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Introduction

GIS, or Geographic Information Systems, is a powerful type of software specially designed for mapping-- from simple cartography and map design to complex analysis.

Typically, you can divide the data used for GIS into two types: Vector and Raster. Vector data can come in lines, points, or polygons; and can be scaled indefinitely without the loss of resolution. It's likely that you see vector data everyday if you use Google Maps on your commute to school or work-- in their streetmap the roads and buildings are vector graphics. Raster, on the other hand, is a grid of pixels, each one containing a specific value. Satellite maps are a common example of raster data. Other types of raster data that you may see on a map are elevation, rainfall, and landcover models.

Follow along with me as I make my own worldbuilding GIS from scrap. This tutorial will show you how to use Vector GIS to transfer your fantasy map from paper or picture into an interactive map that you can zoom in on without the loss of quality and many other perks.

Pros and Cons

Using GIS in your fantasy mapping comes with several advantages and disadvantages, which you should consider before starting.

Pros

Infinite Resolution: Because vector graphics aren't made of pixels, you will be able to zoom in without losing any quality on your map. This will allow you to work in *extreme* detail. Editing the shapes of 2000 mile long continents can be done on the same map that you draw in specific buildings and towns on.

Interactive Data: In GIS, vector graphics store attribute data, a spreadsheet where you can store any and all the information you want about a feature. For example, if you click a river in your map, you can instantly read information about its depth, salinity, flow direction, source, etc.

Geographic Scale: One of the main features of GIS is the ability to measure. Does your Dungeons and Dragons campaign want to know how far it is to the nearest town? GIS has measurement tools, with which you can interactively measure distance, area, and more.

Cons

Complexity: GIS software can be fairly complex, and it certainly looks intimidating to a new user. However, there are hundreds of guides and tutorials out there that can help you learn how to use this powerful software.

Hardware Intensive: Depending on how you use GIS, it can use quite a bit of memory on your computer. However, most of the modules in this tutorial aren't very taxing. I was able to run them on my old computer (which was an i3 processor and 5 years old) with minimal lag.

Work: Using GIS can take a lot of work, and a lot of patience. It can be finicky, but for every issue you find you can find a dozen forums and YouTube videos that show you how to quickly and easily fix it.

Overall, I believe the cons of using GIS are heavily outweighed by the pros. For a little work, you can reap great rewards.

Useful tutorials

These are some useful tutorials that can help as you work through QGIS! I'll try to keep this list updated with tutorials I find. If you find any tutorials you like, feel free to send them to me and I'll include them here.

How to make an old fashion style map: [Old map in QGIS – GIS Unchained](#)

A beginner's guide: https://docs.qgis.org/2.6/en/docs/gentle_gis_introduction/

Making Mountains: [Fantasy Maps Pt 1 | Mountainification](#)

Making a vintage map: [How to create a vintage map in QGIS](#)

Note from the Editor

While I've been using GIS in academic and professional settings for over five years, I am continuing to learn and better my skills with it. If you think you have a better way to go about any of these modules, have any questions, or have any requests, please let me know via [this spreadsheet!](#)

If you like how I make maps I am open for commissions and can also give classes and lessons about my process. Just email fantasymapsgis@gmail.com for more information!

I truly hope that you can find this guide informative and helpful!

Feedback

If you have the time when you're done with this tutorial, please consider taking five minutes to fill out this assessment of this tutorial, so I can improve it :)

[Link to Google Form](#)

Changelog

4/18/21:

Module 1: Getting Started

Downloading QGIS

1. Follow this link and download the QGIS software:
<https://qgis.org/en/site/forusers/download.html>
2. I recommend using the stable release:

Long term release repository (most stable):



The screenshot shows a download page for QGIS 3.16. It features two main download links: one for the 64-bit version and one for the 32-bit version. Each link includes a download icon, the file name, and a sha256 hash value below it.

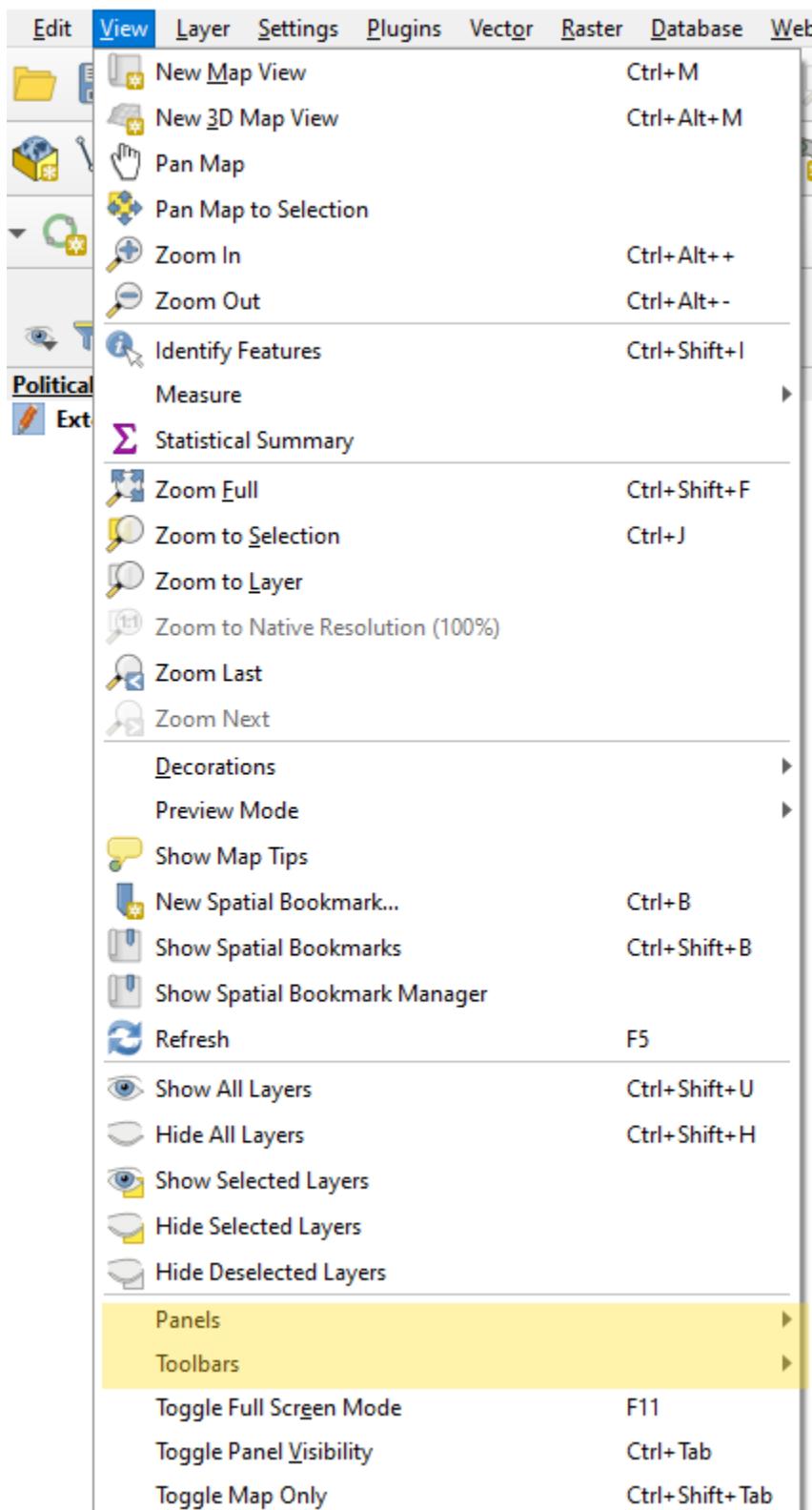
Installer Type	Version	File Name	sha256
Standalone Installer	3.16	QGIS Standalone Installer Version 3.16 (64 bit)	sha256
Standalone Installer	3.16	QGIS Standalone Installer Version 3.16 (32 bit)	sha256

3. Open the download when it has finished and start running the installer.
4. You can leave most of the default settings as is. I don't recommend downloading the pre-installed datapacks unless you fully plan on playing around with them. They can help you learn the software, but add a little bit of time onto the install.

Managing your Panels and Toolbars

5. There are a few panels and toolbars that come with QGIS that make this particular process a lot easier, by providing quick access to important tools. To manage these, click

the “View” menu, and then hover over “Panels” or “Toolbars”.



I recommend enabling the following:

- a. Panels
 - i. Browser
 - ii. Layers
 - iii. Layer Order
 - iv. Layer Styling
 - b. Toolbars
 - i. Advanced Digitizing
 - ii. Attributes
 - iii. Data Source Manager
 - iv. Digitizing
 - v. Map Navigation
 - vi. Project
 - vii. Selection
 - viii. Snapping
6. You can move these toolbars and snap them around your QGIS window by holding down the left edge of the toolbar and dragging with your mouse.



This is how my toolbars are organized, for example:

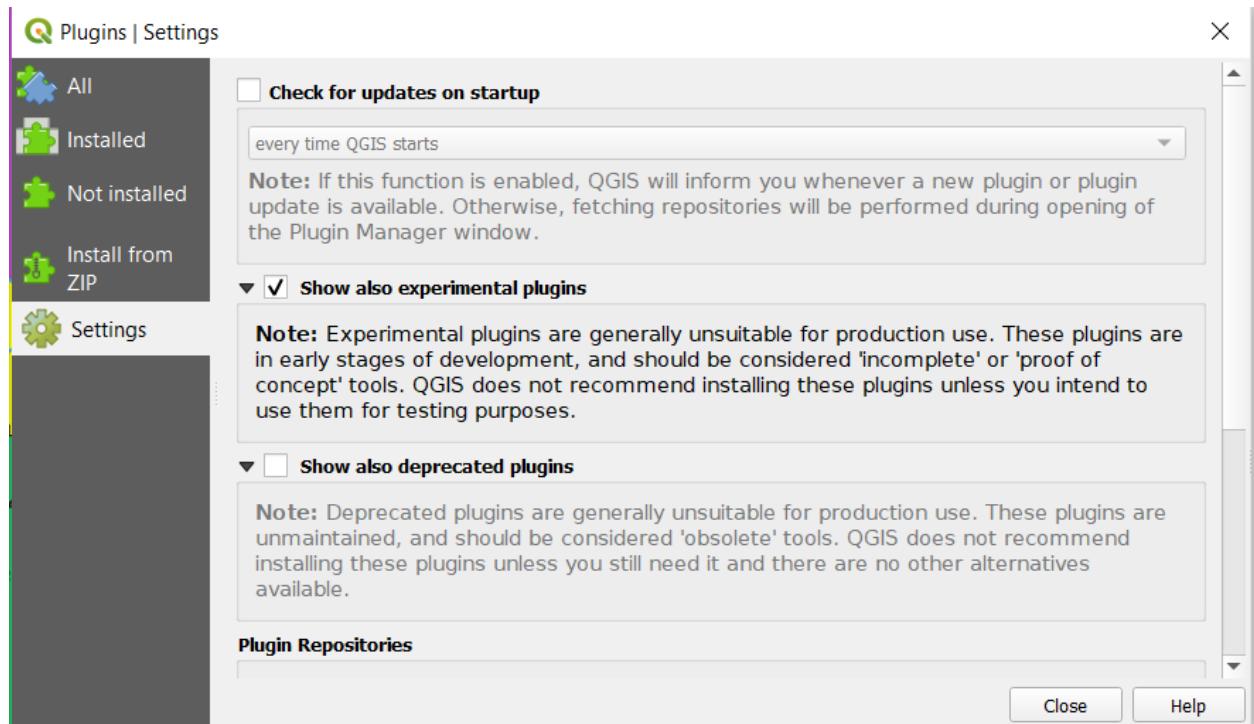


Installing Plugins

There's a few important plugins that help this process immensely, which I highly recommend installing using the QGIS Plugin Repository.

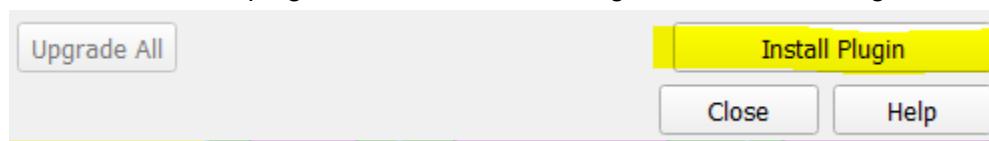
7. Click the “Plugins” menu and then select “Manage and Install Plugins”

8. Navigate to the “Settings” tab at the bottom-left hand corner of the window, and toggle “Show Also Experimental Plugins”



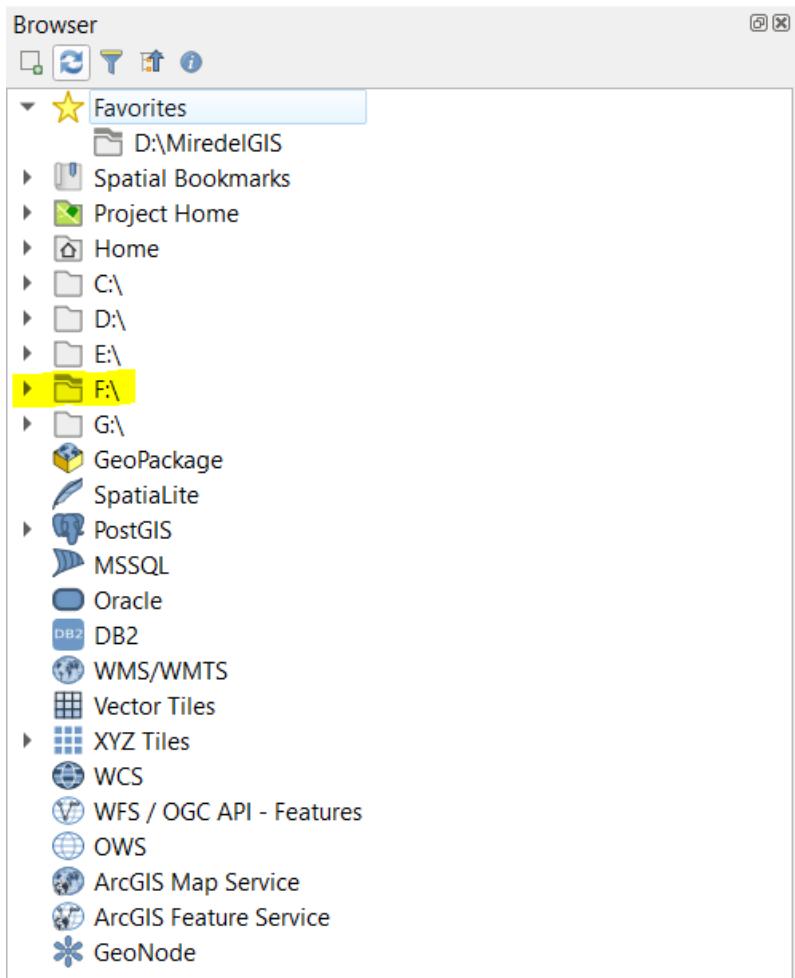
The plugins used in this process are stable.

9. Install the following plugins by going back to the “All” tab and then typing in the search bar:
 - a. Freehand Editing 3
 - b. Geometry Checker
 - c. Shape Tools
 - d. Freehand Raster Georeferencer
10. Select the desired plugin, then click “Install Plugin”, in the bottom-right corner



Choosing a Directory

The organization of your data is just as important as the data itself-- all your data should have a specific dedicated directory to house it, and I also recommend having various subfolders to better organize it. You can select a directory and add data from it in the “Browser” panel.



I keep my data in an external hard drive.

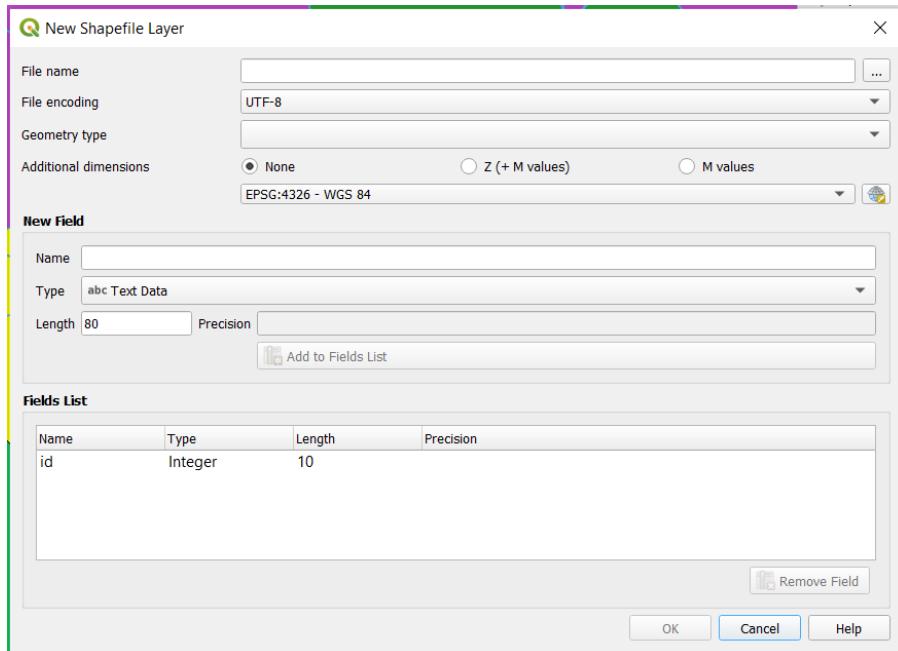
Module 2: Creating an Extent Layer

Now we're on to the fun part: Actually making your map! In this part of the tutorial, we're going to make three layers: A layer for your extent, your landmasses, a layer for rivers, and a layer for cities.

How to Make a Shapefile

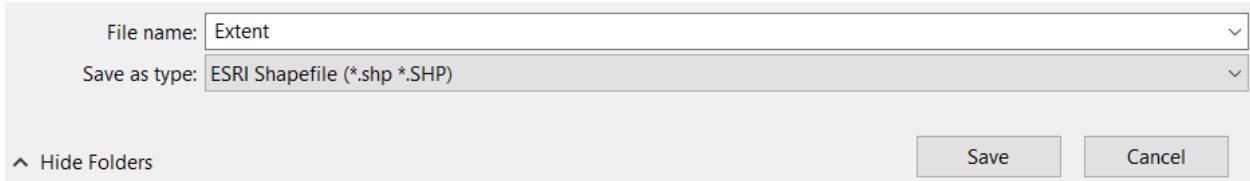
We will start this exercise by making a shapefile that will show you the Extent of your project. This is important for determining how big to make your landmasses, and where to put them.

1. Click the “Create Shapefile Layer” button in the “Data Source Manager” toolbar
2. You will now see this window, and you have a lot of options in front of you.



3. Click the three dots to the right of “File Name” and a windows browser folder will come up, asking where you want to save your new layer. Navigate to your desired directory, and type a descriptive but concise filename, like “Extent”. Then click “Save”.





4. [Hide Folders](#)

5. You can leave the encoding as is, but now navigate to “Geometry Type” and click it. You’ll see five options:

- a. No Geometry
- b. Point
- c. Multipoint
- d. Line
- e. Polygon

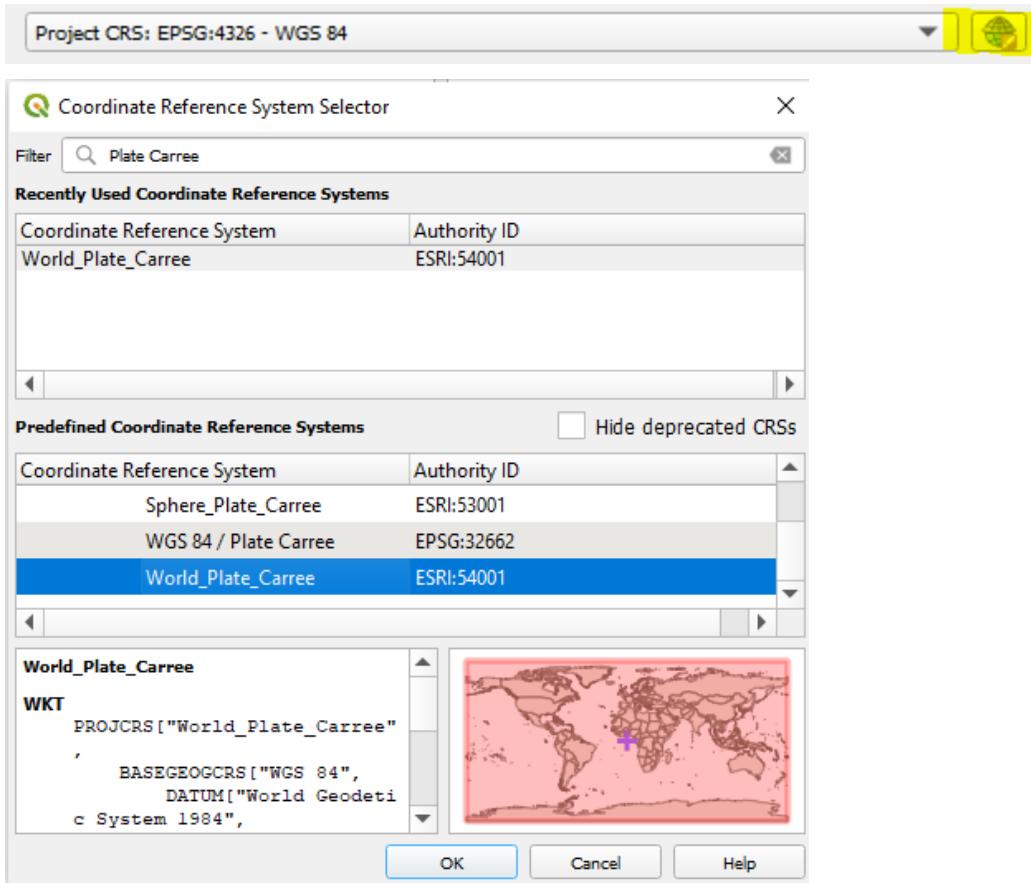
Since we’re making a layer showing your extent, choose “Polygon”.

