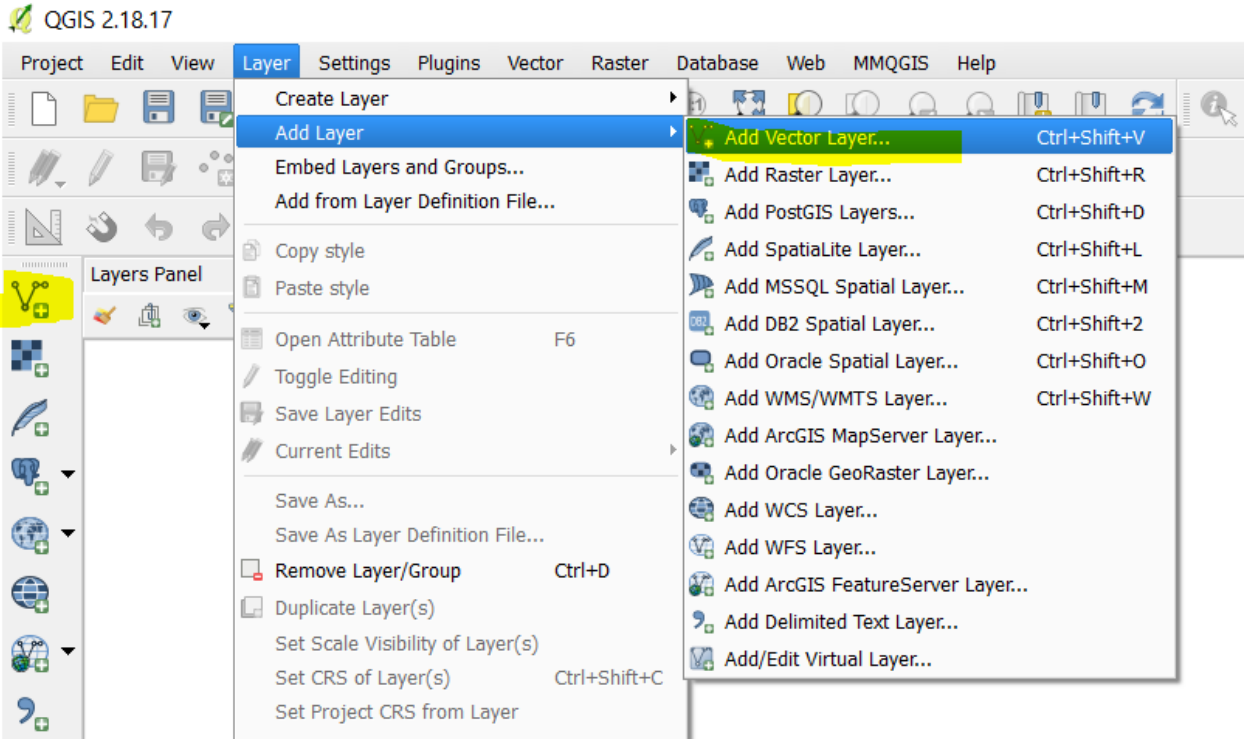
QGIS – Mapping Surficial Geology in 3D

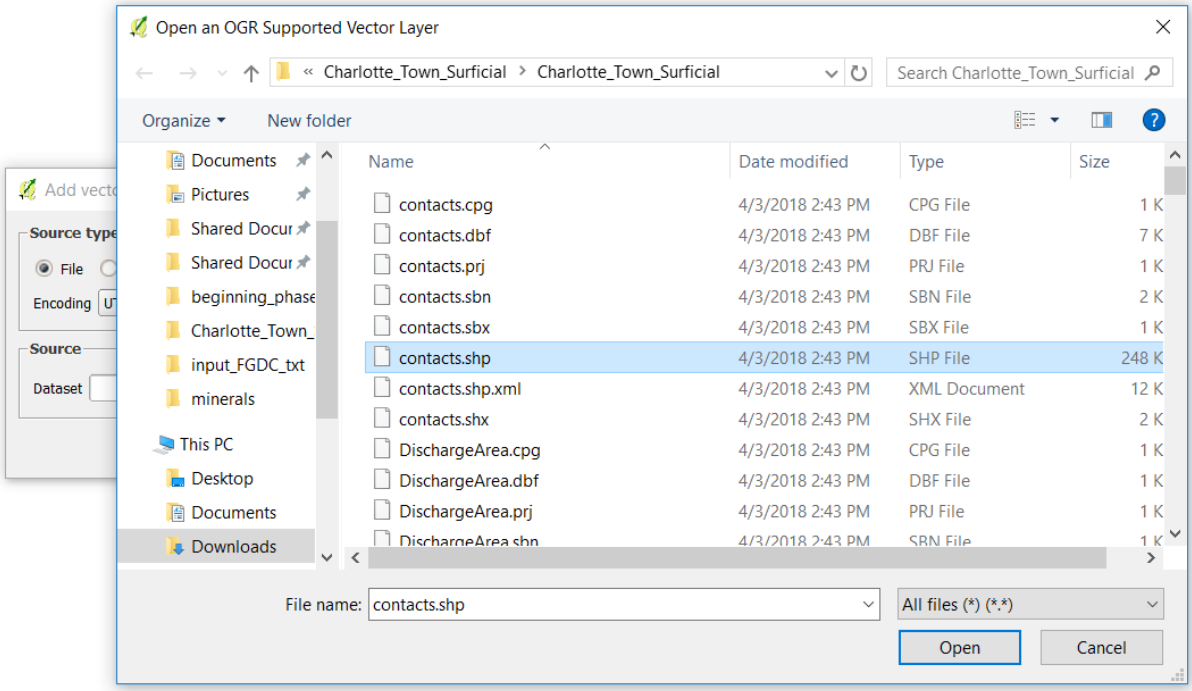
1. Open QGIS Desktop.
2. Try not to be intimidated by the fact that all the buttons are different, the file directory access is different, and… everything is different than ArcMap. This will prepare you for the future shock of moving to ArcGIS Pro, maybe ☺
3. Start a new project by either clicking "New Project" under the Project drop-down, or clicking the blank page.



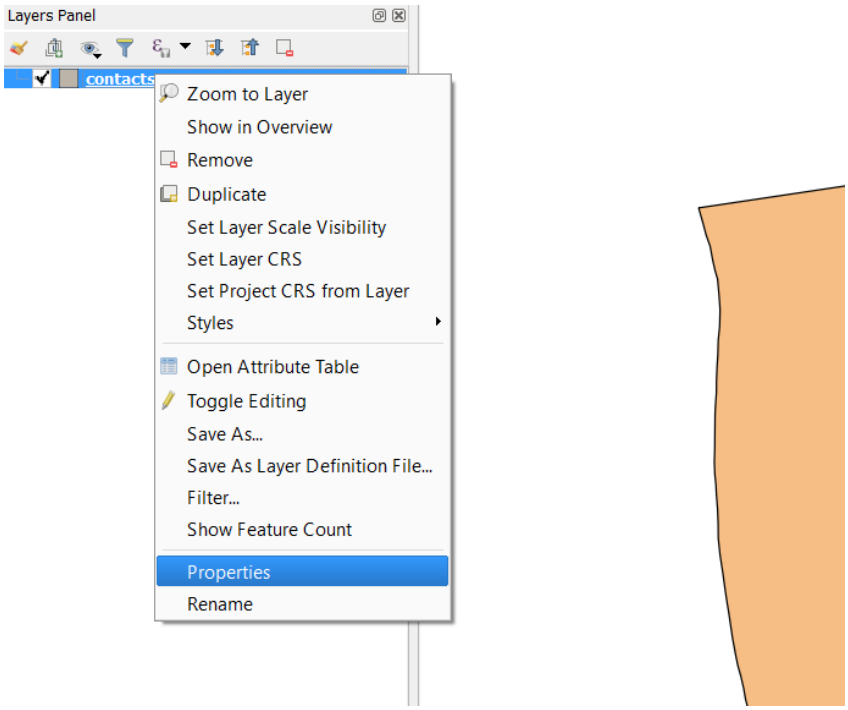
4. Add a vector layer by navigating to "Add Layer" under the Layer drop-down, and selecting "Add Vector Layer" (the weird V button also does this, also highlighted).



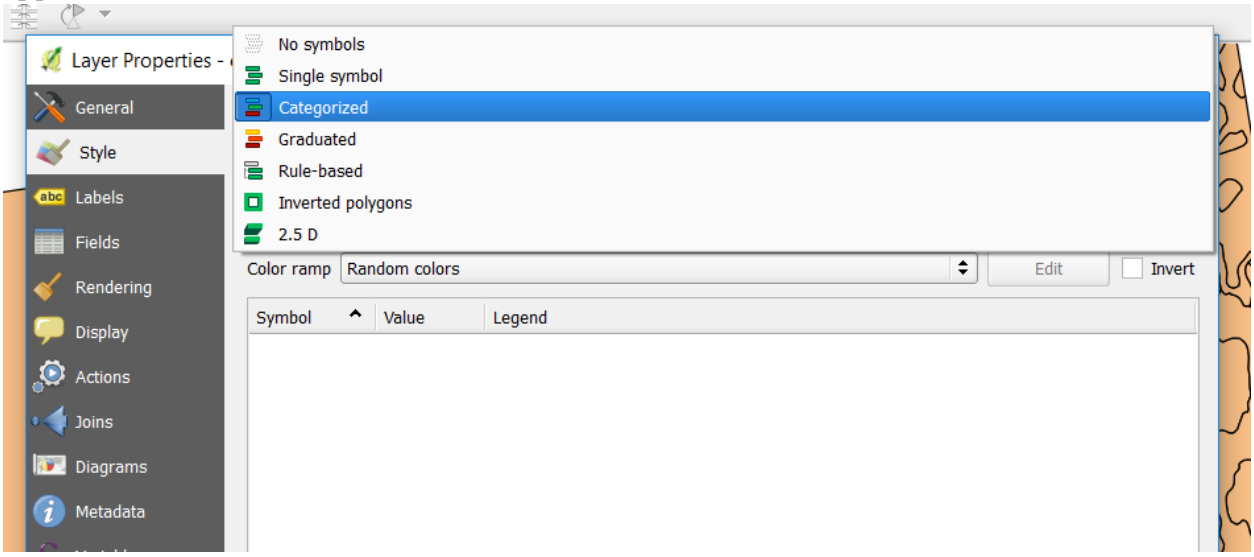
5. Navigate to and select the .shp file from the contacts shapefile, which represents our surficial geology polygons. QGIS only needs you to click on one of the shapefile files, although it needs the rest of them to be within the same directory/folder. Don't worry about the encoding.