6. Skip over the “Additional Dimensions”

7. Now select your Projection, it is the drop menu under “Additional Dimensions”, with an icon next to it that looks like a globe wearing a hat.

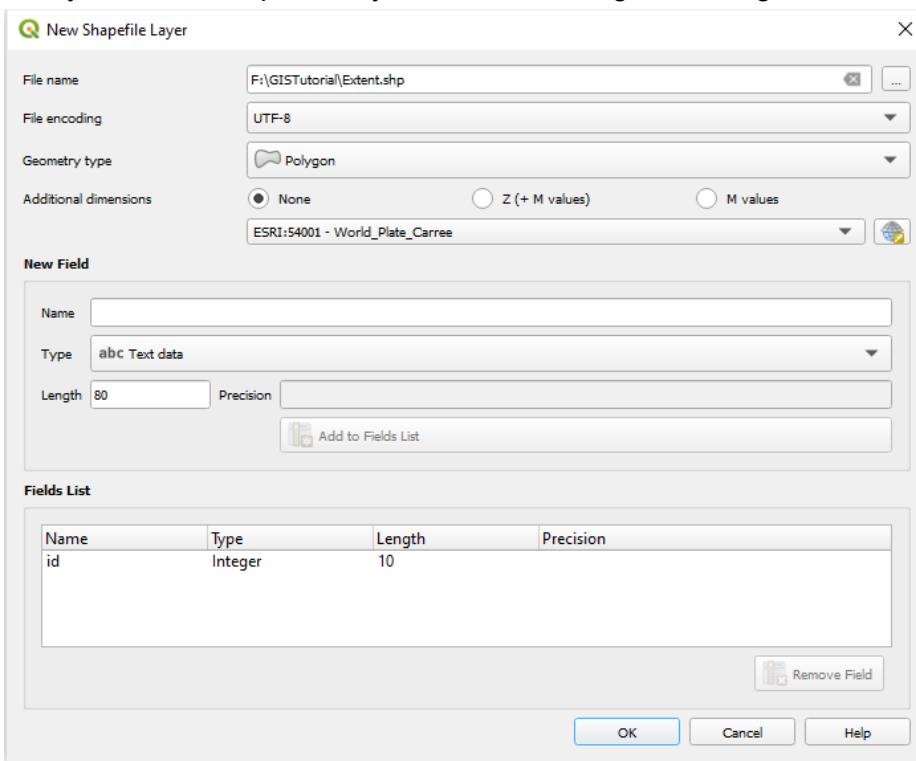
Choosing a projection is an important part of making your map, and various considerations should be made regarding where on your world’s globe your map will focus on, and the kind of distortions you want to avoid.

For now we’ll use the Plate Carree, or Equirectangular Projection. Scale stays constant, polar distortion is minimized (compared to projections like the Mercator), and its shape is rectangular, making it easy to work with and compatible with websites like MaptoGlobe.com



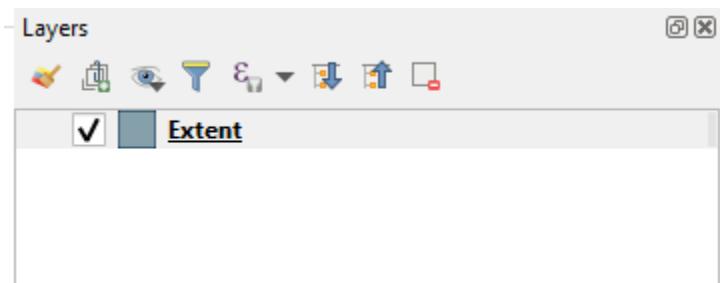
8. Click "Ok"
9. Skip the "New Field" section of this window (we'll come back to it for the next layer we'll make).

10. With your “New Shapefile Layer” window looking something like this



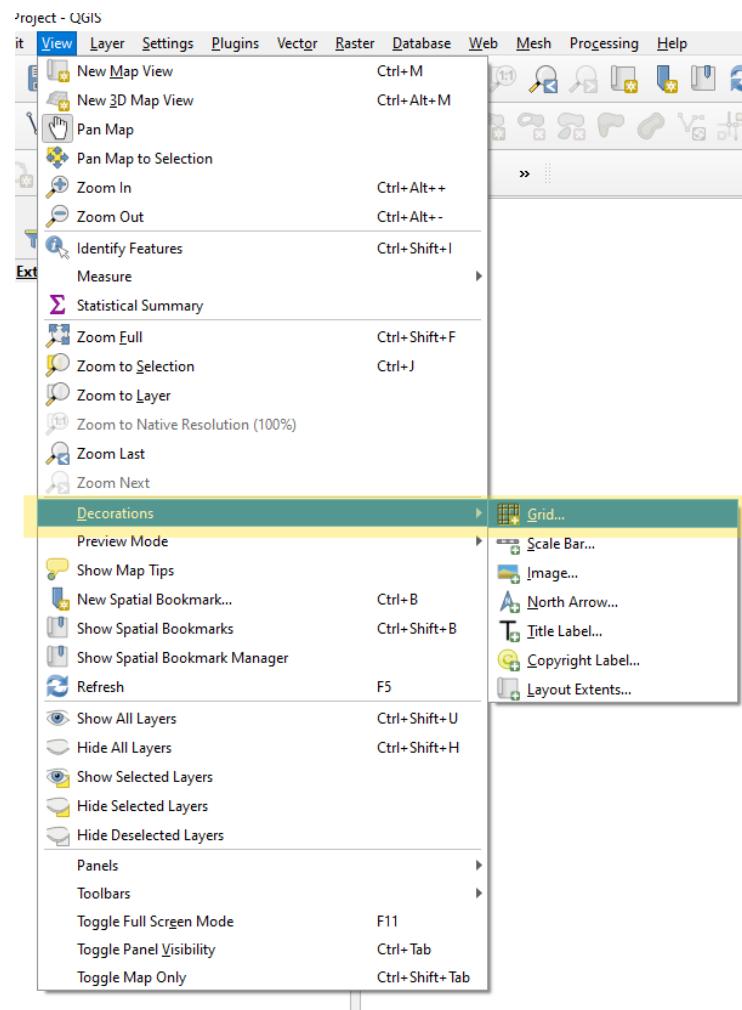
11. Press “OK”

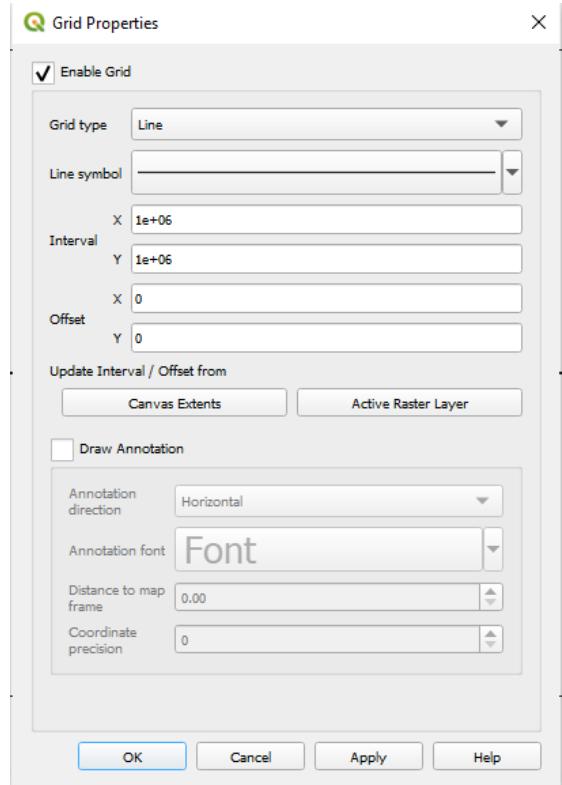
12. You’ll now see the layer in your “Layers” panel



13. Now you’ll notice that there’s nothing in your map canvas-- that’s because you haven’t drawn anything in! Now what you’re essentially drawing in is your ocean, so to help you get a sense of how big you want your world to be, navigate to

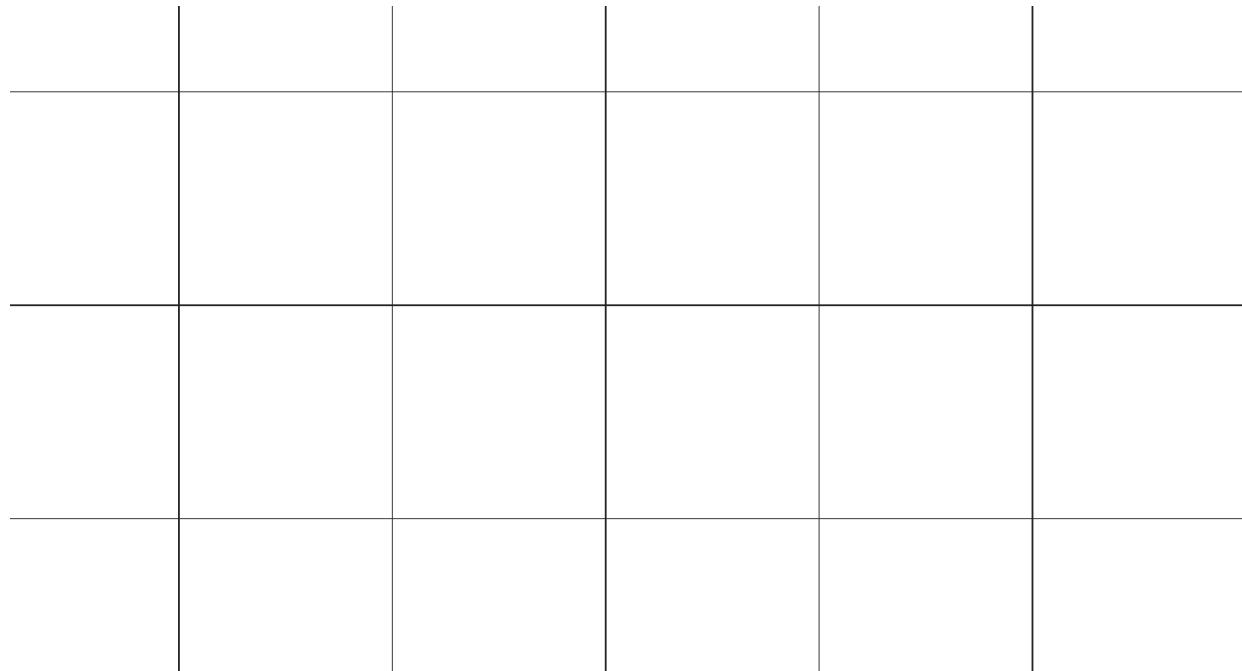
"View"-->"Decorations"-->"Grid"





- a.
- b. Toggle the Checkbox for “Enable Grid”
- c. Keep “Grid Type” at “Line”
- d. Ignore the “Line Symbol”. This option allows you to change how your grid looks, but for now we’ll keep it as a black line.
- e. We want each cell of this grid to be 1000 Kilometers by 1000 Kilometers. The units of the projection you are using are in Meters, so set the X and Y intervals to 1000000.
- f. Leave everything else as default and press “OK”.

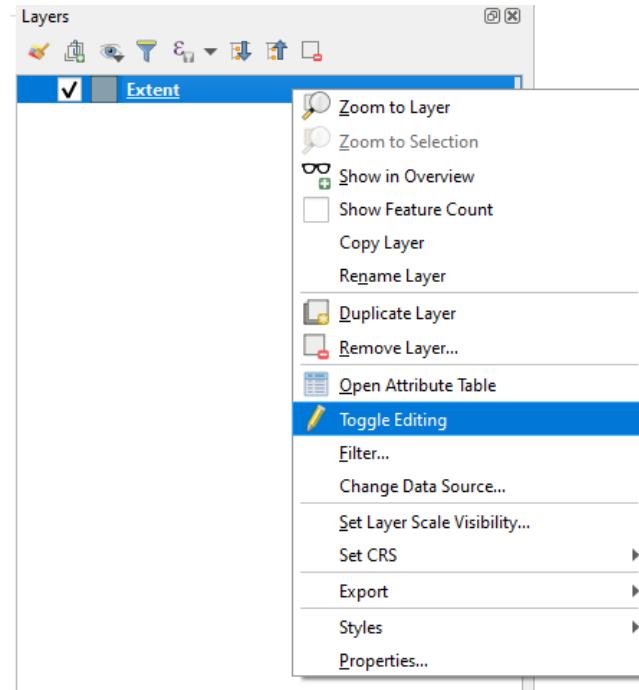
g. Your map canvas will now look like this



Each of these squares is 1000 Kilometers square. You can test this by clicking

the measuring tool (), setting the units to “Kilometers”, and measuring from one end of a cell to another.

14. Now let's make your oceans! Right click on your Extent layer in the Layer Panel and toggle “Toggle Editing”



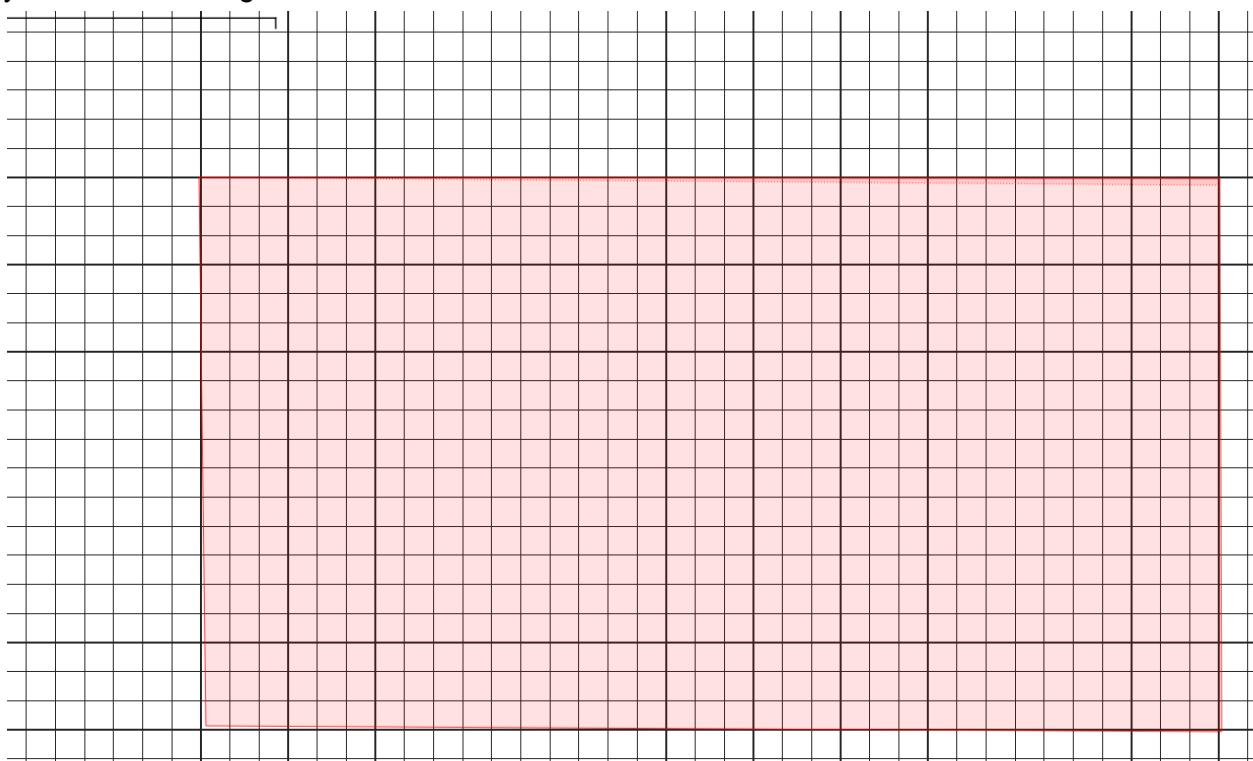
15. With the editing for this layer now enabled, you'll see that your Digitizing toolbars are no longer greyed out!



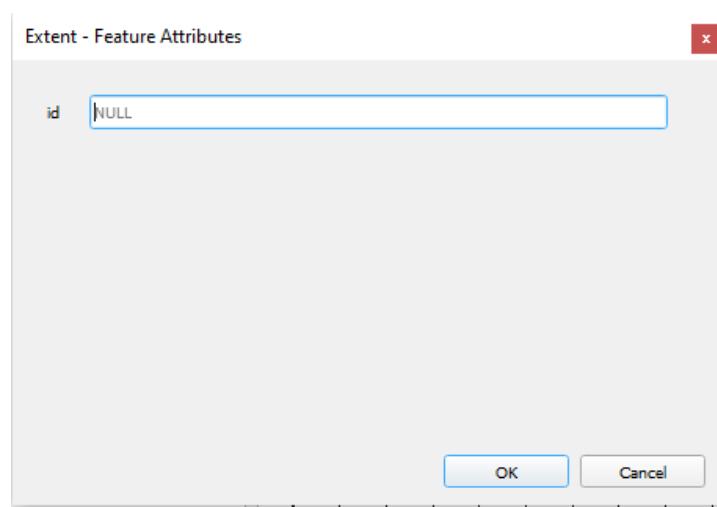
16. Using the grid and the measuring tool, get a feel for how big you want your ocean to be, and then select "Add Polygon Feature" from your Digitizing Toolbar



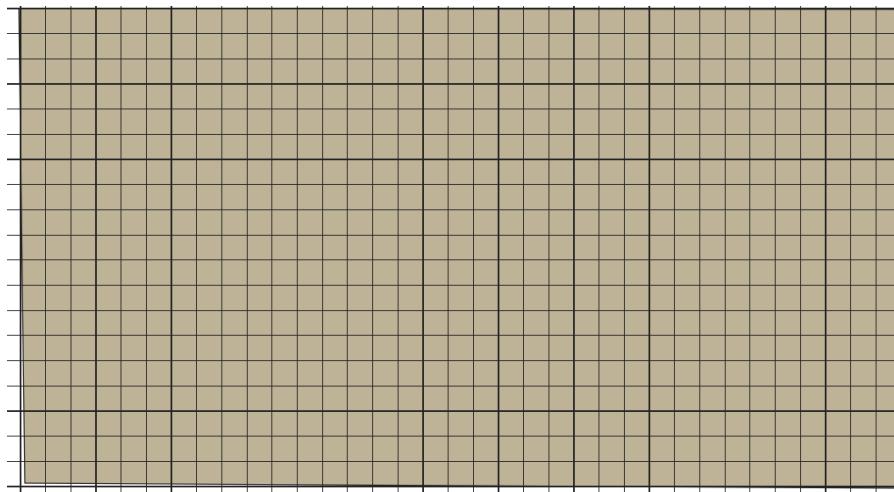
17. With your "Add Polygon Feature" Tool enabled, left click around your canvas in a 2:1 rectangular pattern, according to the size you want your world to be. As you left click, you'll see a rectangle form



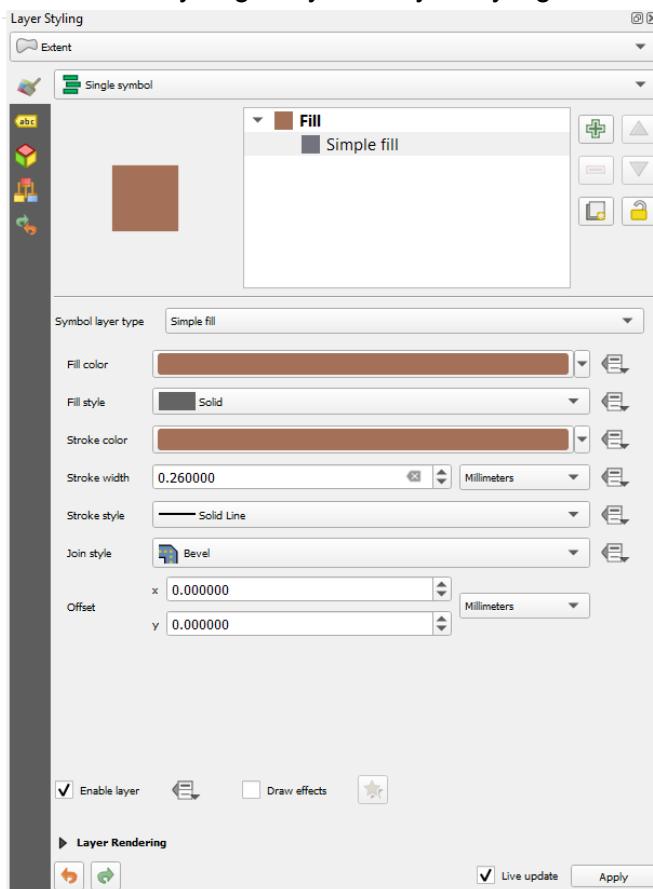
18. When you have your rectangle ready, right click this window will pop up, but since we don't have any attribute fields to fill in you can just click "OK" (The "id" field will be automatically filled).