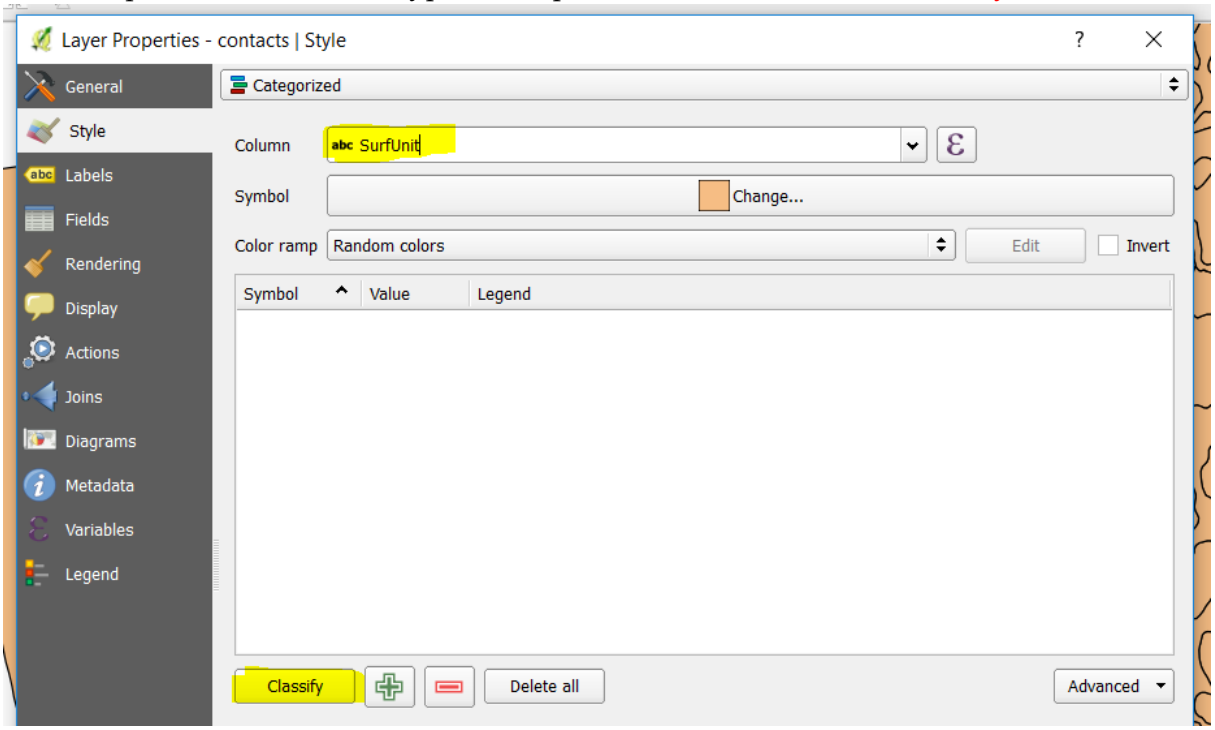
6. You should have a lovely, randomly-colored map of some surficial geology polygons in Charlotte, VT. We want to symbolize these polygons to show that they are different types of surficial geology. Right-click on the layer in the table of contents and click on "Properties."



7. It should automatically show the Style tab. Change “Single symbol” to “Categorized”, since we want to symbolize based on the type of surficial geology. Notice some of the cool options – you can do “inverted” symbology, as well as a birds-eye 3D (2.5D) approximation within this version of QGIS. We’ll be using a plugin to do 3D in a web browser, but the newest version of QGIS has support for actual 3D within the application.