19. Yay! Now you have an ocean! But it may not look like one....



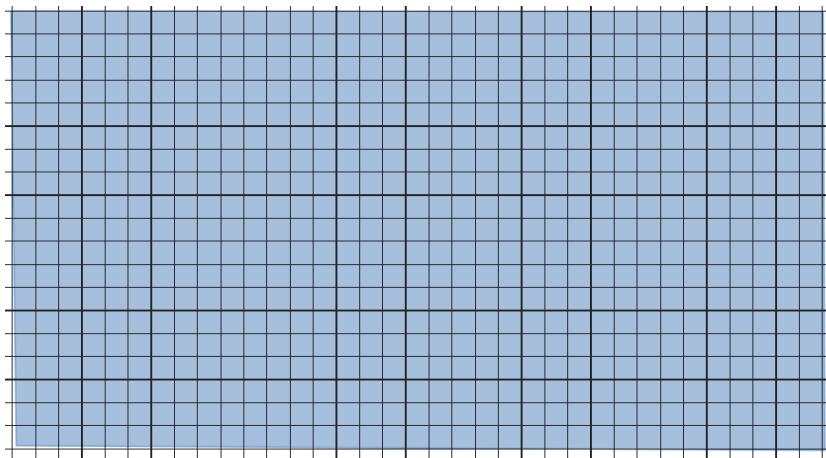
20. This is where you go to your “Layer Styling Panel”.



The layer styling panel gives you total control over how your layer will look. We're going to use it to change the color of your Extent layer to a more fitting Ocean-Blue.

21. With “Fill” Highlighted click the “topo water” symbol in the window that shows all these conveniently pre-made symbols you can use for your symbols. Once you click it, you'll

see your layer re-render in real time as that color.

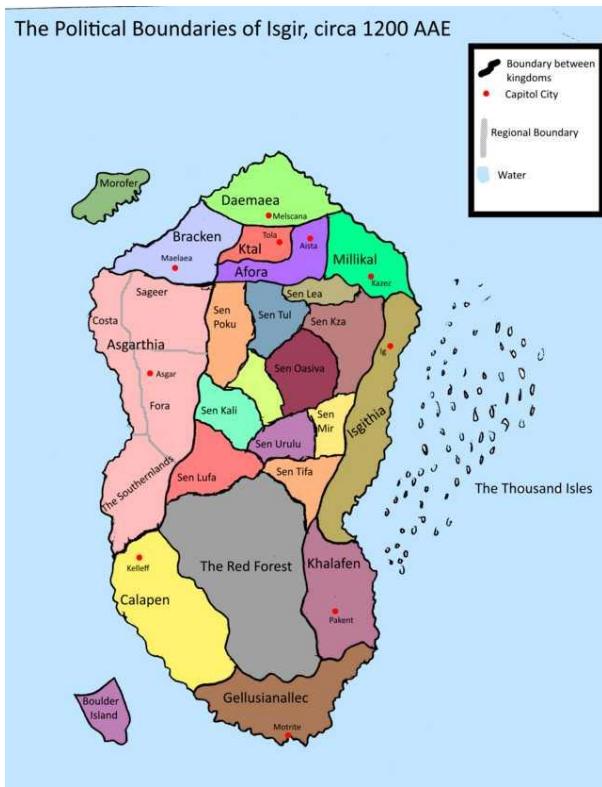


22. Right click on the Extent layer in your “Layers” panel and press “Save Layer Edits”. Then press “Toggle Editing”.
23. This is a great time to save your project as well. Press the “Save” icon  and save your project as a .qgz file in a directory of your choice.
24. Congratulations! You’ve created your first layer in GIS! In our next module, we’ll learn how to create your landmasses!

Module 3: Inserting a Raster

If you already have maps of your worldbuilding that you're looking to digitize, you can insert

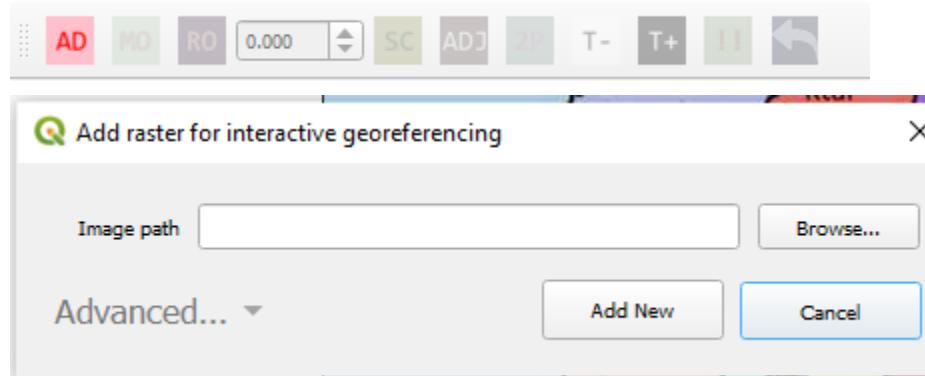
those images as rasters into QGIS, and then trace off of them. Follow along to this module using your own world map. In this case, I am using the map of one of my continents. It is a JPG image.



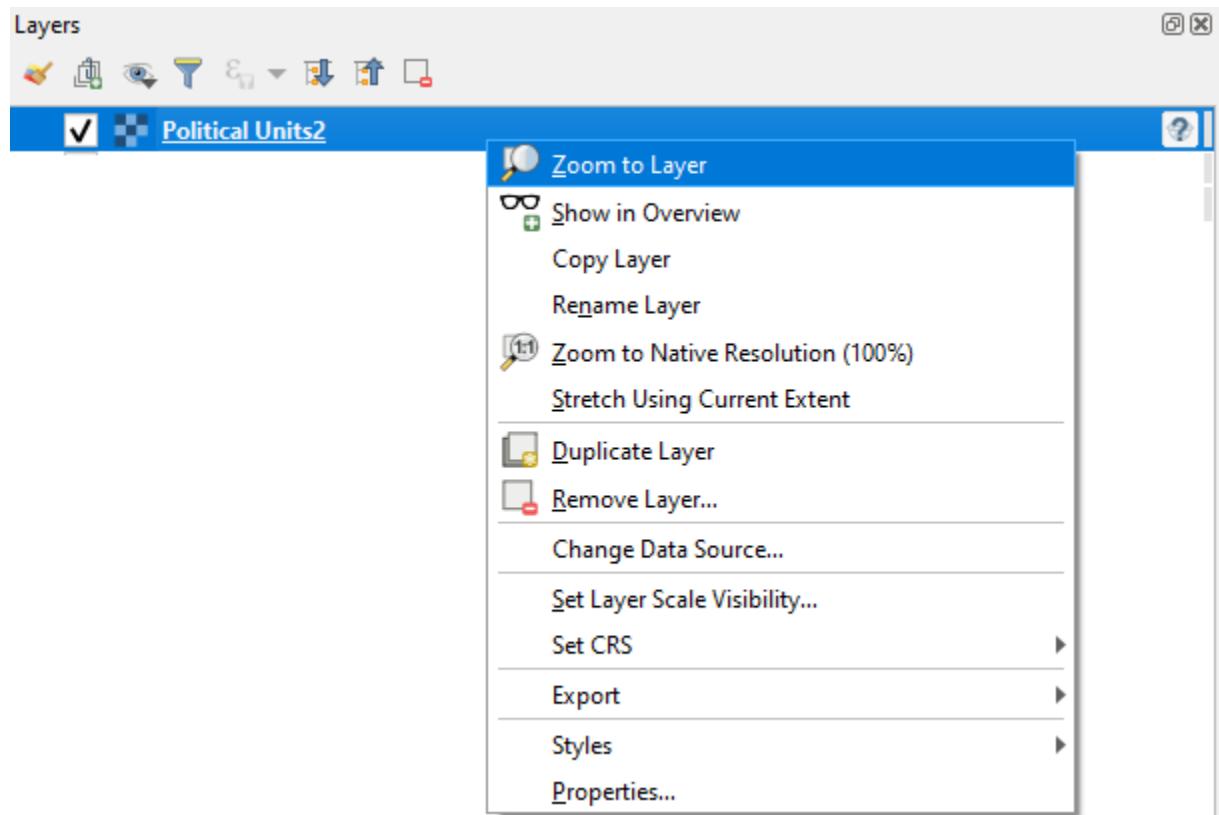
Inserting your Image into QGIS

1. If it's not already enabled, go to View → Toolbars to toggle the “Freehand Raster Georeferencing Toolbar”

2. You may see that you can only press one button-- the pink “AD” all the way to the left. Press this button to open the “Add Raster for Interactive Georeferencing” dialogue.



3. Press the browse button, and select the image that you want to add to your project. Press “OPEN”, and then “Add New”
4. Now when you open this raster, you won’t be able to immediately see it in your map canvas. That’s because when first opened, the image is VERY small. Mine for example is just over 600 meters in width when first added.
5. To see your image, right click the layer in the “Layers” panel and click “Zoom to Layer”



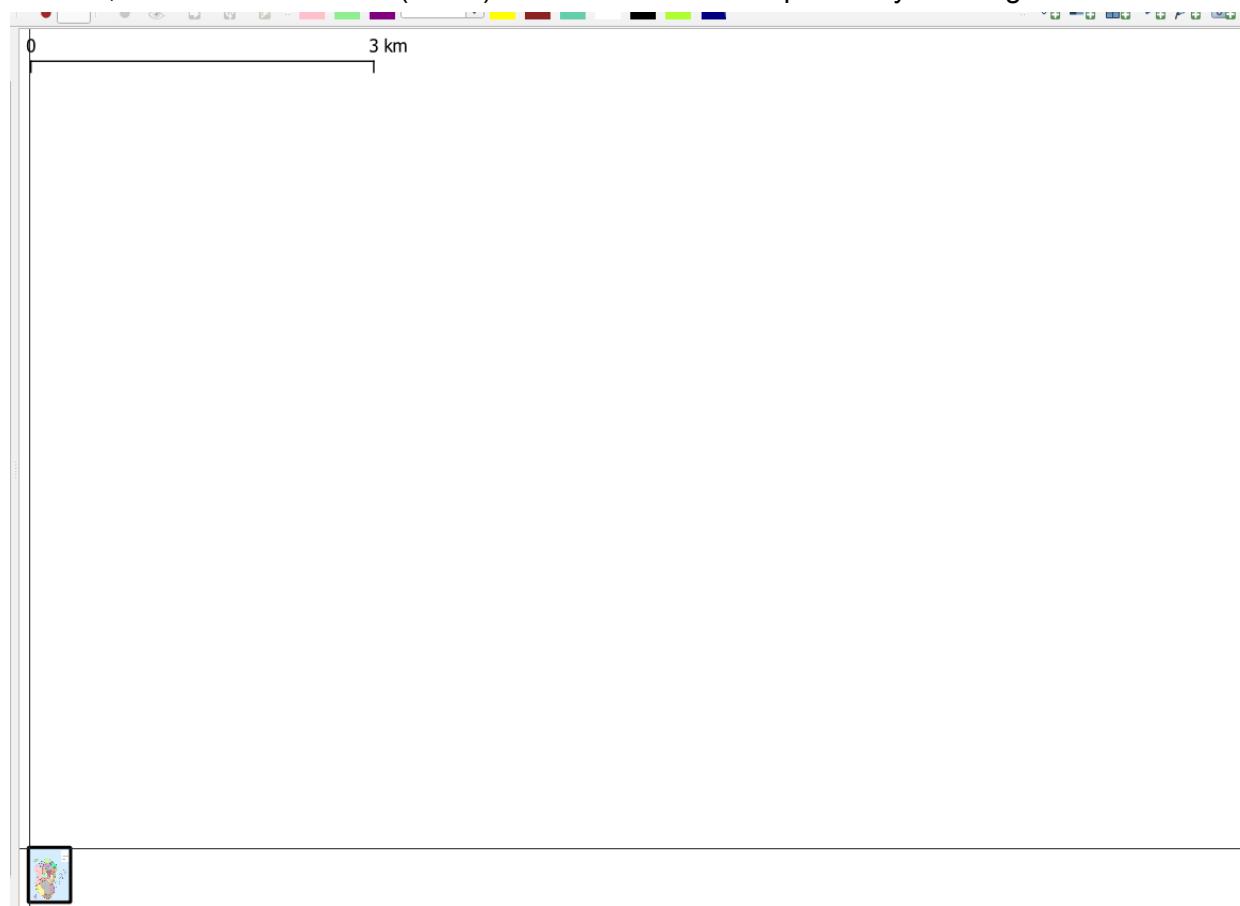
6. As you zoom in and out, you'll see that this image is not only tiny, but also offset from your Extent layer. You'll use the other tools in the Freehand Raster Georeferencing toolbar to move, rotate, and resize it to your specifications.

Moving, Resizing, and Rotating your Image

7. First things first you'll want to resize your image. This is done using the brown "ADJ" button in the toolbar, which allows you to adjust the size of one side of the image at a time.



8. To reize, use the "Pan" button () and Zoom function to position your image



in the corner of the map canvas.

9. With the "ADJ" tool selected, hold left-click on a side of the image and drag it out. Since you can't adjust both sides at a time, you will lose the original aspect ratio, but this can be fixed by adjusting the other side. You'll need to repeat this process-- positioning, resizing one side, then resizing the other, a few times before you have your image at the desired size.

10. Now you'll have it at the right size, but it's still going to not be positioned on your extent. Use the green "MO" tool to click and drag it to your desired position.

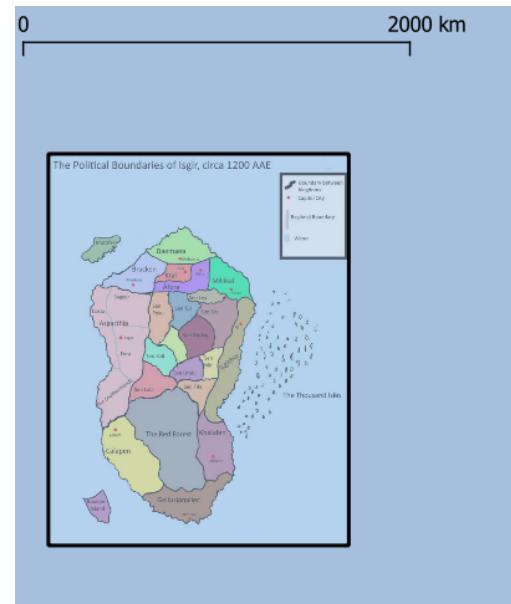


11. To rotate it, select the purple “RO” tool, and similarly click and drag your image to your desired angle.



12. If you find that your image is distractingly bold, you can use the white “T-” and the black “T+” to decrease or increase the transparency of the image.

13. You can use these buttons to fine tune the size and position of your image before digitizing it. In the next module, we'll create a layer for landmasses.

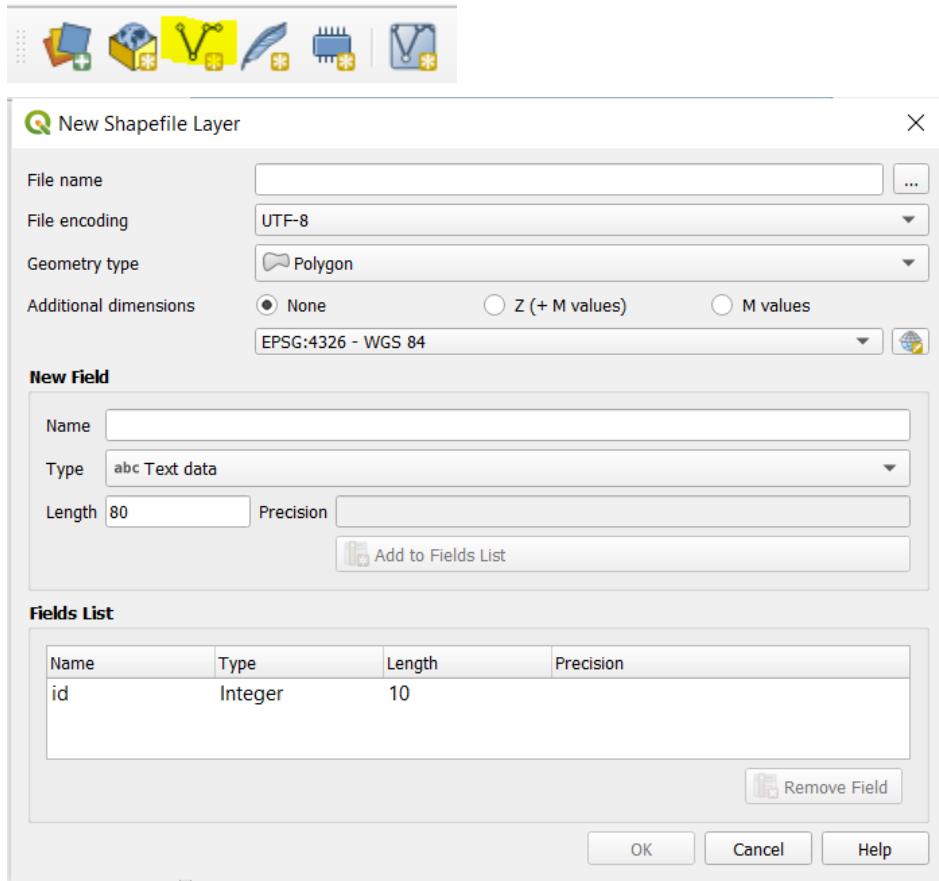


Module 4: Creating your Landmass Layer

You have your ocean, you have your trace map. Now it's time to draw your landmasses, islands, and continents. You can do all of this on one layer, and have it store all the information you would want.

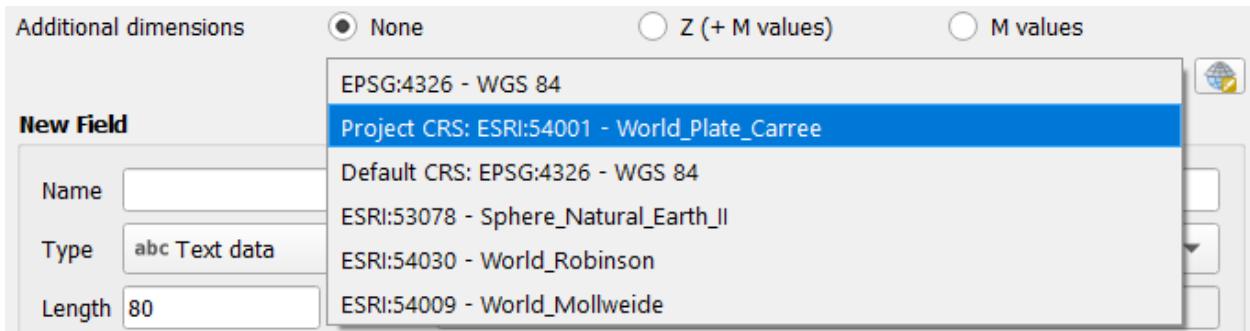
Creating the Layer

- Just as we did with the extent layer, press the “New Shapefile Layer” in the Data Source Manager toolbar

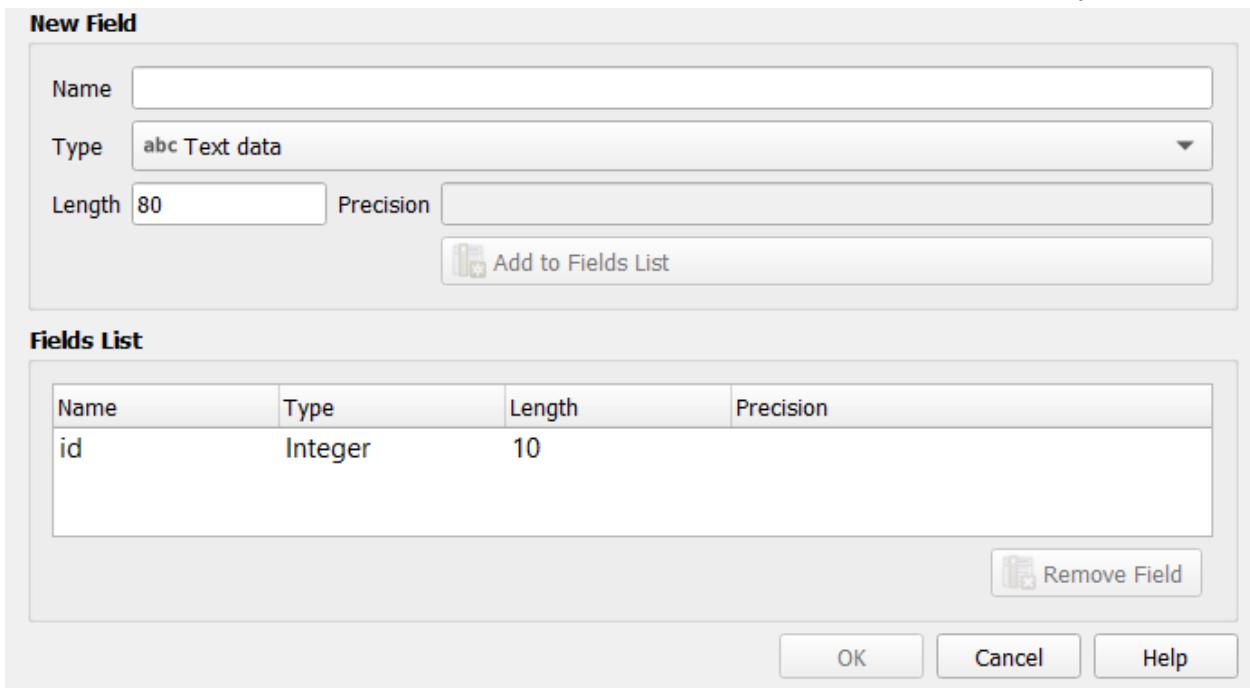


- Click the three dots to the right of “File Name” and select “Save to File”. Find your desired directory, and save it with a descriptive name like “Continents” or “Landmasses”.
- Leave the File Encoding as is.
- Set the Geometry Type to Polygon
- Set your projection to Plate Carree, the same projection used with your Extent Layer. Instead of clicking the button that looks like a Globe wearing a conical hat, press the

dropdown menu and select it from your list of recently used projections.

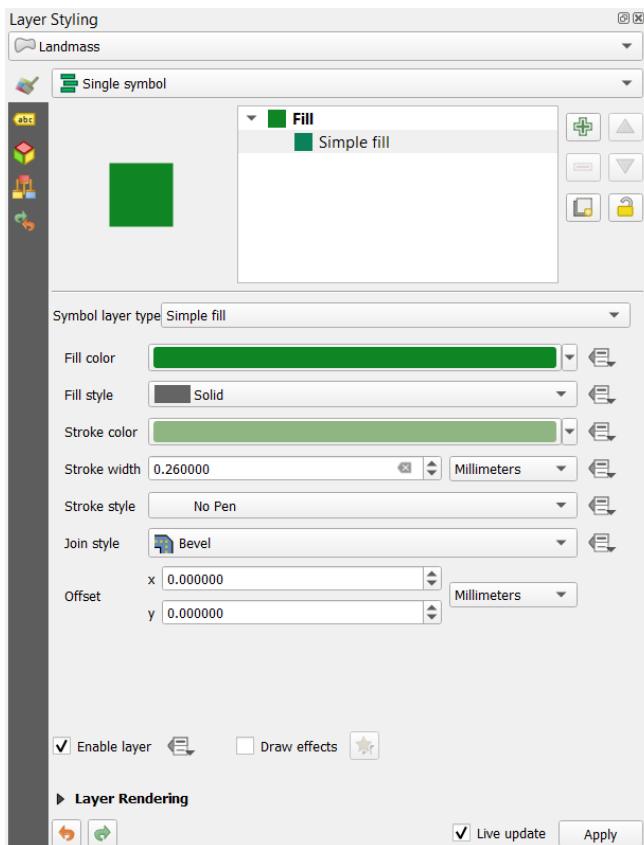


- With these parameters set, it's time to add some useful fields to store data in this layer.



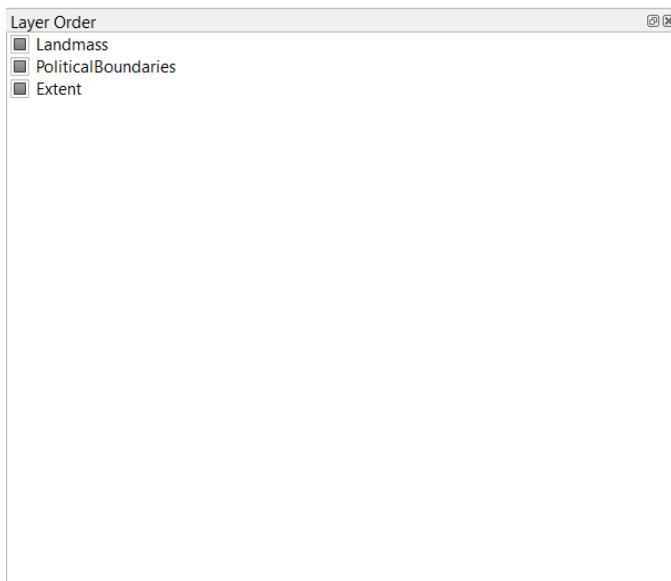
- Let's start by adding a field to store the name of each continent. In the "Name" parameter, type "Name".
 - Keep the data Type as Text Data
 - Keep the length as 80
- Press "Add to Fields list".
- Repeat this process for as many fields as you'd like. If there's information you feel would be relevant about a continent.
 - QGIS lets you use four types of data for your field:
 - Text Data, or String
 - Whole Numbers
 - Decimal Numbers
 - Dates
- When you have all the fields you want, press "OK". Remember that you can always add new fields later on.

- When you press OK, the shapefile will be created and added to the map. Just like with your extent layer, it will be blank until you draw in features.
- At this point I recommend getting the Symbology out of the way. Open the “Layer Styling Panel” for your Landmass layer, and click “Simple Fill”. You can now choose which color you want to outline your shapes, and which color to fill your shapes with. In my projects, I use a dark green for my landmass layer.



Adjusting the Layer Order

- When you create a new layer in QGIS, it typically goes to the bottom of the layer order, meaning that if another layer is above it it won't be seen. To change this, open the “Layer Order” Panel



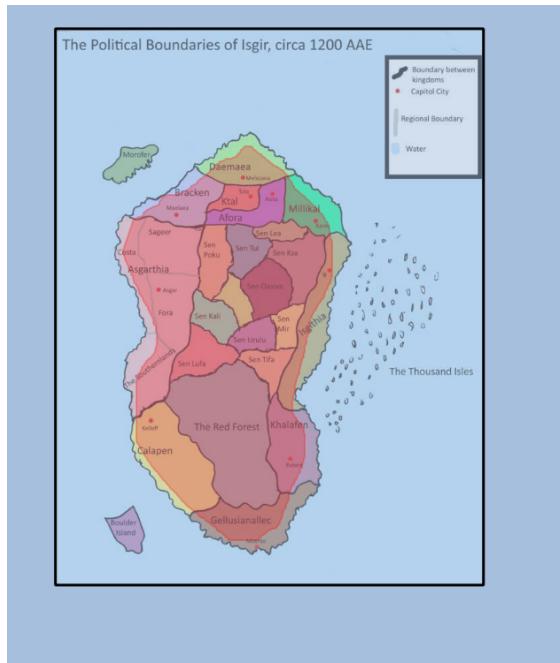
14. Toggle “Control Rendering Control”
15. Now you can drag each layer to edit the visibility order.
 - a. NOTE: While you don’t have these layers yet, the top most layers should be point files, the middle line files, and the bottom Polygon files.

Editing your Landmasses

16. Just as you did with your Extent layer, right-click on your Landmass layer in the “Layers” panel and Toggle Editing.
17. Make sure that you have the “Freehand Editing 3” plugin enabled-- it will show up in your “Digitizing” toolbar, looking like a green pen.

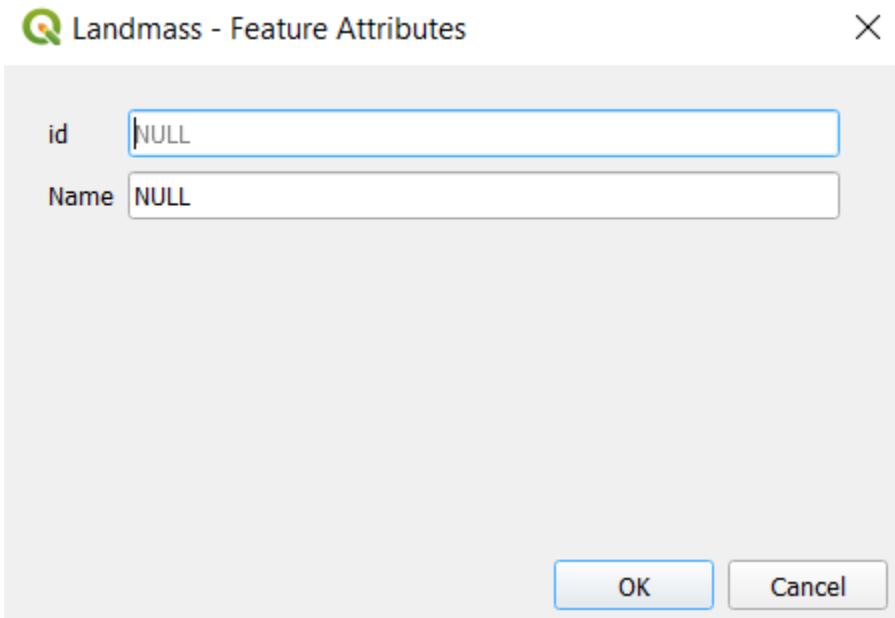


18. Now select the Freehand Editing tool. To Freehand Draw a feature, click and drag over your map. I recommend keeping it inside your coastlines-- this allows you to keep the shape simple-- you can add more detail to your coastlines in the coming steps. The area you’re drawing will appear as a semi-transparent red area:



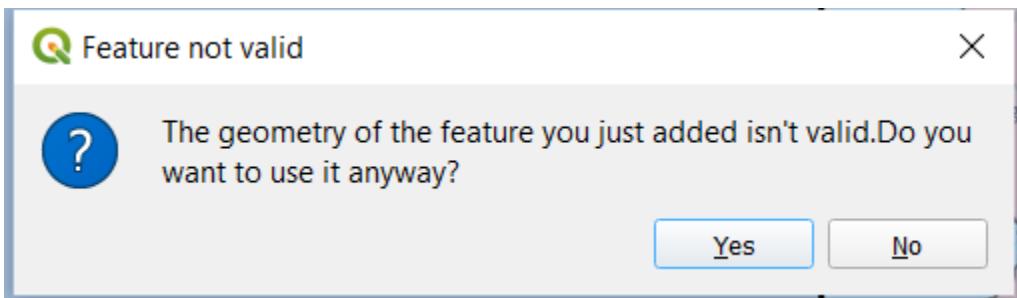
- 19.

20. When you have your basic shape, let go of your mouse button.



This dialogue will appear, and you can enter in information into the fields you created when you made this layer.

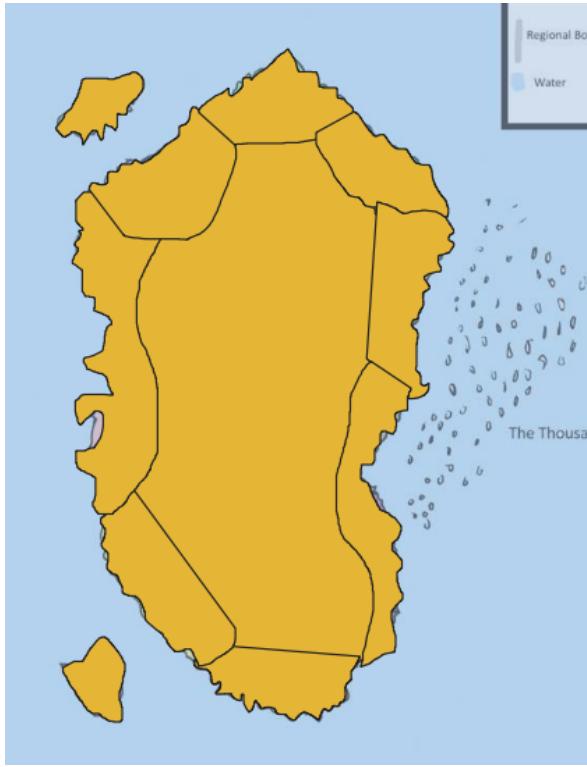
21. HOWEVER: IF YOU GET THIS WARNING:



PRESS “NO”.

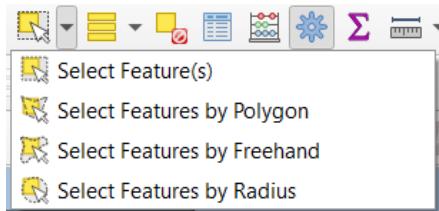
Having invalid geometry in your layer can cause major problems in the future. Invalid geometry can be caused by your polygons touching themselves, containing slivers, or containing holes. While there is a geoprocessing tool in QGIS that can detect and fix invalid geometries, you can save the frustration by simply remaking your shape, while staying cognisant of what can cause bad geometry.

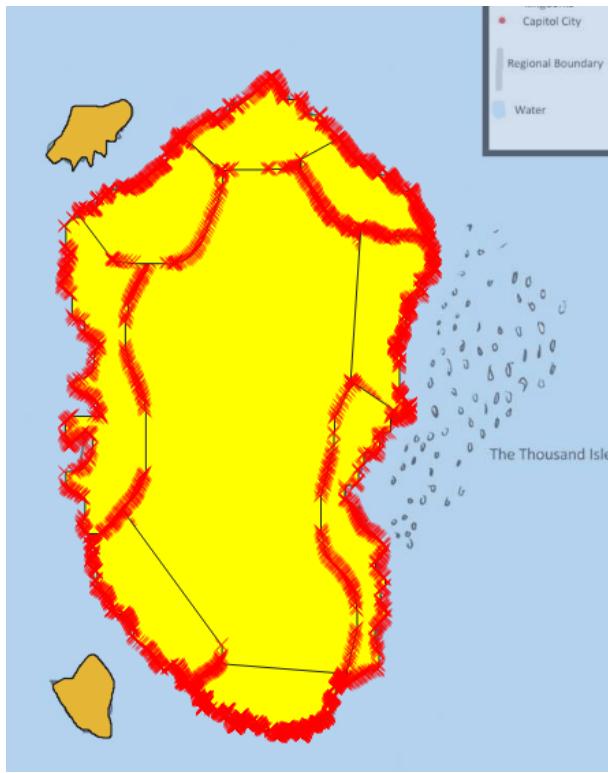
22. Try adding more detail by zooming in on your basic shapes and drawing out your coastlines. At first it'll look like this:



23. But you can use the “Merge” tool to combine these separate features.

- a. Using the “Selection Tool”, left-click drag over the features that you want to combine.

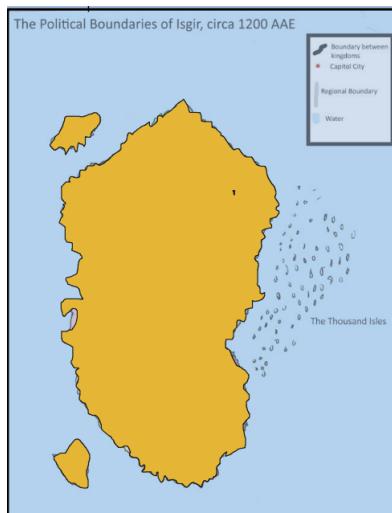




- b. Press "Merge Features", in the Advanced Digitizing Toolbar



- c. Press "OK". Now your layer will look like this:



d.

- e. You can keep adding detail like this to all of your continents, at infinite scale. As you'll see in coming modules, you can even draw in individual docks and houses!

Module 5: Creating Rivers

Water is the foundation of life, and most maps you see have a layer for rivers and other water bodies on them. In this module, we'll explore three methods you can use to draw in your rivers. These techniques vary in effort, time, and detail. We'll also learn how to draw in lakes and inland seas.

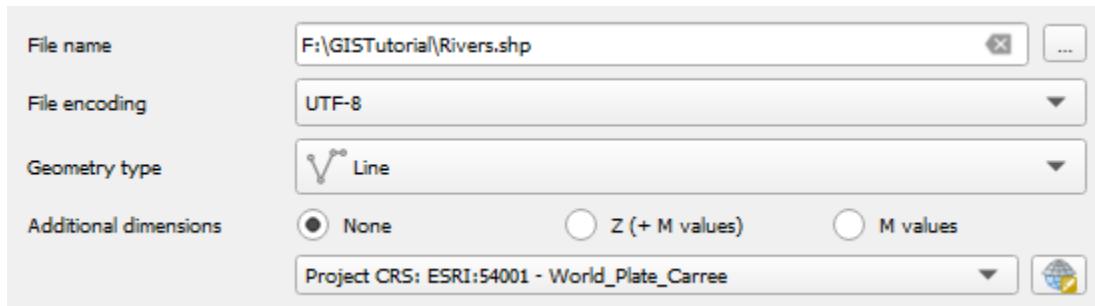
1. Since I'm done drawing my landmass, I'm going to turn off the basemap I've been using. To do this, go to your "Layers" panel and click the checkbox next to your raster layer. Doing this will disable the layer, meaning you can't see it on your map canvas.



Method A: The Line Technique

The Line Technique is a quick and easy way to draw in your rivers. At its core it consists of two elements: Creating a "Line" shapefile, and categorically symbolizing it.

2. Start this technique by opening the "New Shapefile Layer" dialogue, as you have already done when creating your Extent and Landmass layers.
3. Save your file in the directory of your choosing, with a descriptive name like "Rivers" or "WaterBodies"
4. Set the Geometry Type to "Line"
5. Set the Projection to the Project CRS: World_Plate_Carree

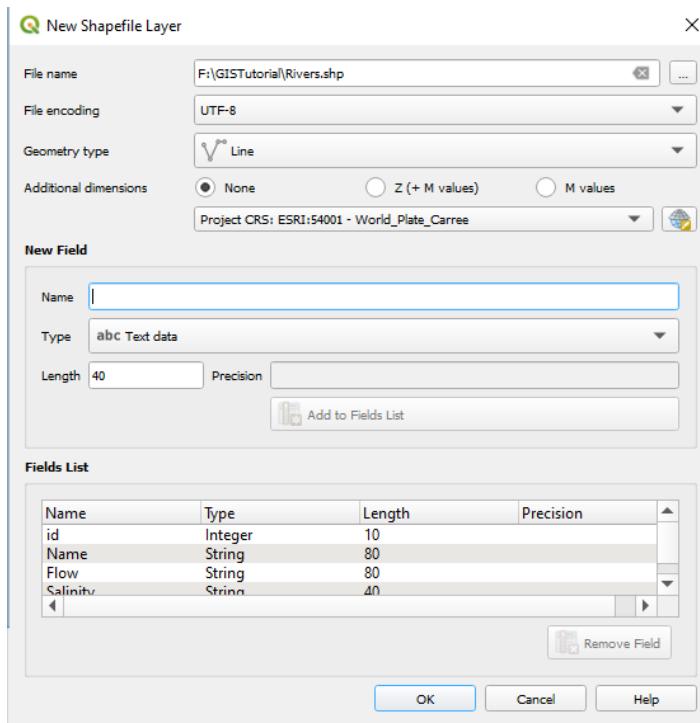


6. Now let's add some fields. Think for a moment about what information you think would be useful to know about a river. Here are some suggestions:

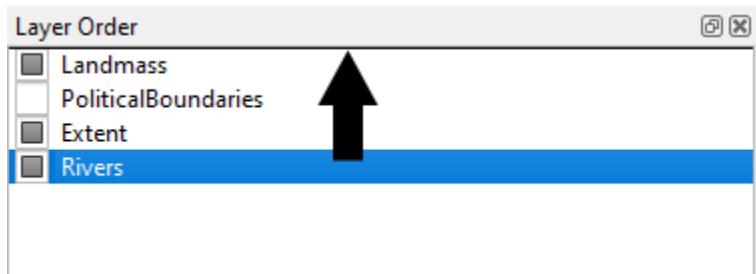
Field Name	Field Type	Description
Name	Text	Record what people may call you river
Depth	Whole Number	Choose a desired unit (feet or meters would make the most sense) and use this to record

		how deep a river gets, or how deep it is on average.
Salinity	Text	Is the river Freshwater, Brackish, or Saltwater?
Flow	Text or Whole Number	Is this river a wide flow of rapids, dumping millions of gallons into its bay? Or is it a lazy stream?
Flow Direction	Text	Does your river flow north, south, east, or west?

7. If you don't feel like adding all of these, for now just add "Name" as a text field, and "Flow", also as a text field. The flow field, which you can record on a scale from 1-5 or 1-10, or as words, like "High", "Low", or "Intermediate" will layer be used in the symbology, to determine how thick the lines will be.
8. With your "New Shapefile Layer" dialogue looking something like this, press "OK".



9. Remember to go into your "Layer Order" panel and drag "Rivers" up to the Top!



10. Before we draw your rivers, lets choose a better symbol than that ugly red line

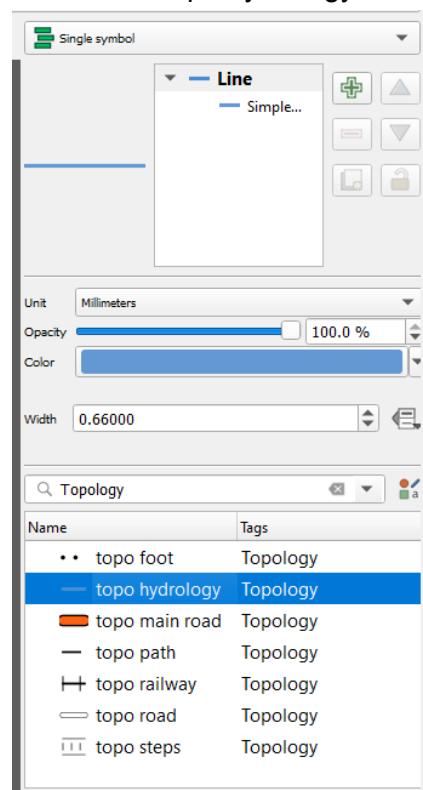


11. Go to the “Layer Styling Panel” with your Rivers layer selected.

a. Make sure that “Line” is highlighted



b. And select “topo hydrology” from the premade-symbols panel



c. Now when you draw your river in, it'll actually look like a river!