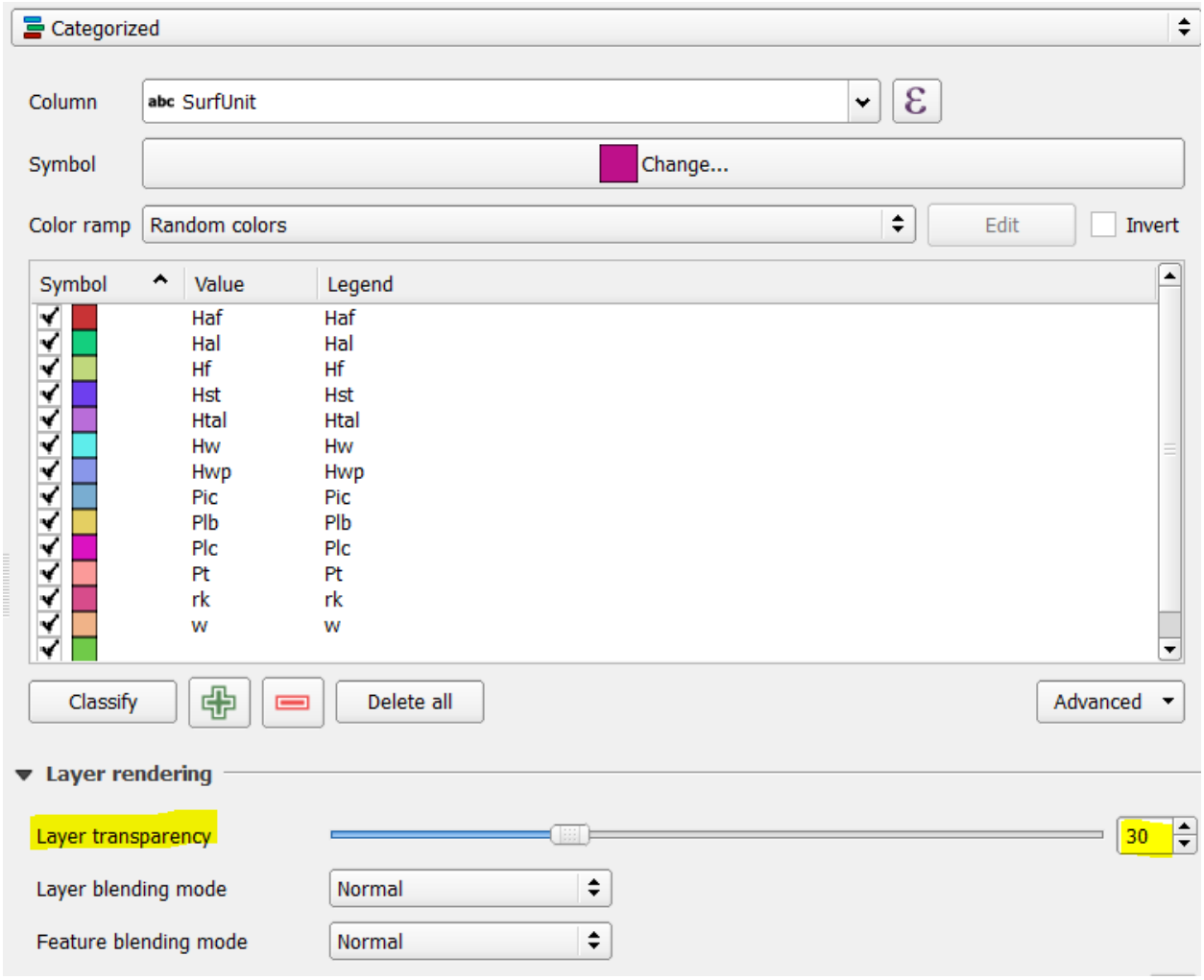


8. Select the field that represents the surficial geology units (SurfUnit) and leave the “Random colors” as it is – we don’t need a graduated color ramp since these represent distinct (qualitative) sediment types, not (quantitative) values. Press “Classify” to load!



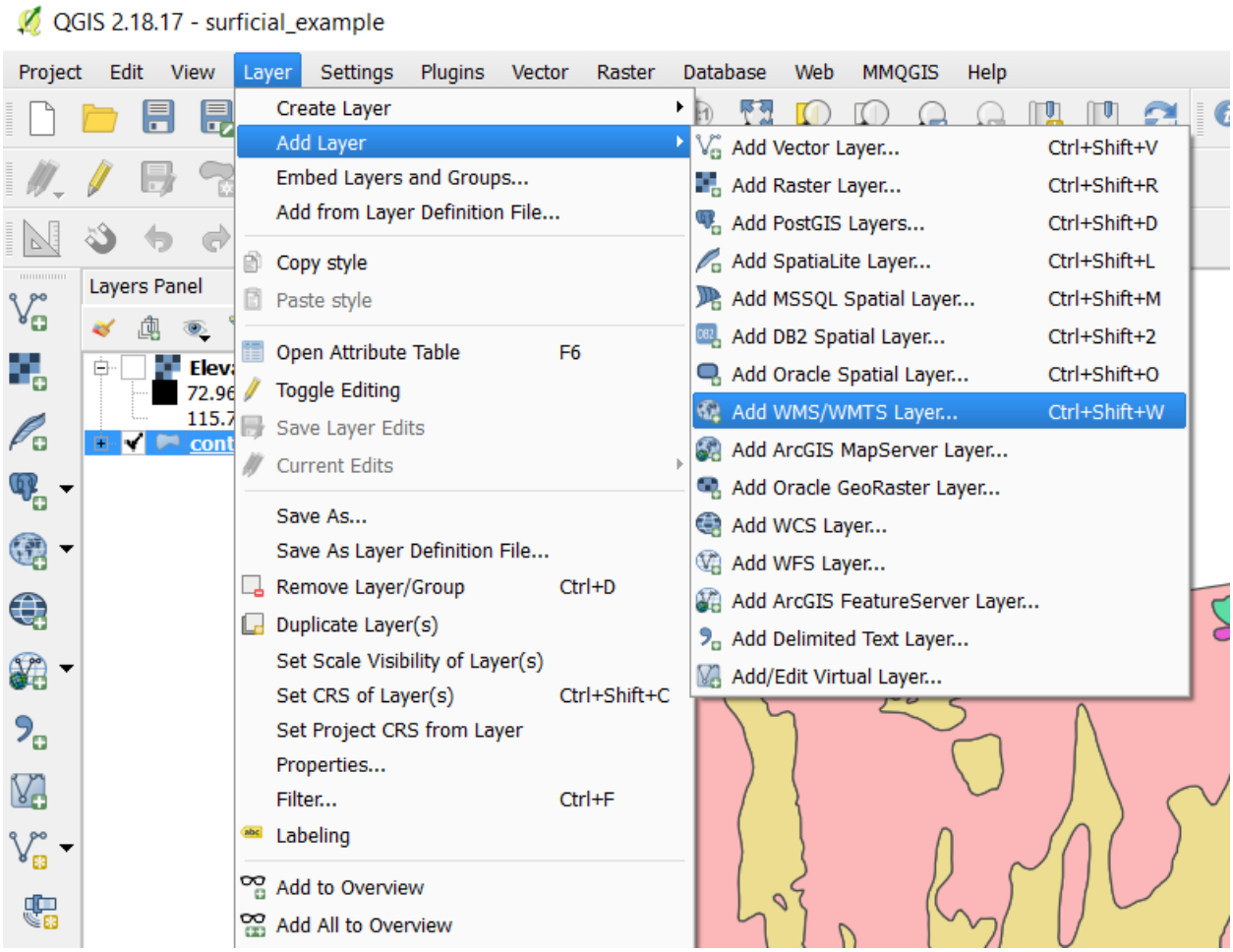
Click okay.