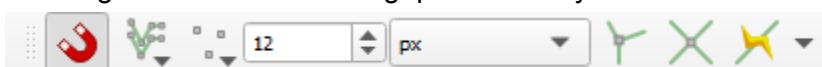
12. Now right-click on your Rivers layer to Toggle Editing



13. And select the “Freehand Editing” tool



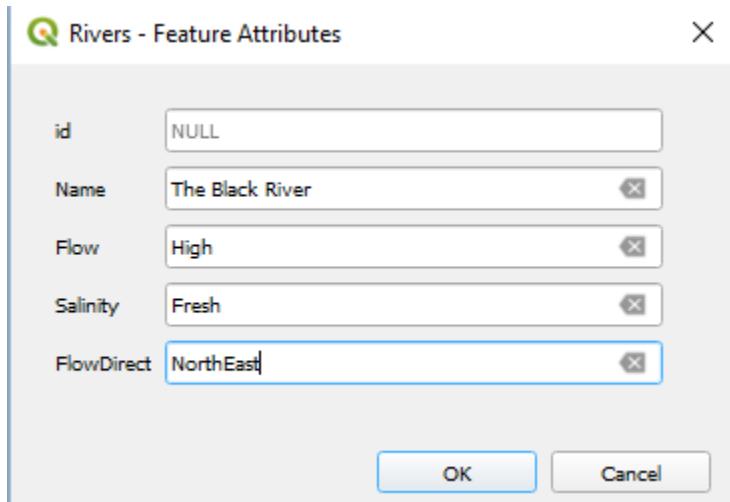
14. Also make sure that your “Snapping” toolbar is enabled and click the Magnet button to enable Snapping on this layer. Doing so will have your mouse “snap” on to vertices, meaning that there will be no gaps between your tributaries.



15. With the pen selected, hold it down and draw in a river. The path you’re drawing will show up in red:



16. When you let go of the cursor, this dialogue will pop up:

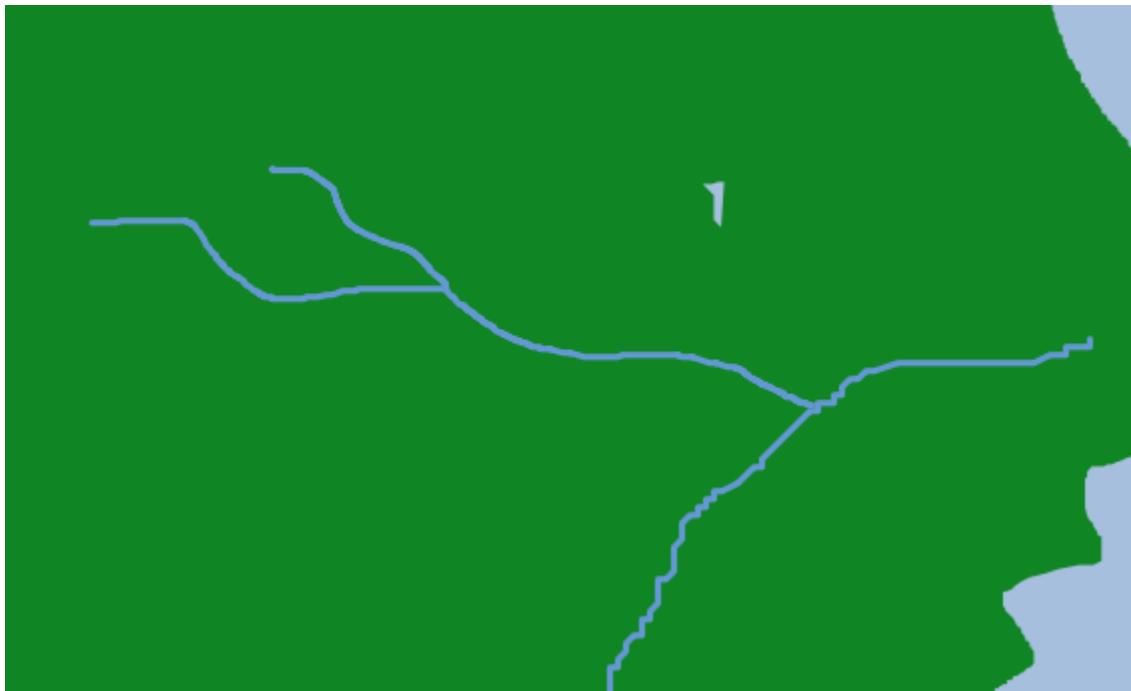


I'm filling it in as such but you

can choose your own information to put in. Press "OK" when finished.

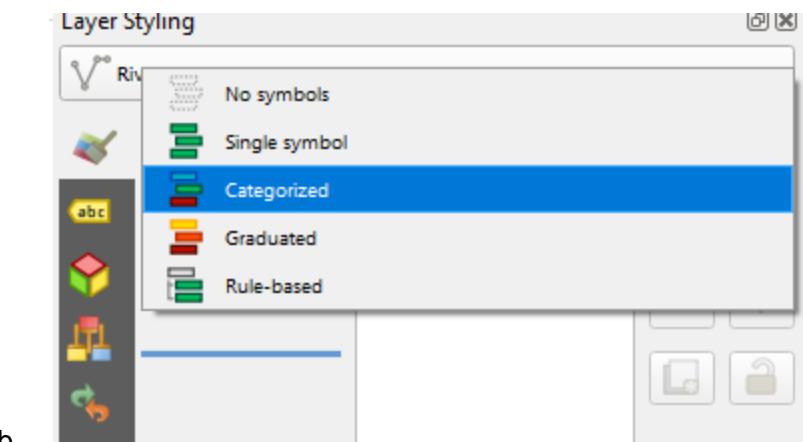
17. Try drawing two more rivers-- one with a low flow, and the other with an intermediate flow.

18. Now we have three different rivers with three different flows

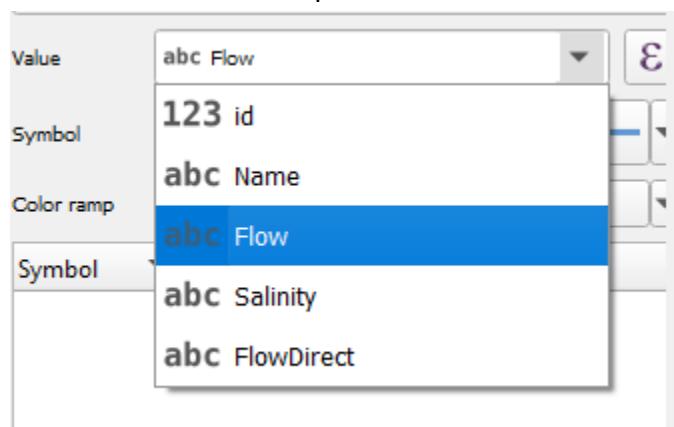


19. To make them look different, we'll go back to the "Layer Styling" panel.

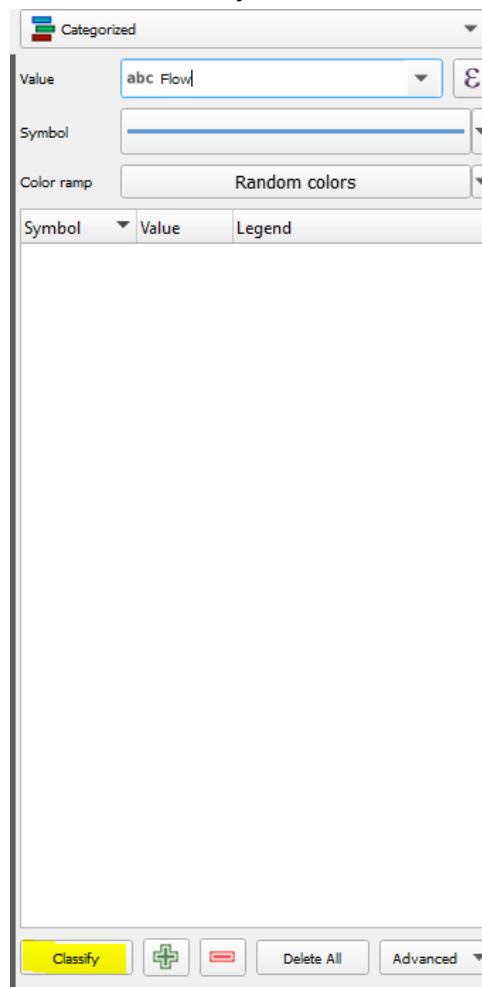
- With your "Rivers" layer selected, click the "Single Symbol" dropdown menu and select "Categorized"



- b.
c. For "Value" click the dropdown and select "Flow"



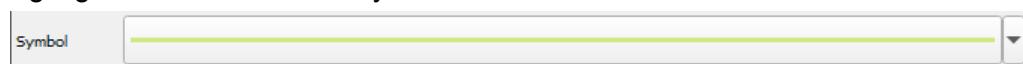
- d. Now click “Classify”, at the bottom of this panel



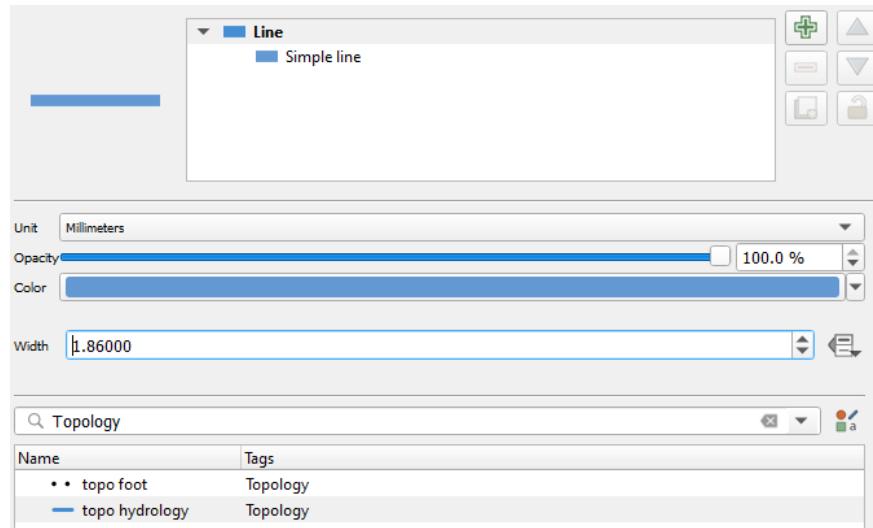
- e. If you added a river with a “Low”, “Intermediate”, and “High” flow, those values will show up with their own separate symbols.

Symbol	Value	Legend
✓ - green line	High	High
✓ - red line	Low	Low
✓ - purple line	Medium	Medium
✓ - cyan line	all other v...	

- f. To change each of these symbols, make sure that that particular value is highlighted and then click “Symbol”

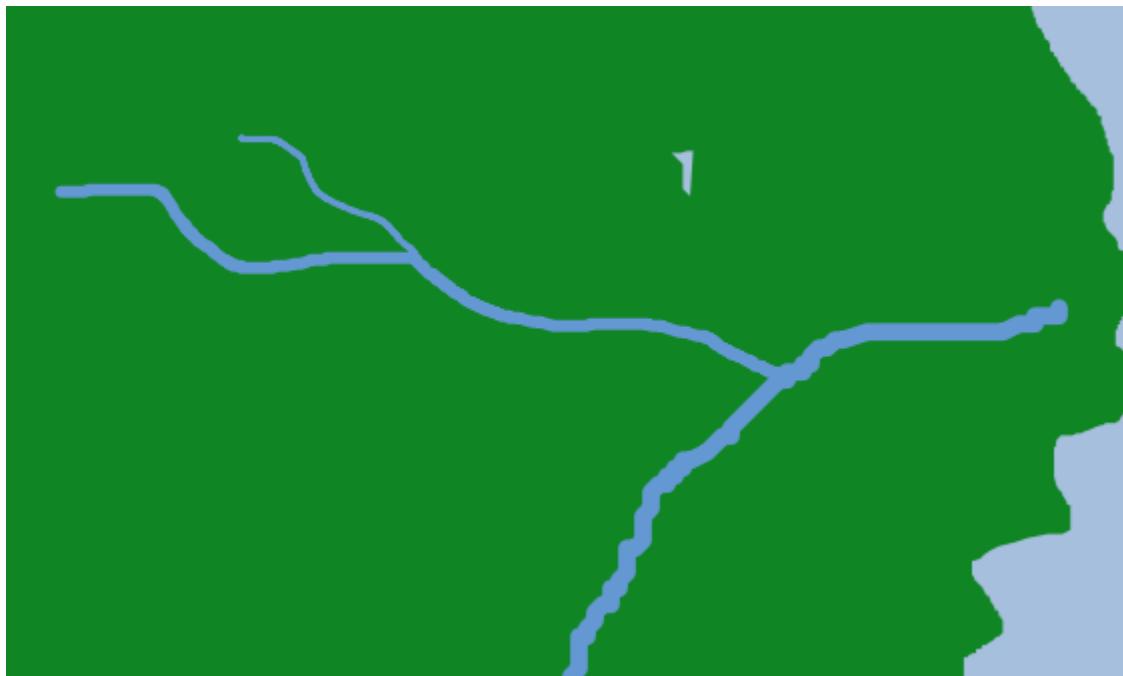


- g. Choose the “topo hydrology” symbol again, but this time adjust the width as well. Choose a thicker width for higher flows, and a thinner width for lower flows.



- h. Do this for all the flow values

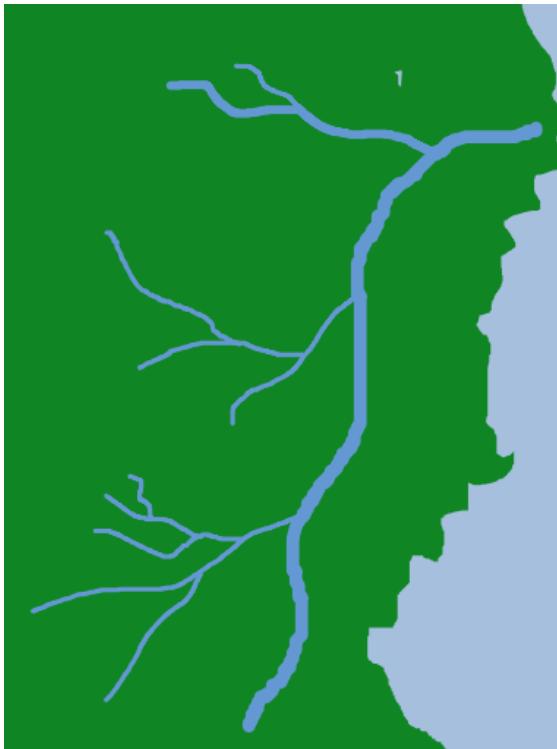
Symbol	Value	Legend
<input checked="" type="checkbox"/> —	High	High
<input checked="" type="checkbox"/> —	Medium	Medium
<input checked="" type="checkbox"/> —	Low	Low



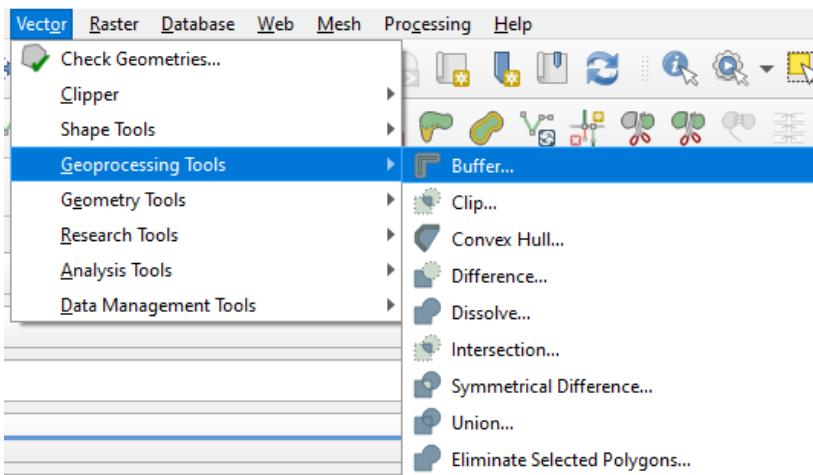
And now you can see that each river has a new thickness by flow.

Method B: The Buffer Technique

20. The buffer technique is another technique I found that can quickly and effectively make rivers that look good at a high and medium scale.
21. To start, draw in a few other rivers on your “Rivers” layer.

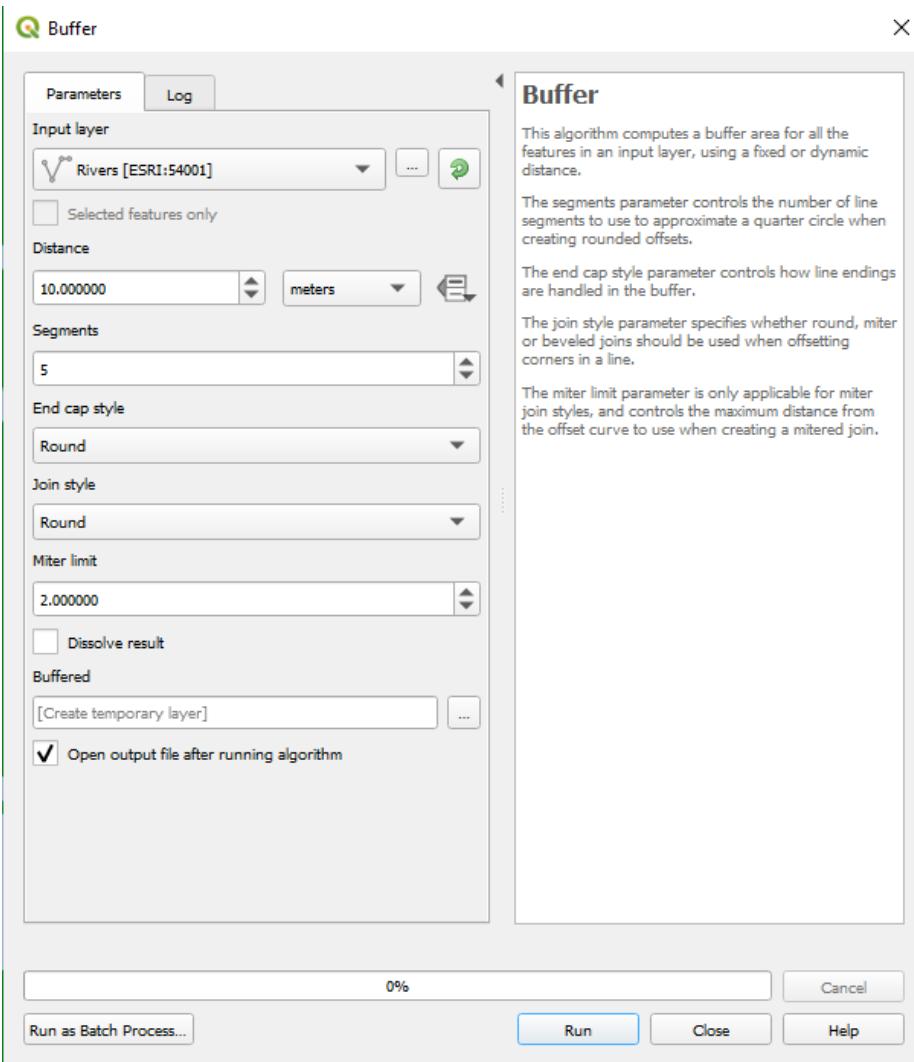


22. Save your edits.
23. Now go to the “Vector” menu → Geoprocessing Tools → Buffer



24. The Buffer tool is a great geoprocessing tool that builds a buffer around the features in a layer of a specified radius outwards. Additionally, you can specify specific features to use

by selecting them.



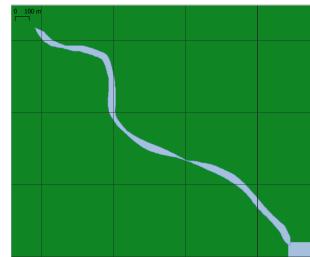
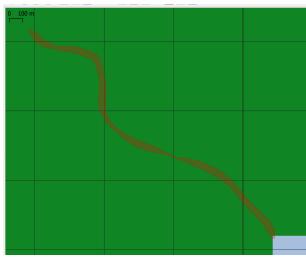
25. Set "Rivers" as your input layer
26. Set your Distance. This will go out from both sides of your line file. So if you set your distance to 10, then you will get an output of a 20 meter wide polygon river. I'm going to set my river widths to 20 meters.
27. You can keep segments as they are if you want. It doesn't have a huge effect on the end result
28. Keep the Endcap and Join style at round
29. Keep the miter unit as its default.
30. Keep "Dissolve Result" untoggled.
31. In this run of the geoprocess, create a new layer in a directory of your choice named "RiverPolys". Save it as a .shp (shapefile).
32. Run the process.
33. When the process finishes, change the layer order to put this new RiverPolys layer on top, and turn off the lines layer.
34. Change the symbology to "topo hydrology" in the Layer Styling panel.

35. Now zoom in. You'll see that your output rivers are now polygons instead of lines, and have exact widths. As you zoom in though, you'll see that these rivers have very straight lines, in both the Rivers lines and Rivers buffer. The next and final method will be the most detailed.

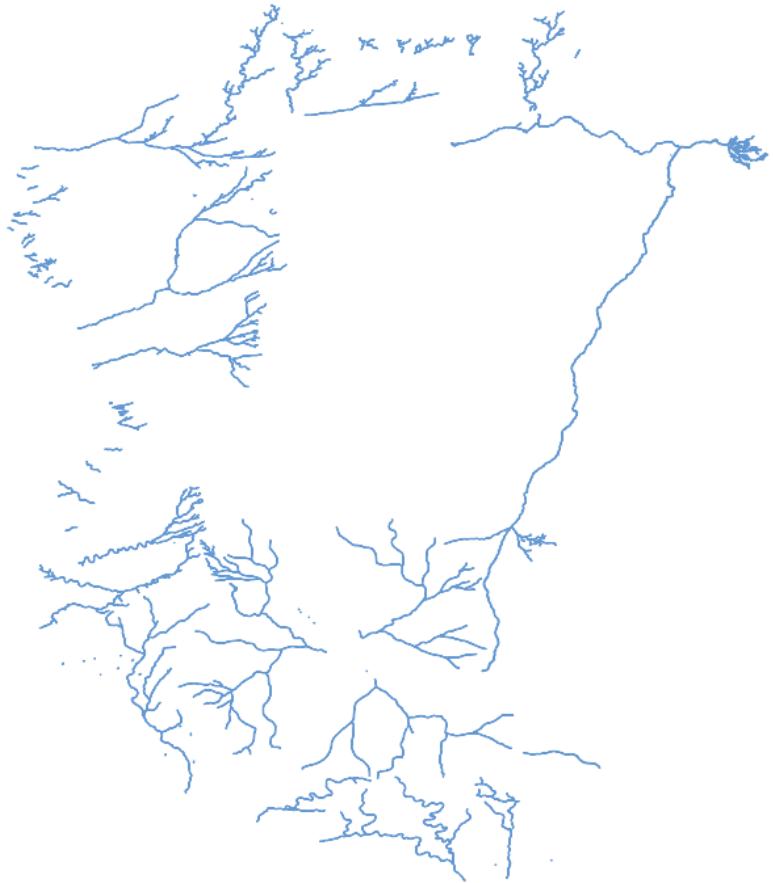
Method C: The Hand Drawn Technique

The Hand Drawn technique is a time-consuming way to get rivers that look *amazing* at all scales.

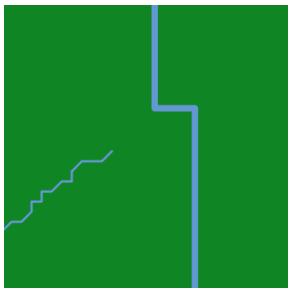
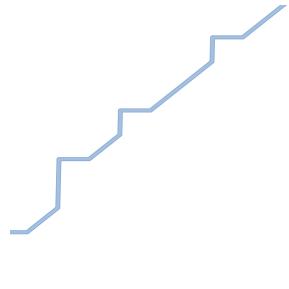
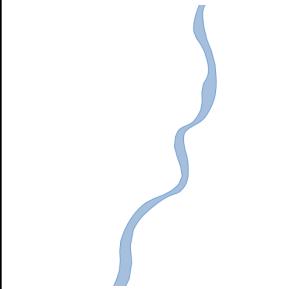
36. Save your edits in your Rivers file and untoggle the editing. Now toggle the editing in your RiversPolys file.
37. Since this technique is done so far zoomed in, you'll need a constant sense of scale. To do this, go to View→ Decorations → Grid, and enable the grid with 1000 meter intervals.
38. Now zoom in, very far, and use your Freehand Editing Tool to draw long, narrow ribbons of rivers, while being very careful to avoid bad geometry.



39. With this method, you'll need to draw your rivers in segments, merging them with one another as you move to the next one.



Shown in this image is the nearly complete Rivers Layer from my personal project. It has a mix of all three techniques. From a large scale (1:9600000) they look the same. But zoomed in you'll see the difference.

Comparing Each River Drawing Method			
	Method		
	Line Technique	Buffer Technique	Hand Drawn Technique
How does it look when zoomed in?			

Effort	Low	Medium	Very High
Time	Short	Short	Time Intensive

These three methods for drawing your rivers in are effective for different things. If you are making a vast overview map, I suggest using the Buffer Technique. But should you need to zoom in on an area, I suggest touching up the rivers there with the Hand Drawn Technique.

While the Line Technique is quick, it won't always look good, because the symbol widths are dictated by the scale you're at, meaning the width of the rivers won't always be constant.

You can always add to your polygon layer with buffering by setting the output of your buffer to be a temporary file, and then copying and pasting the results from it over to your main river polygon file.

Module 6: Making a Layer for your Mountains

If you want your map to have some of the feel of some more old-timey maps, you may want to add mountain ranges. I'm still working on finding the best way to make these, so for now we'll keep it simple: In this module we'll make a Point geometry Shapefile layer, where each point you place will represent a mountain. When you're done with this module, your mountains layer will look something like this:

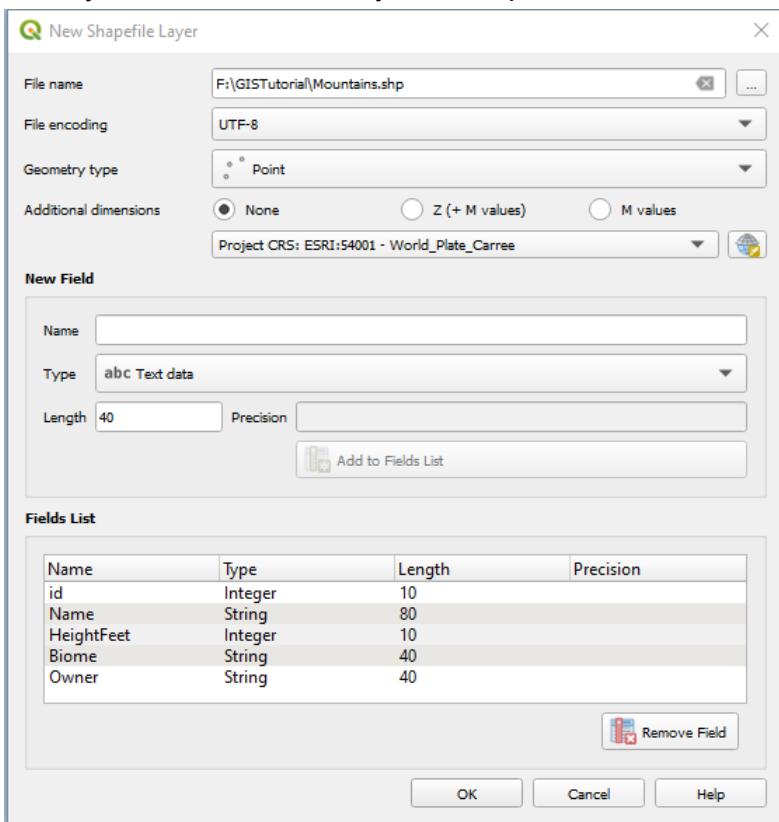


Let's get started.

Making the Layer

1. Make a New Shapefile Layer ()
2. Name your layer "Mountains"
3. Set the Geometry Type to Point
4. Set the projection to the Project CRS: World_Plate_Carree
5. Fields-- with this layer you don't have to add any if you don't want, since you'll be placing quite a lot of mountains. But here are some suggestions for fields you can include:
 - a. Name (text)
 - b. Height (Whole Number)

- When you have all the fields you want, press “OK”

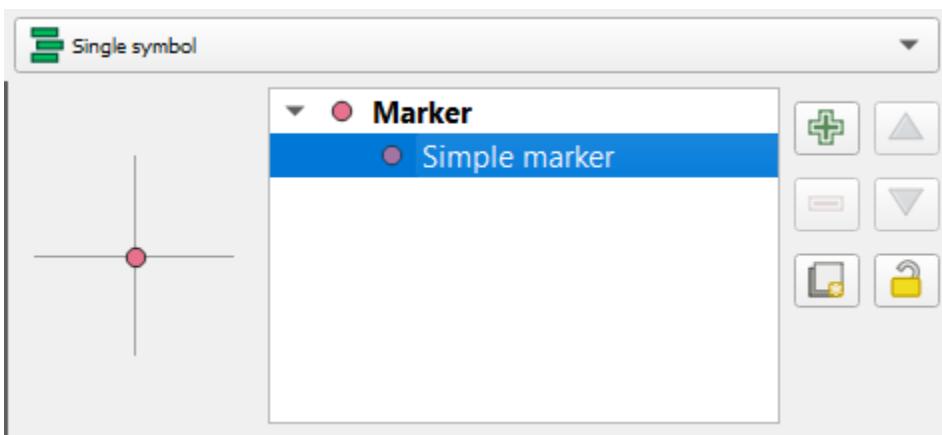


- As with the other layers, you'll need to go into the “Layer Order” panel and move “Mountains” to the top of the list. Since this is a Point file, it's best always at the top.

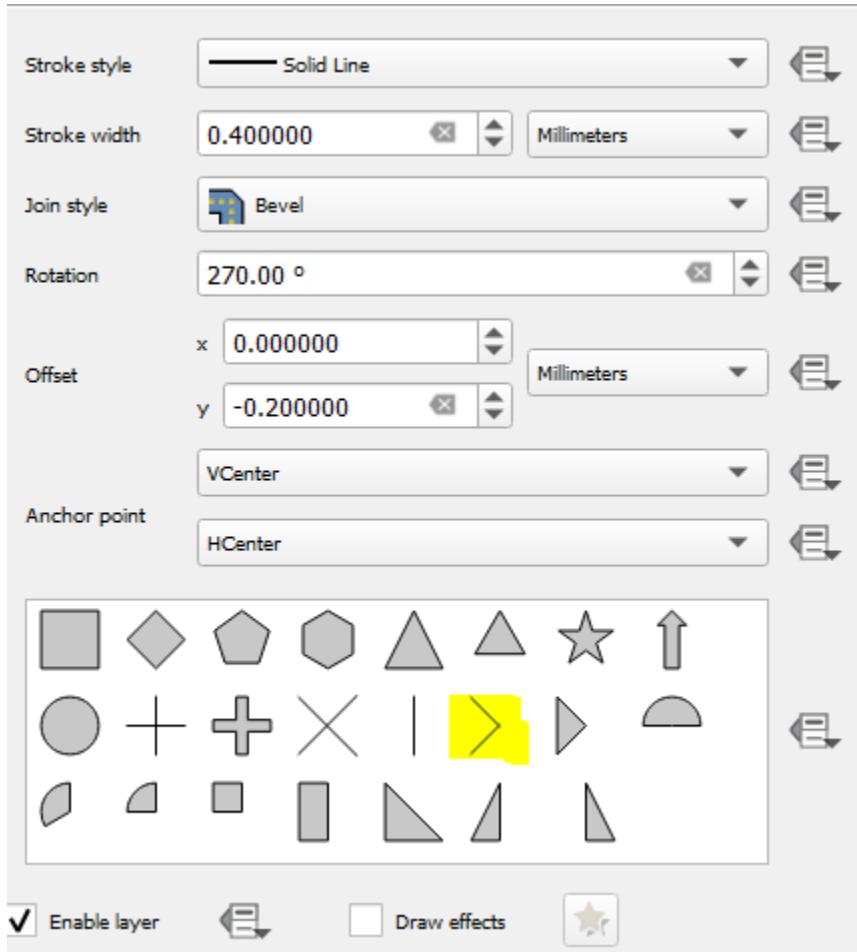
Symbolizing your Mountains

Making my mountains layer look good is still something I'm working on-- this is the best technique I've found so far for symbolizing them.

- With your “Mountains” layer highlighted in your “Layers” panel, open the “Layer Styling” panel.
- Select “Simple marker”



10. Select this symbol > from the preprepared symbols in this tab

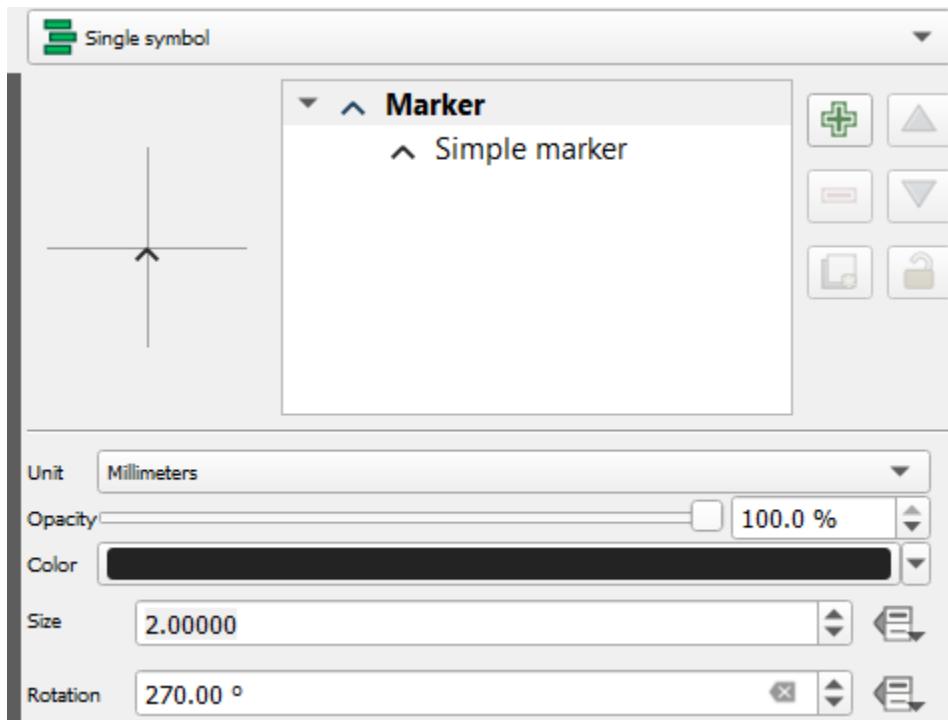


11. Set the stroke width to .4

12. Leave the join style as is

13. Set the rotation to 270 degrees

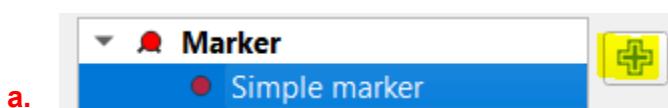
14. If you want to change the size of your mountain, highlight “Marker” and then you can change the size of the whole symbol.

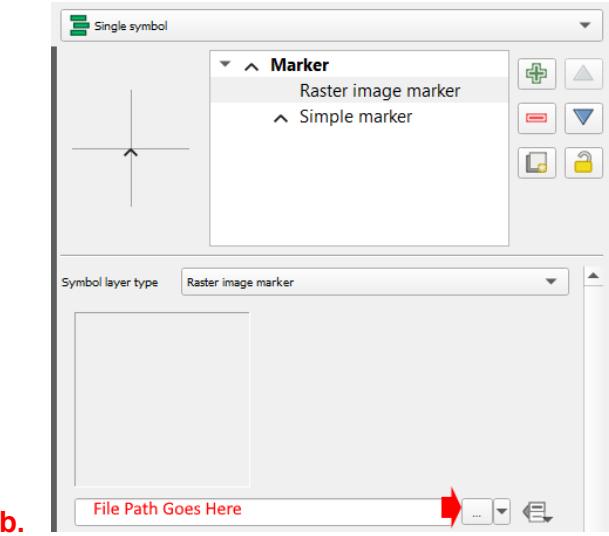


15. And tada! Here's your mountain symbol:



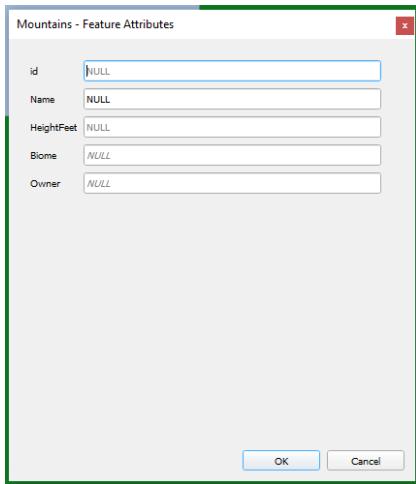
16. Note: For the more artistic types, you can draw your mountain symbol as a transparent .png file, and then import it to your symbology as a Raster Image Marker:





Placing your Mountains

17. Now it's time to place your mountains! Luckily for you, this is a pretty easy process!
18. Toggle Editing for your "Mountains" layer.
19. Select the "Add Point Feature" tool from the Digitizing Toolbar
20. Left-click on the map where you want your mountain to go
21. The Feature Attributes dialogue will pop up. If you don't want to add any information, just press your "Enter" key on your keyboard. Usually when I place my mountains, I do a quick succession of clicks and enters to so I can quickly and efficiently place my mountains.



22. When you are happy with your mountains, save your layer edits and untoggle the editing-- remember-- you can always come back and edit some more!

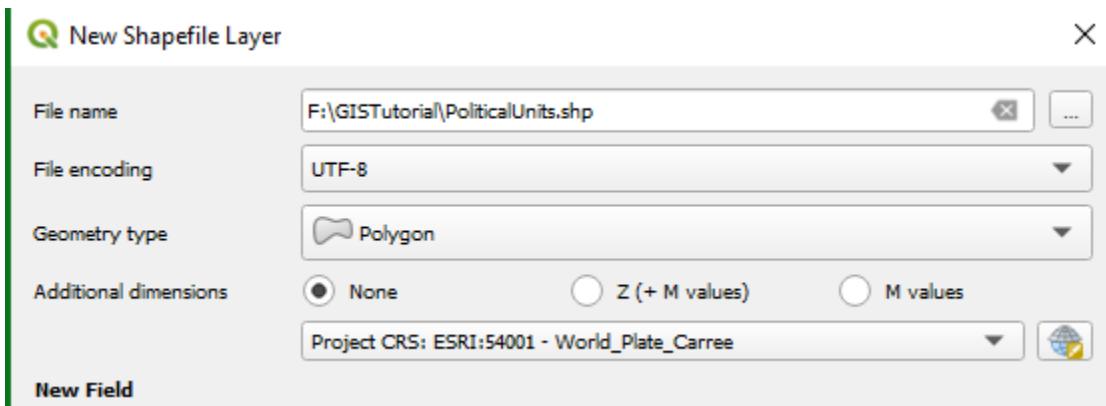


Module 7: Creating Political Units

We now have Landmasses, an Ocean, Rivers, and Mountains in this map, which are coincidentally the traditional borders between many political units (The Rio Grande constitutes much of the border between the US and Mexico, and Spain and France are separated by the Pyrenees Mountains. Italy is separated from the rest of Europe by the Alps). Would you like to get started on your political units?

Creating the Layer

1. Just as we've done with all the past layers we've made, open the "New Shapefile Layer" dialogue in the Data Source Manager Toolbar.
2. Set the filename to "PoliticalUnits"
3. Set the geometry type to "Polygon"
4. Set the coordinate system/projection to "World_Plate_Carree" using the dropdown menu for choosing your projection.



5. There are many fields you can add to this layer. If you want to be quick, just add a name field in text format. But here are some ideas that I've gathered with the help of Wikipedia and the Worldbuilding Discord:

a.

Field Name	Data Format
Status	Text
Capital	Text
Largest City	Text
Official Language	Text

Official Religion	Text
Denonym	Text
Political System	Text
Ruler	Text
Establishment	Text
Population	Whole Number
Currency	Text
Size	Whole Number
Class System	Text
Military Power	Whole number or text

6. Once you have all your desired fields entered in, press “OK”
7. Now go to the layer order tab and move the PoliticalUnits layer to be over your Extent and Landmasses, but under your Rivers and Mountains.
8. Toggle editing by right clicking on the layer and left clicking “Toggle Editing”.

Creating and Editing your Political Units with the Tracing Tool

9. To make this process much easier for you, we’re going to use the Tracing tool that comes with QGIS.
 - a. Make sure that your Snapping toolbar is enabled and that Snapping has been turned on



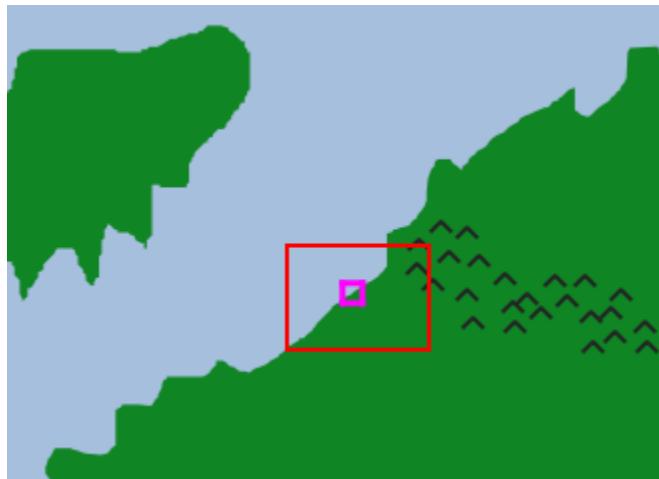
- b. To toggle tracing, click the button furthest to the right.