9. Import the DEM file. I've already downloaded it from the Open Geodata Portal to save you some time. It's Lidar data from 2012 (resolution: 1.6 meters). We're only going to use one tile (a tiny section of Charlotte) to do our 3D visualization, since we want to avoid mosaicking and increasing our processing time. Click the Layer drop-down again and hit "Add Raster Layer" (or click the 9-square checkerboard button to the left of the table of contents). Navigate to the DEM (Elevation_DEMHF1p6m2012_AVT_020.img). Uncheck it in the table of contents to render it invisible, since we don't need to see it (we just need it to be our elevation source).
10. Let's add a hillshade service to our map so we can get some visible surface texture within our surficial geology. First, adjust the transparency of the polygon layer by going back into the Properties, and setting the Layer transparency to 30 under "Layer rendering" in the Style tab.



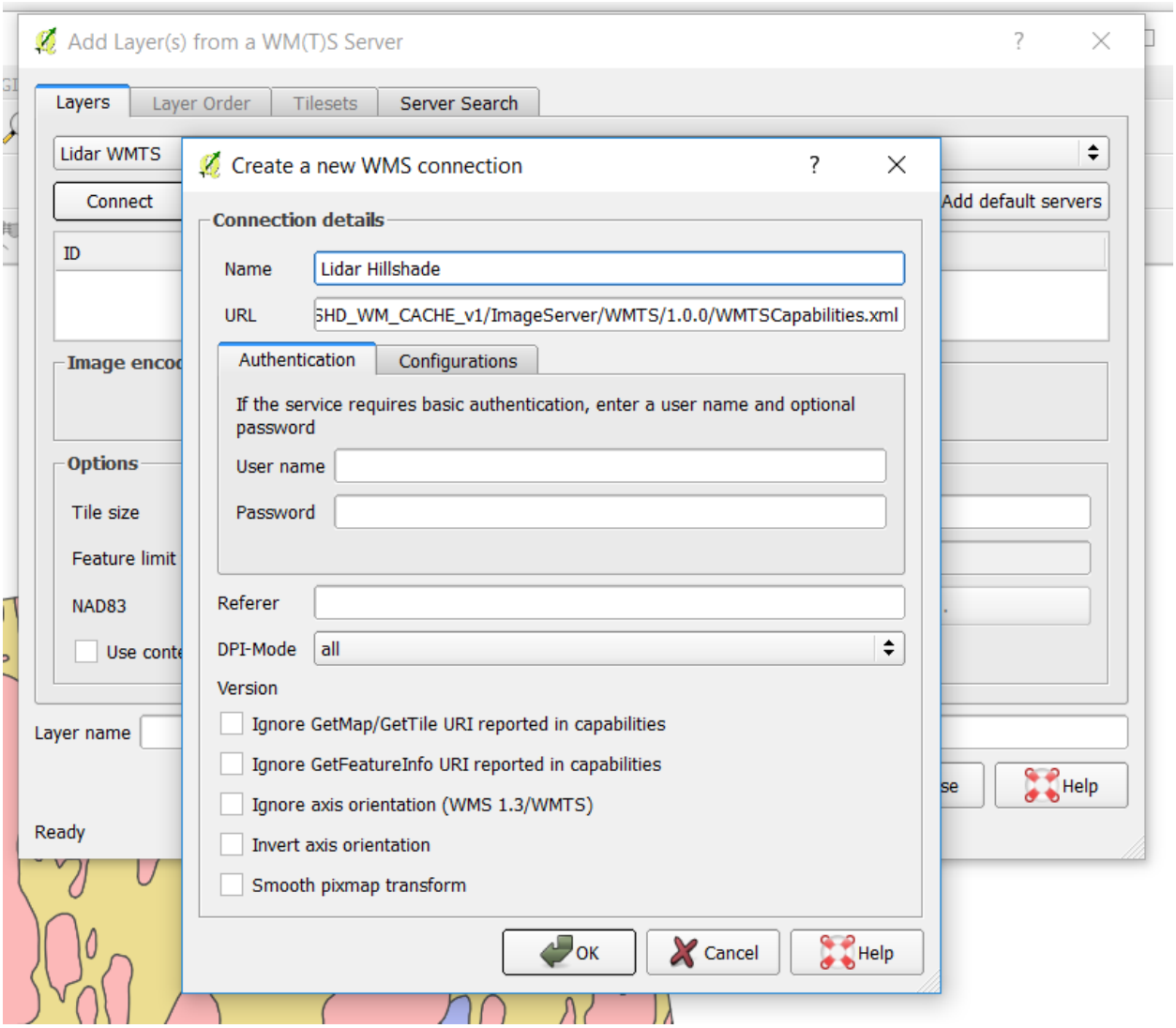
11. Now add the service. Google what a GIS service is if you don't quite know. The short explanation: it's a streamable data connection served over an internet connection. Kind of like Netflix for GIS data. To add it, go back to the Layer drop-down, Add Layer, and

click on “Add WMS/WMTS Layer” (stands for Web Map Service/Web Map Tile Service).



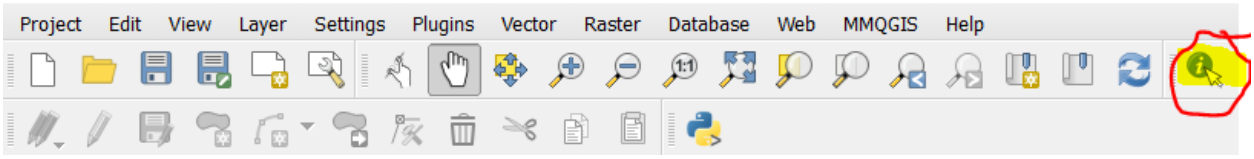
We’re going to add a hillshade service published by VCGI, available from the Open Geodata Portal at this horrible-looking webpage: http://maps.vcgi.vermont.gov/arcgis/rest/services/EGC_services/IMG_VCGI_LIDARHILLSHD_WM_CACHE_v1/ImageServer

Click “New” to create a new connection. Give it a name and put this in the URL (I can show you where this comes from on the above webpage for future reference): http://maps.vcgi.vermont.gov/arcgis/rest/services/EGC_services/IMG_VCGI_LIDARHILLSHD_WM_CACHE_v1/ImageServer/WMTS/1.0.0/WMTSCapabilities.xml

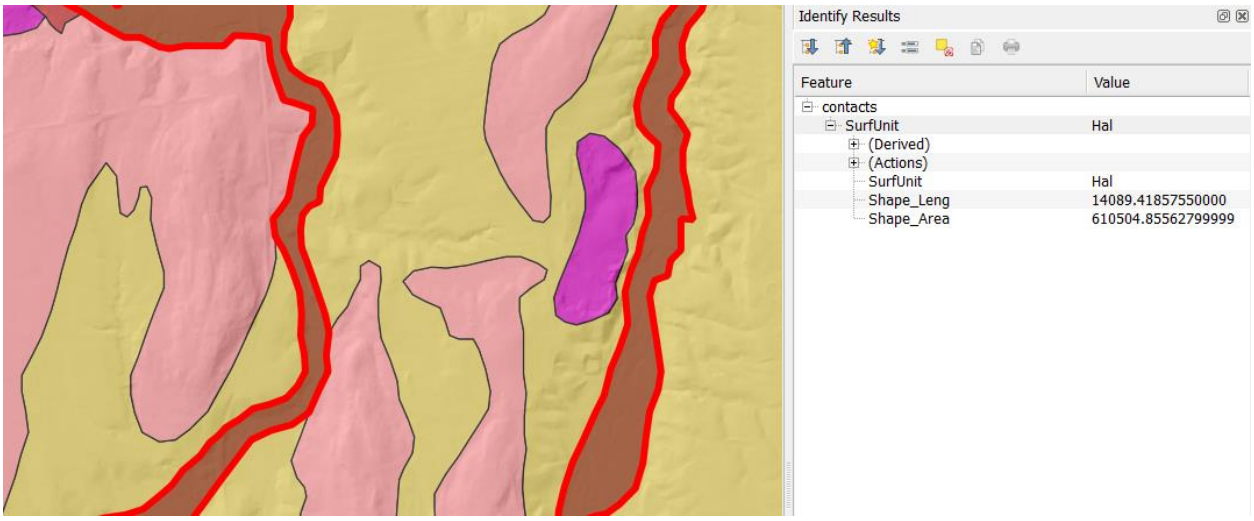


Click OK.

12. Now hit the Connect button (next to "New"), choose either of the available options (not sure why 2 come up), and click "Add".
13. It should show up! Move it underneath your contacts to see it.
14. Before we visualize all this in 3D, let's inspect our surficial geology to get a sense of what's going on in our area. Zoom into the extent of your DEM (right click on the DEM and select "Zoom to Layer").
15. Now use the Identify button to see what the local units are by clicking on each of them. Make sure the contacts layer is selected first (this determines which layer you're "identifying" from).



Who the heck is Hal??



I've included the descriptions of the relevant SurfUnits below, so you can know what they are.

Hal

Holocene Alluvium. Silt, sand, pebble gravel, cobble gravel, and boulder gravel deposited by modern streams. Deposits include stream channel and bar deposits and finer-grained floodplain deposits. Minor wetland deposits are common. In parts of the clay lowlands, pebbles, cobbles, and boulders are exposed along reaches where streams have eroded down to the underlying till. Thickness is typically less than 3 meters.