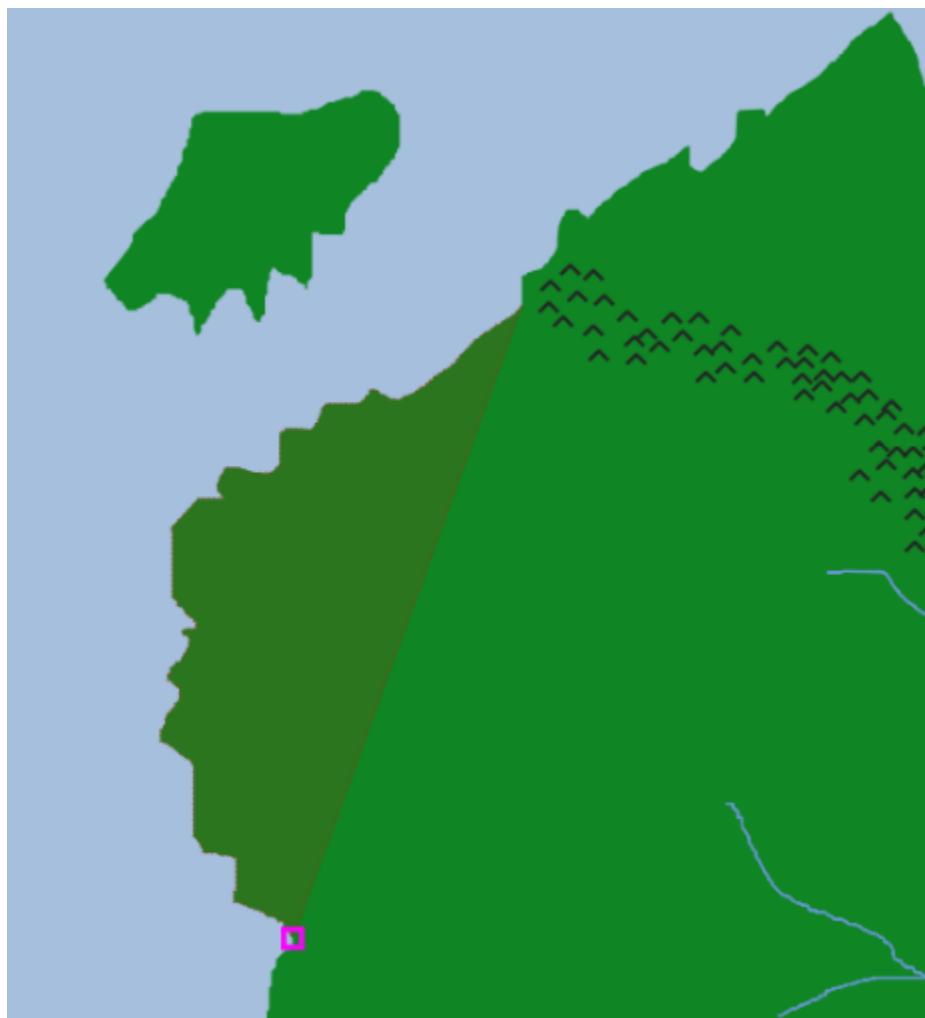
10. If you’d like, turn on your raster map again if you want to trace over any borders you drew on it.
11. To draw your Political Units, select the “Add Polygon Feature” from the Digitizing toolbar.



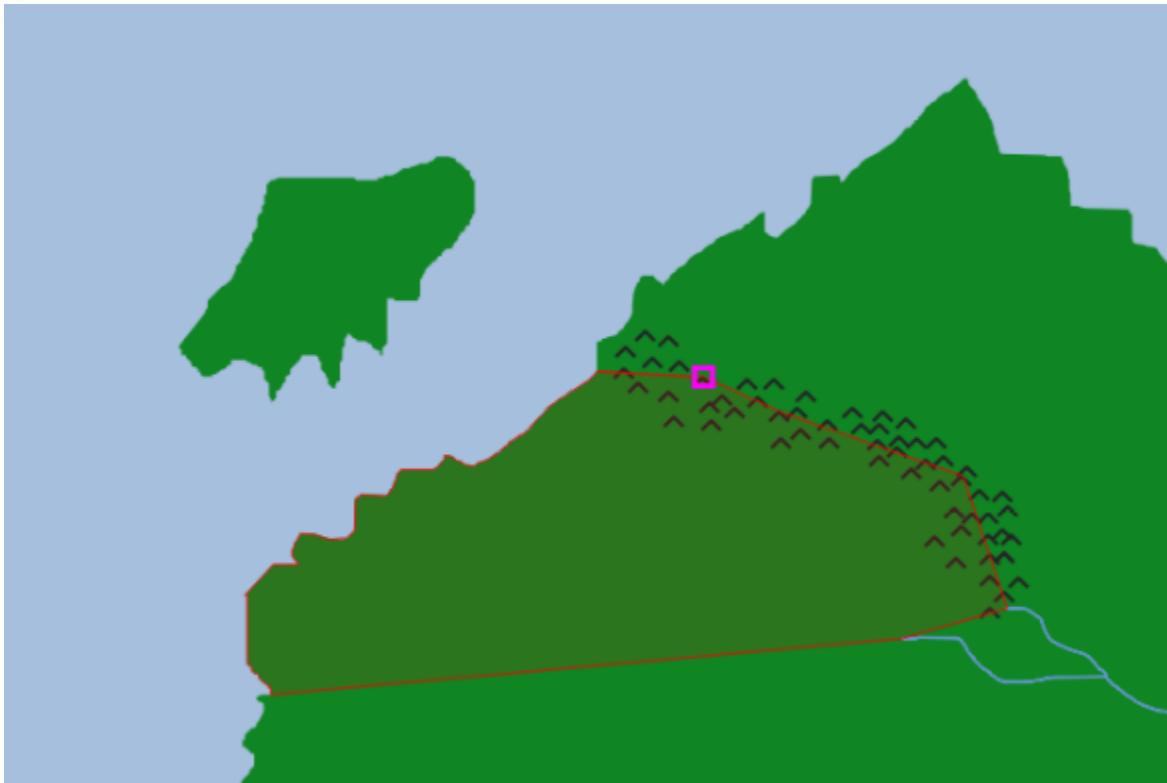
12. We will start with coastal political units. Hold your cursor close to the edge of a desired landmass- you'll see a pink square show up on the vertex that your tool is snapping to.



13. Left Click on that vertex and then hover your cursor over another vertex-- you'll see the program trace your coastline in a dark red shade.



14. Keep left-clicking to make the shape of your country.



15. When you are satisfied with its shape you can right-click to finish the polygon and pop-up the Feature Attributes dialogue.

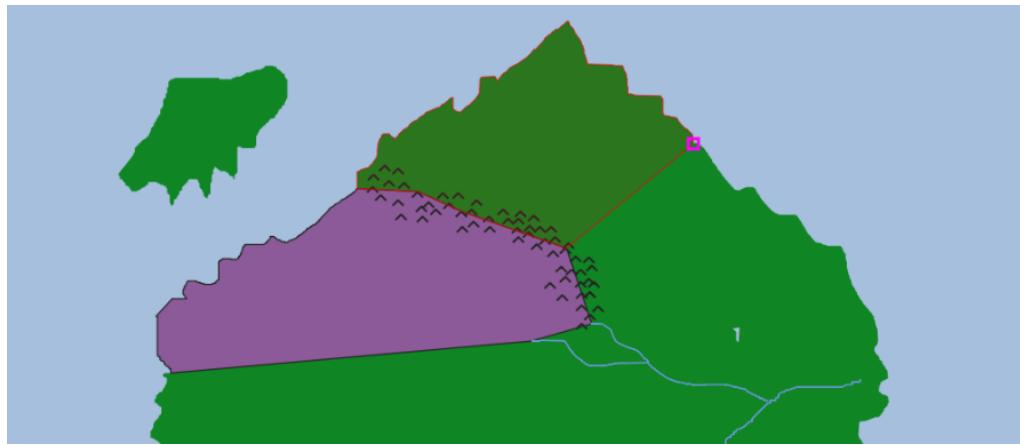
16. REMEMBER TO BE CAREFUL OF CREATING INVALID GEOMETRY.

17. This tool won't trace on everything-- if you would like to make various borders more complex, you can use the Freehand Editing tool to create more jagged shapes and then merge them together.

18. You can keep on tracing your other units now. Take some time to play around with the trace tool and learn its various nuances. It took me some practice to learn how it worked. A good way to ensure its success is to make sure of the following:

- a. Your geometry is valid on all your layers. To check your geometry, go to Vector → Check Geometries.
- b. Make sure your rivers are all connected, and that they all connect to the ocean. This makes realistic watersheds that would historically separate different groups.

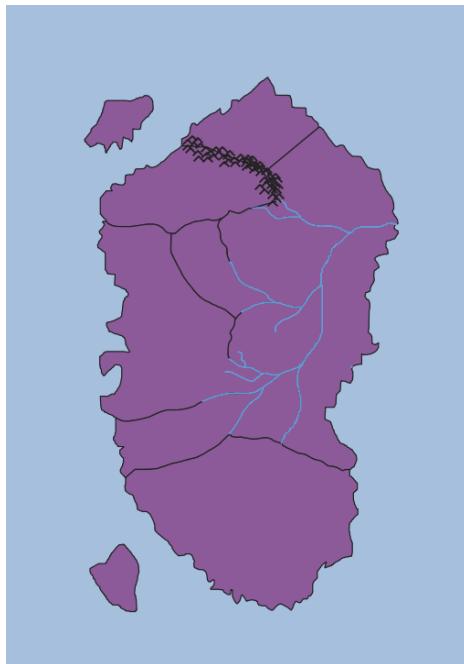
- c. Consider using the Freehand Editing tool to add vertices for the tracing tool to catch on to.



- d. Another option is to only use the tracing tool when absolutely necessary, and use the Freehand Editing tool to cover the insides of your political units, only using the tracing tool against your borders.

Symbolizing your Political Units

While you were working on filling out your political units, I made some quick ones on this map as well.

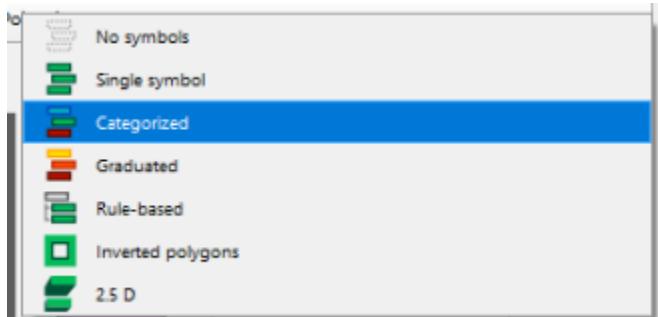


You may notice that these units don't look very good. So what we're going to do is *symbolize* them so that they look nice and contrast well against each other.

Random Symbology

One method you can use is to have QGIS assign a random color to each feature.

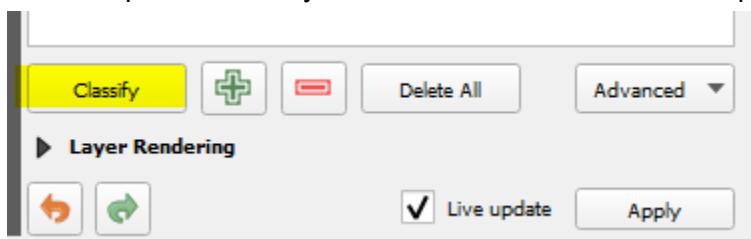
1. With your Political Units layer selected, open the Layer Styling tab.
2. Click the “Single Symbol” dropdown and select “Categorized”



3. Select your “Name” field for the categorization value.



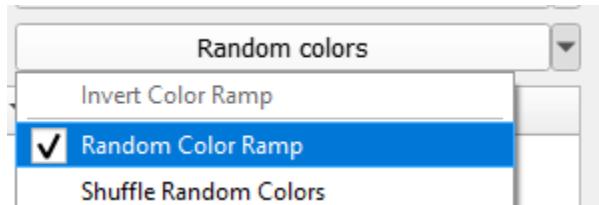
4. And now press “Classify” in the bottom left corner of this panel.



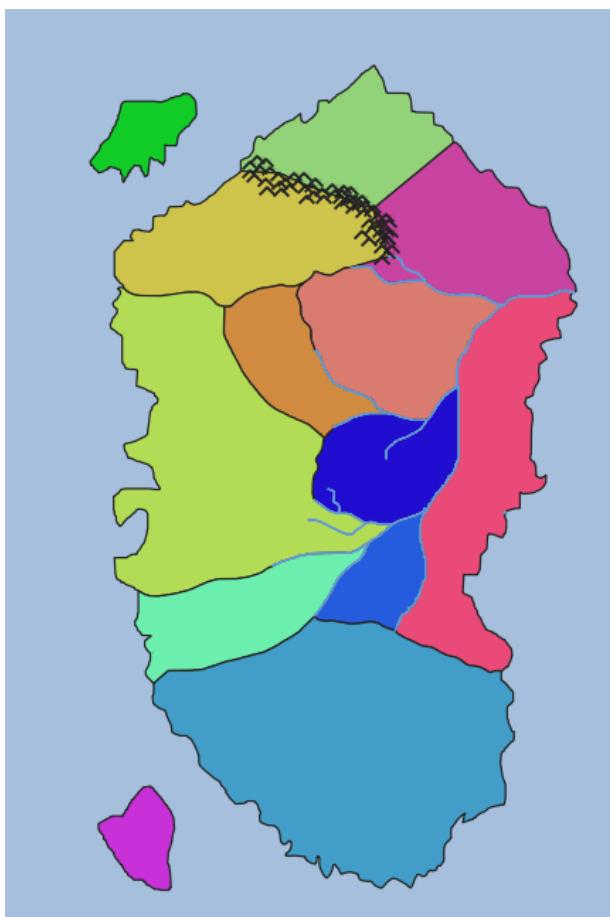
Symbol	Value	Legend
✓	Boulder Is...	Boulder Island
✓	M'Ladria	M'Ladria
✓	Mountania	Mountania
✓	Ohman	Ohman
✓	Runninou...	Runninouttanahmay
✓	The Burg...	The Burghentine Empire
✓	The Com...	The Computer Kingdom
✓	The Gold...	The Golden Coast
✓	The Nam...	The Named Kingdom
✓	The Narro...	The Narrows
✓	The Riverl...	The Riverlands
✓	The Stretch	The Stretch
✓	The Tutor...	The Tutorian Empire
✓	The Woo...	The Wooden Ghost Kingdom
✓	all other v...	

You will see the names of each of your features show up in your legend panel.

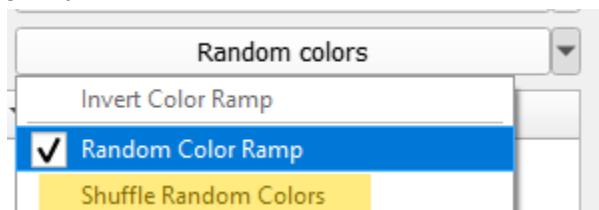
5. If your color ramp isn't already set to "Random Colors", click the dropdown and toggle the checkbox for "Random Color Ramp"



6. And now you will see on your map that the colors in your legend are now being used to color in each feature:



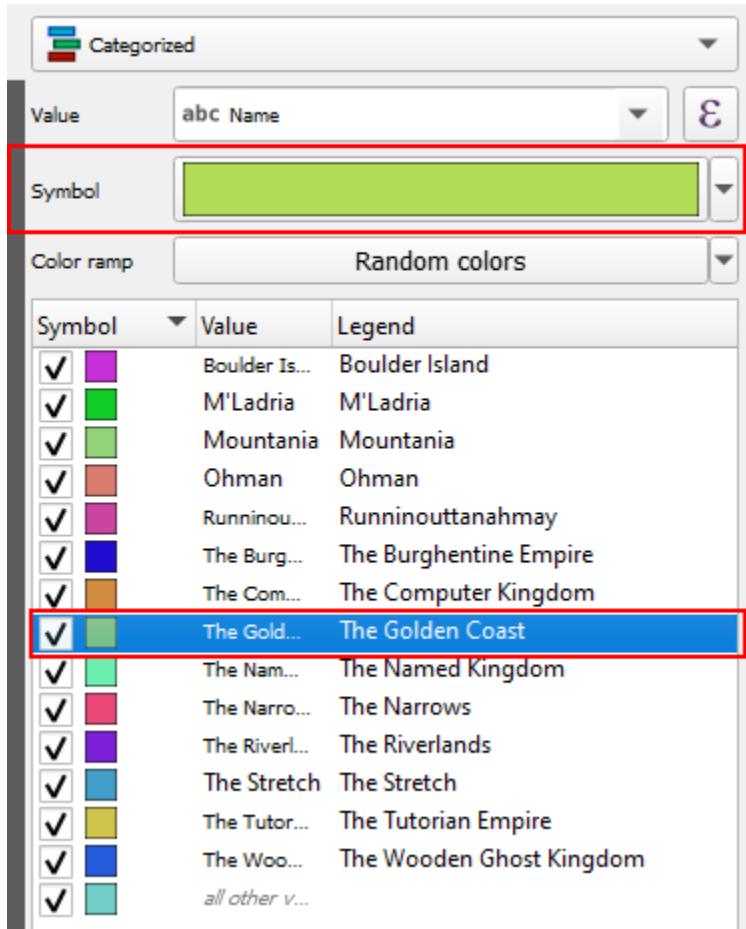
7. If you are unhappy with these colors you can shuffle the randomized symbols, which will give you a new palate.



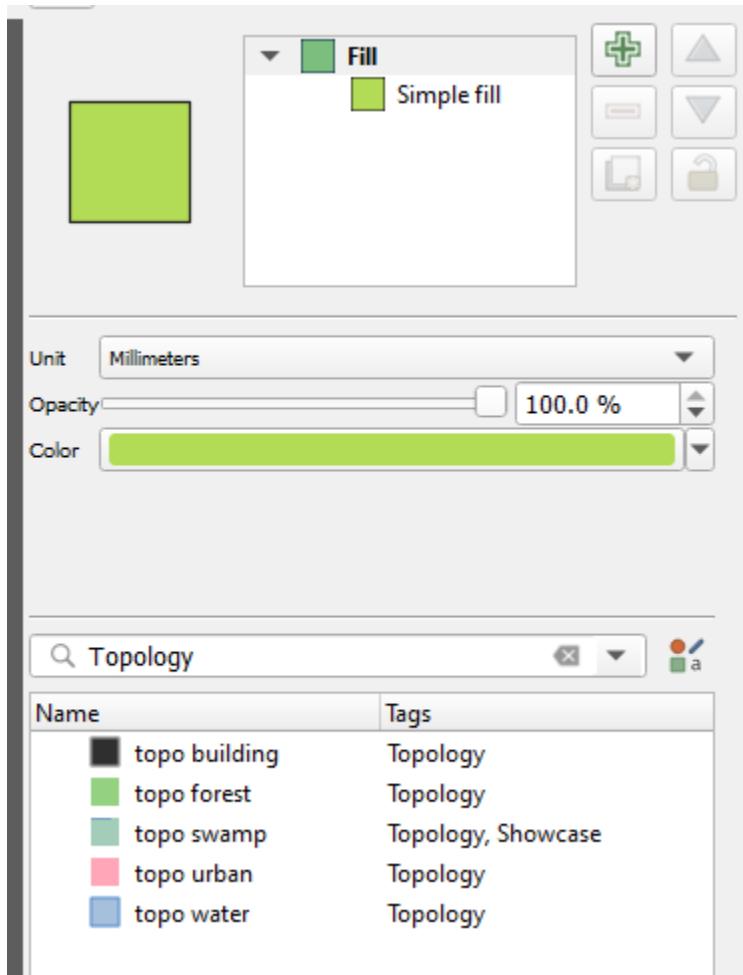
Manually Choosing Each Symbol

If you are still unhappy with how these symbols are randomized, you can set each one individually. Depending on how many features you have this could be a very viable option.

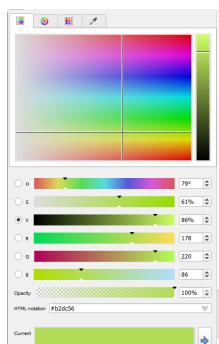
1. Highlight a few symbols in your layer styling tab. You will see that the symbol of the feature you highlighted will show up in the Symbol drop down.



2. If you want to change this, left-click the “Symbol” drop down. You will be directed to the symbol styling tab. In this tab you can change the color of a symbol and add layers to it.



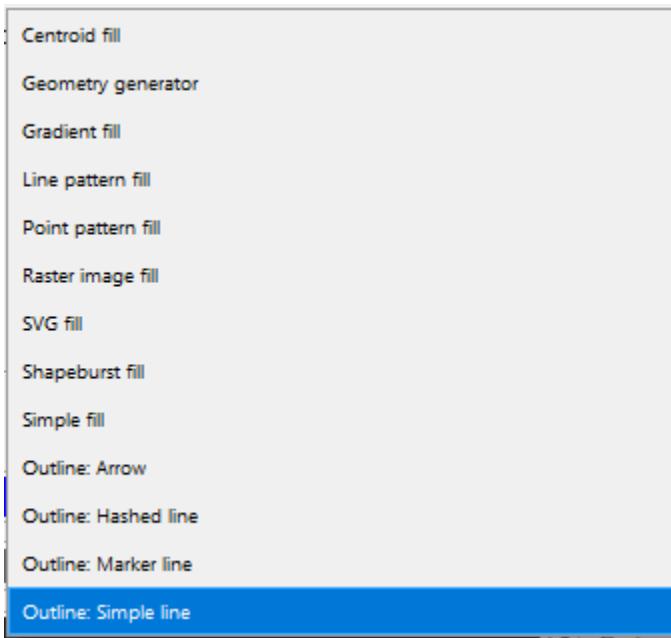
3. To change the color, simply press the “Color” dropdown, where you’ll see a multitude of ways to choose your color. You can do so with a gradient, a wheel, by history, or by color picker.