Plb

Pleistocene Lake and Marine Bottom Deposits. Predominantly clay, silty clay, and silt with lesser amounts of fine to very fine sand. Lacustrine sediments of glacial Lake Vermont occur throughout the study area and consist of bedded silt/clay couplets (varves) but can include fine and very fine sand layers where deposited in ice-proximal environments. Marine sediments of the Champlain Sea occur in the western third of the study area below about 295 feet (90 meters). These consist of laminated very fine sand, silt, and clay and overlie the lacustrine sediments. Thickness of these bottom deposits ranges widely; from less than 1 meter to greater than 30 meters.

Plc

Pleistocene Lake Deposits, Coarse-grained. Moderately- to well-sorted medium to fine sand, pebbly medium to fine sand, and pebble/cobble gravel deposited in shallow waters or on shorelines of glacial Lake Vermont. Generally less than 10 meters in thickness.

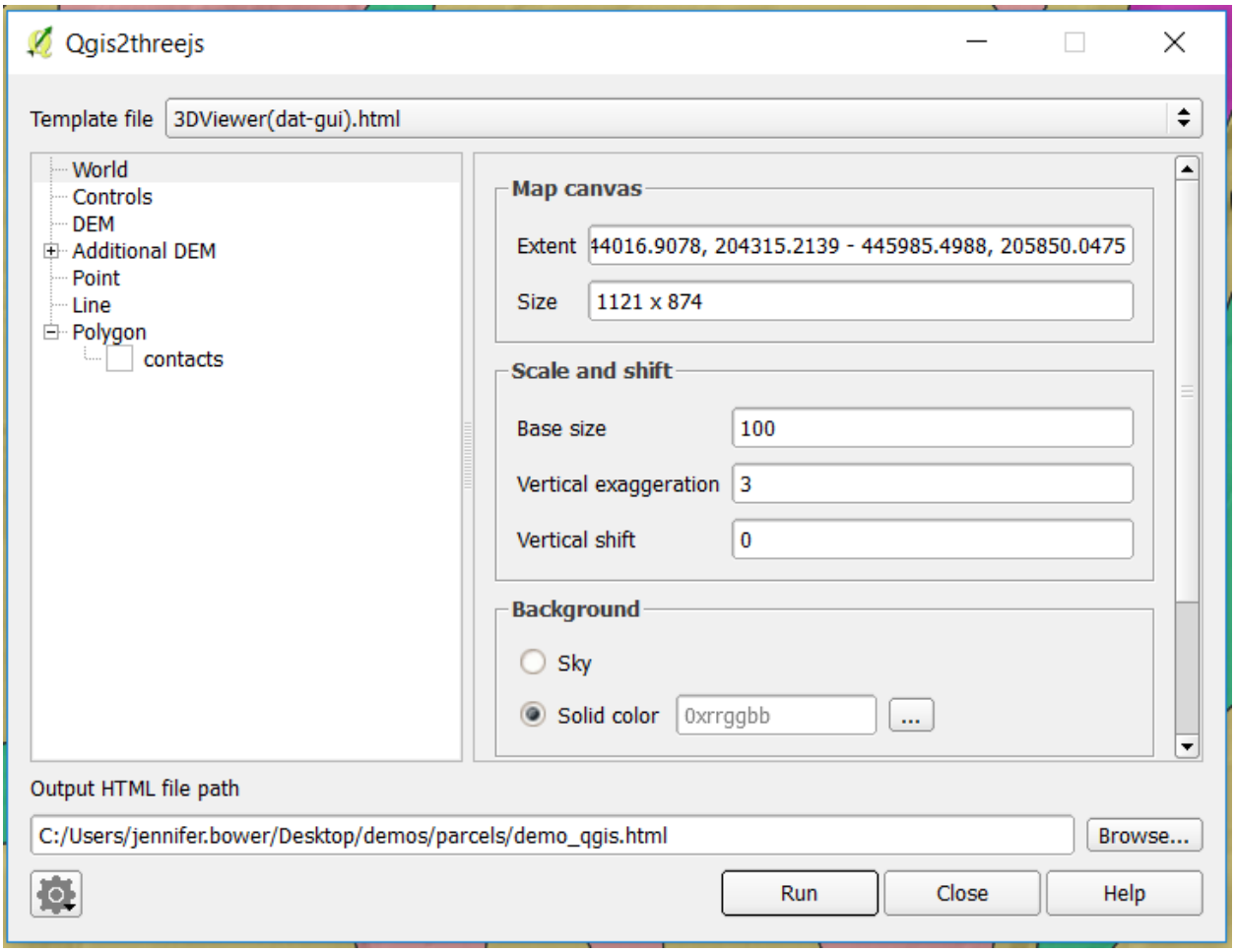
Pt	Pleistocene Till. Two types of till were discerned in the area but are not mapped separately. Deformation or readvance till: Many road areas are underlain by till consisting of variable mixtures of clay, silt, and fine sand with occasional pebble, cobbles, and boulders. these materials are interpreted to be deformation till produced when the Laurentide ice sheet overrode recently-deposited lacustrine sediment. Rare exposures reveal intensely deformed lacustrine sediment with erratic pebbles, cobbles, or boulders mixed in. Lodgement till: Dense, unstratified diamict with grain sizes ranging from clay to boulders. Pebble, cobble, and boulder density is high compared to the deformation till. A weak subhorizontal foliation or fabric is visible in fresh exposures. Thickness of these tills is highly variable, from less than 1 meter to greater than 30 meters.

Okay, cool. We have a sense of what is going on. Note which colors correspond to which SurfUnits for future reference.

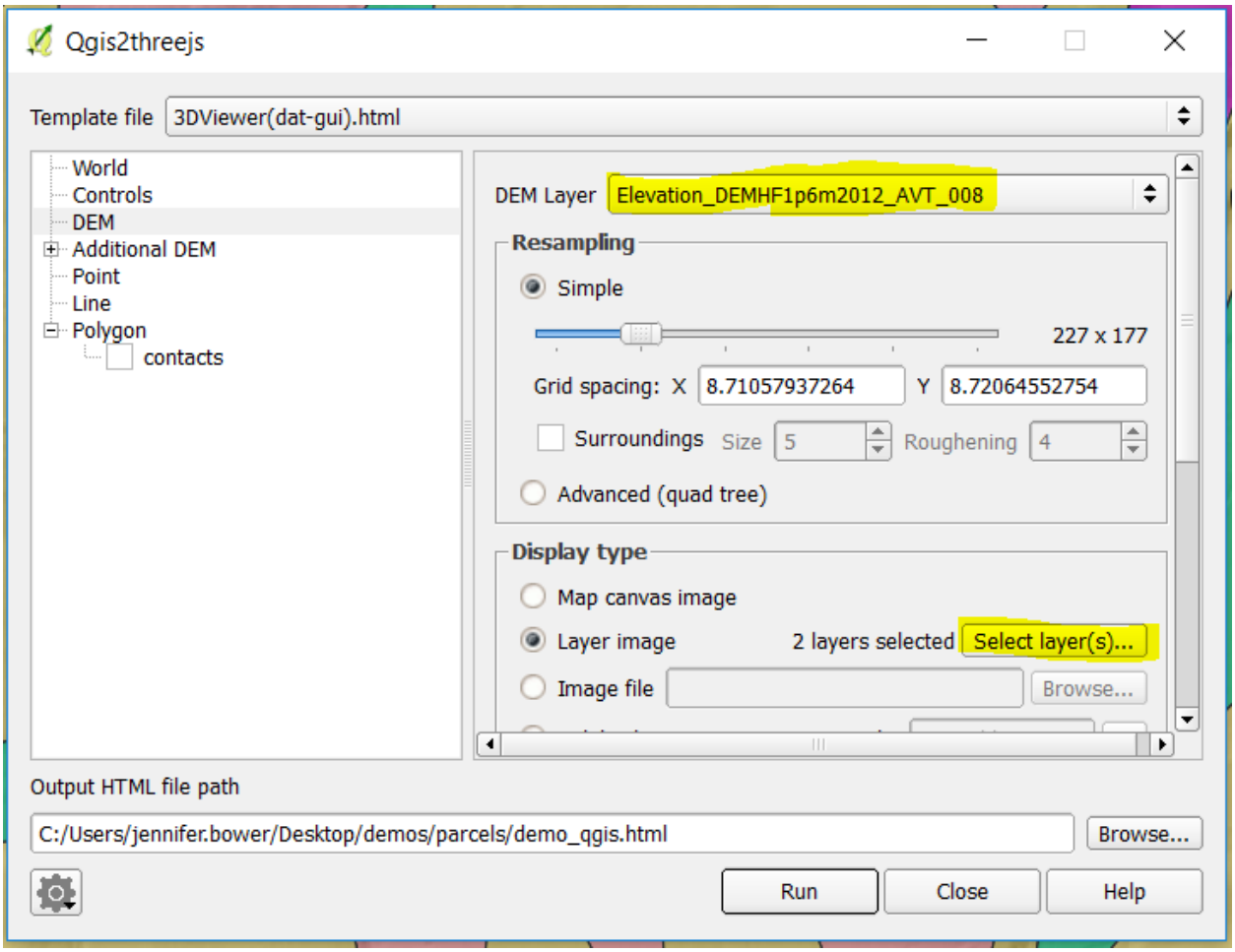
16. We're ready to go 3D! Go to the Plugins drop-down, click on "Manage and install plug-ins," and search "Qgis2threejs" in the search bar of the Plugins window. If it doesn't have a check box next to it, click the check box so that it does.
17. Now click on the Web drop-down and click on Qgis2threejs. This is the plug-in that will allow us to see in 3D.

18. Click on World and input these coordinates to make sure you have the right extent: 444016.9078, 204315.2139 - 445985.4988, 205850.0475

19. Change Vertical Exaggeration to 3 (see below).



20. Click on “DEM” on the left, selecting your DEM as the DEM layer and your contacts + hillshade as the Layer image layers.



Save it to a location. Notice it's an html file. This will enable it to open locally in a browser (not hosted publicly), but you could also host this file on your own public webpage.

Questions:

Remember/refer to which colors correspond to which surficial geology types (we could have also labelled our polygons but didn't). Look back at the descriptions. Can you find a relationship between topography/elevation and surficial geology type? If so, what is it?

Of the three sediment types, which is likely to have been deposited most recently? Justify your answer.