4. To add a new layer to your symbol, press “Add Symbol Layer” plus button .

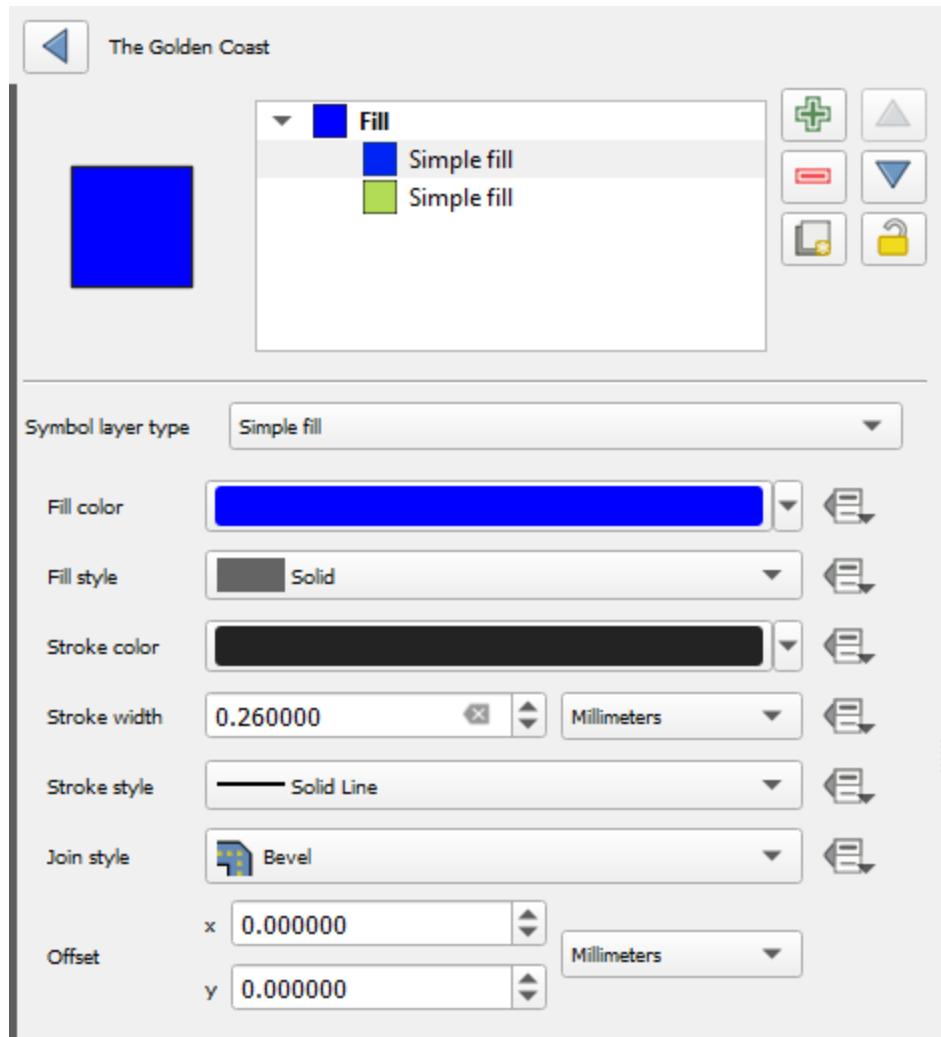


5. When you click the “Symbol Layer Type” dropdown you can choose a multitude of ways to fill your layer.



Try playing around with these different options!

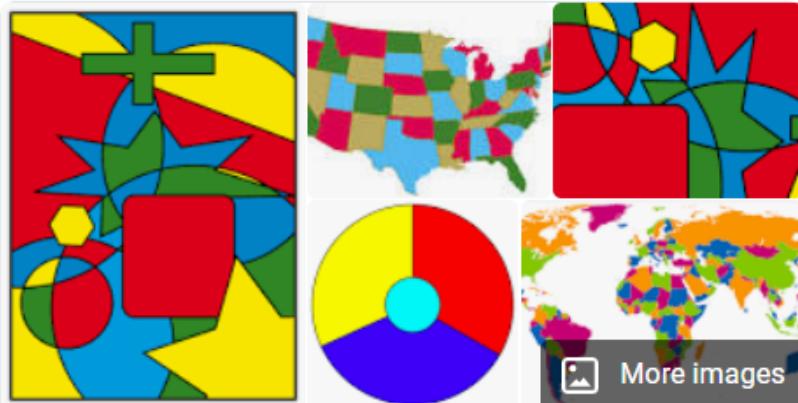
6. You will also have control over your fill color, your fill style, your stroke color, your stroke width, your join style, and the offset of each symbol (you can use offset to create drop shadows for instance)



Instituting Four Color Theory in QGIS

For those who want their maps to look like our real-life world maps, you may know that they typically have a limited amount of colors used to symbolize each country. This is called “Four Color Theory”, or the ability to use just four colors on a map and have none of them touch.

From Google:



Four color theorem



In mathematics, the four color theorem, or the four color map theorem, states that, given any separation of a plane into contiguous regions, producing a figure called a map, no more than four colors are required to color the regions of the map so that no two adjacent regions have the same color. [Wikipedia](#)

There is a way to incorporate this into QGIS using the “Topological Coloring” tool. This tool adds a new field to your layer which a code that you can then categorically symbolize your layer by. The field calculates four color theorem into your layer.

7. Make sure that your geometries are valid in your PoliticalUnits layer.
8. In your Processing Toolbox, search for “Topological Coloring” and open the tool.

Processing Toolbox

Recently used
 Topological coloring
 Cartography
 Topological coloring
 Vector creation
 Raster pixels to polygons

Topological Coloring

Parameters Log

Input layer
 PoliticalUnits [ESRI:54001]

Selected features only

Minimum number of colors
 4

Minimum distance between features
 0.000000 meters

Balance color assignment
 By feature count

Colored
 [Create temporary layer]

Open output file after running algorithm

0%

Topological coloring

This algorithm assigns a color index to polygon features in such a way that no adjacent polygons share the same color index, whilst minimizing the number of colors required.

An optional minimum distance between features assigned the same color can be set to prevent nearby (but non-touching) features from being assigned equal colors.

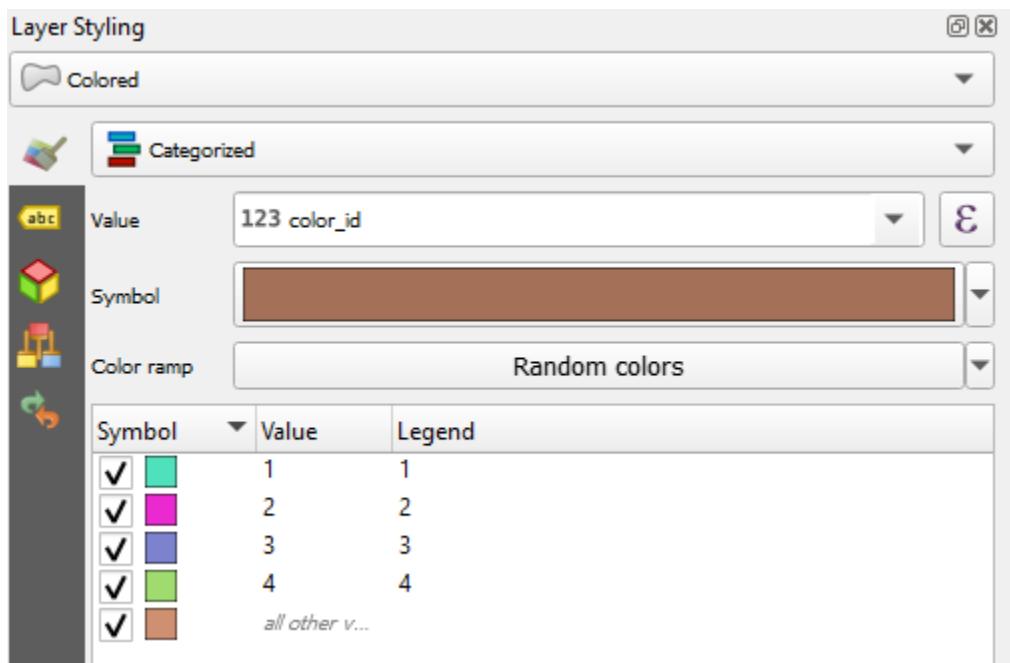
The algorithm allows choice of method to use when assigning colors. The default method attempts to assign colors so that the count of features assigned to each individual color index is balanced.

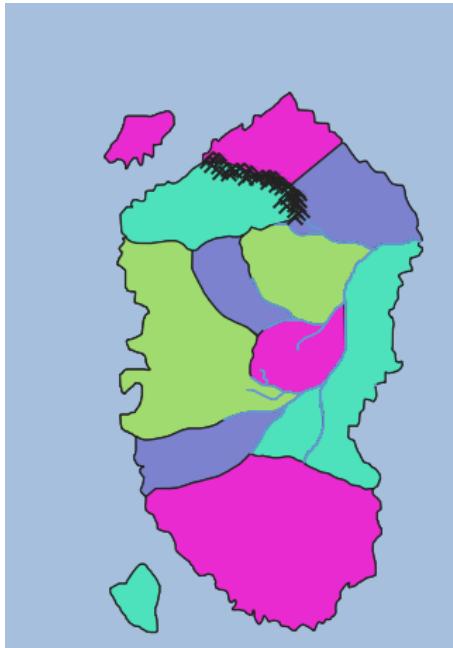
The 'by assigned area' mode instead assigns colors so that the total area of features assigned to each color is balanced. This mode can be useful to help avoid large features resulting in one of the colors appearing more dominant on a colored map.

The 'by distance between colors' mode will assign colors in order to maximize the distance between features of the same color. This mode helps to create a more uniform distribution of colors across a map.

A minimum number of colors can be specified if desired. The color index is saved to a new attribute named `color_id`.

9. Set your input layer to your PoliticalUnits layer
10. Set the “Minimum number of colors” to 4
11. I kept the “Balance Color Assignment” as the default, but the help tab to the right gives you a summary of the other options in that drop down.
12. Options for your Output:
 - a. Create a temporary layer. When the process finishes, copy and paste your features from the temporary layer to your main Political Units layer, replacing the.
 - b. Save the output as a new .shp layer.
13. Press “Run”
14. When your new layer appears in the map, go to the “Layer Styling” panel and set the Symbolization to “Categorized”, based off of the new “color_id” layer.
15. Left-click “Classify”.
16. Now each feature in your layer has been given a color ID based on its proximity to other features. This will ensure that you can use just four colors in your map that do not touch eachother.





17.

18. As you can see, you have just instituted the Four Color Theorem into your map! If you are unhappy with the four colors used, you can manually change them using the steps in [Manually Choosing Each Symbol](#)

Module Conclusion

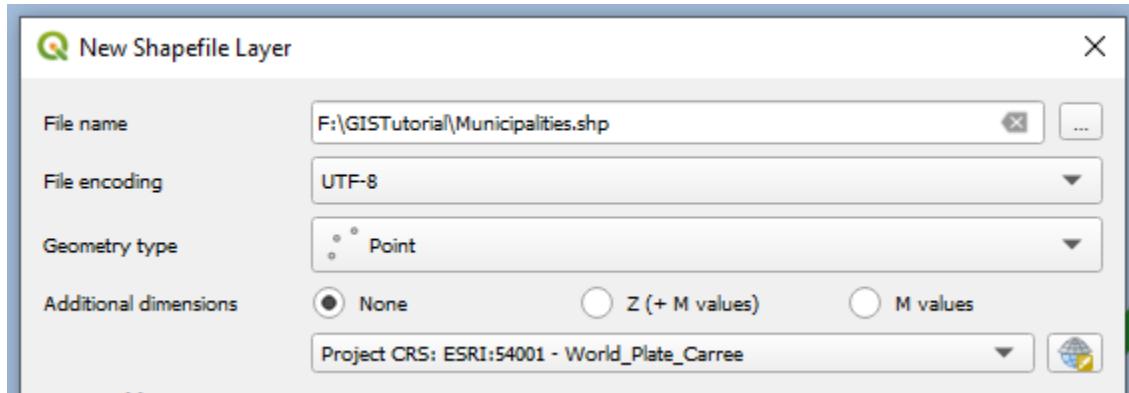
You have now successfully used this module to create a good looking layer to show off your political units! But political units aren't the only thing you can use this for. You can also use this for Lingual boundaries, Religious boundaries, Political Sub-Units, Biomes (but in this tutorial you'll learn another method for making biomes), and any other layer that would require precise, discrete polygons.

Module 8: Placing and Drawing your Towns

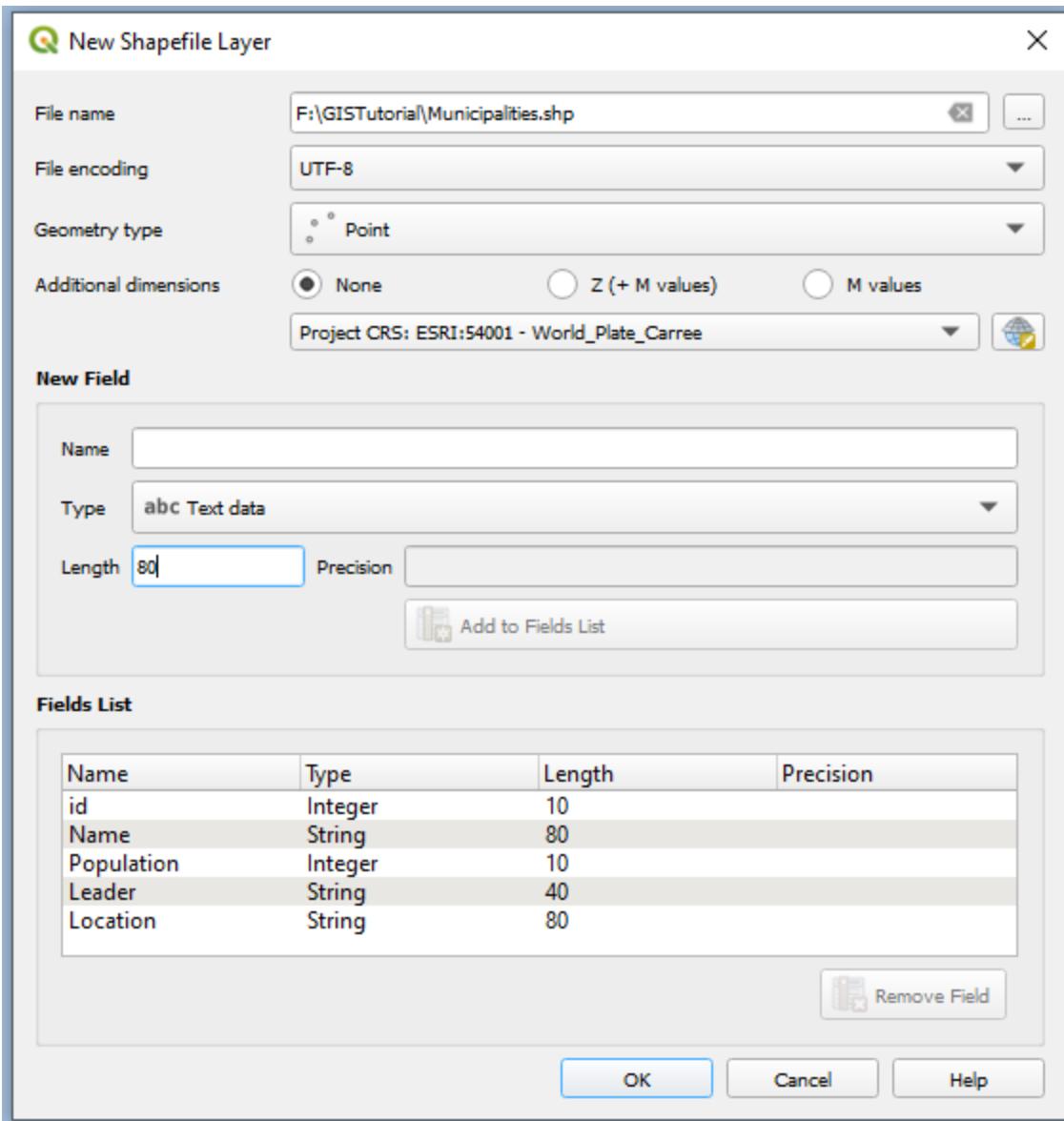
What is a kingdom without its cities and towns? In this module we'll create a point file layer to mark down the precise locations of the cities and population centers in your world. We'll also explore a way to draw these towns in at a very fine scale. While this latter method is very detailed, I only recommend it if you are considering playing a D&D campaign on this map.

Making your Town point layer

1. Left-click “Add New Shapefile Layer”
2. For “File Name” give your layer a descriptive name like “Towns”, “Cities”, or “PopulationCenters”. I chose “Municipalities” for this layer’s name.
3. Set the “Geometry Type” to Point.
4. Set the Coordinate System to World_Plate_Carree.



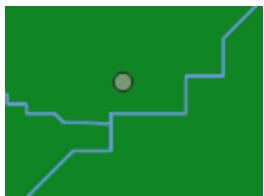
5. As with most of the layers we've created so far, the only field you absolutely need is a field that records the name of each town you place, but of course there's many other fields you can consider.
 - a. Name (Text)
 - b. Population (Whole Number)
 - c. Mayor (Text)
 - d. Authority (Text)
 - e. Location (Text)
6. When you are happy with the fields you have, press “OK”



7. When you press “OK” this layer will be added to your project. Go to the “Layer Order” panel and drag it up towards the top, where it will be visible over your Polygon and Line layers.
8. Right-Click on the layer and Toggle Editing.
9. Placing your towns will be just like placing your mountains. Select the “Add Point Feature Tool” in your Digitizing toolbar.

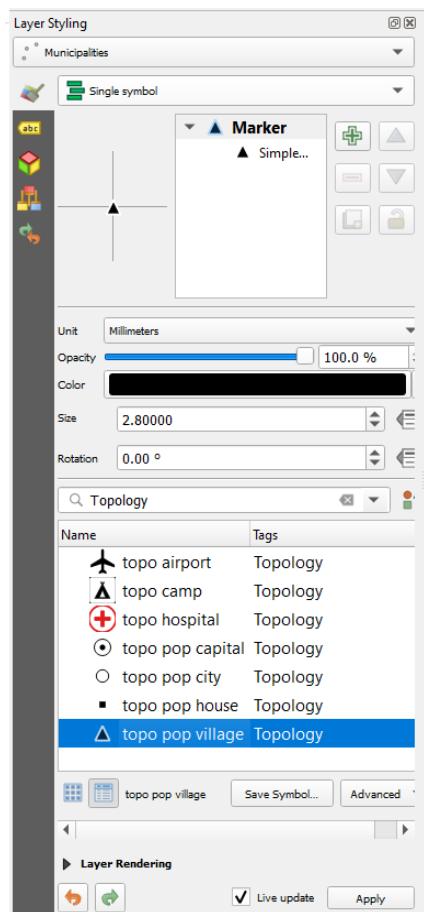


10. Now click on a location where you want your town to be and the “Feature Attributes” dialogue will pop up. Fill in how many fields as you would like and press “OK”. Your town will now show up on the map as a point.



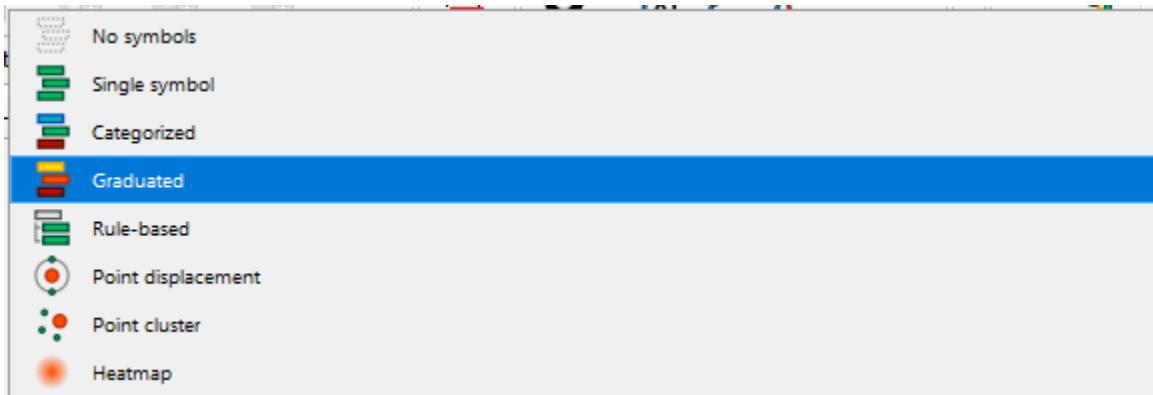
Symbolizing your Towns

11. You can always change this symbol in the “Layer Styling” panel if you’d like. I’m going to set my symbology for this layer as a single symbol for now.



12. Many real life maps use the size or shape of the symbol to note the size of a town. You too can do this if you fill out the population field (make sure that it’s in Integer/Whole number format!!).

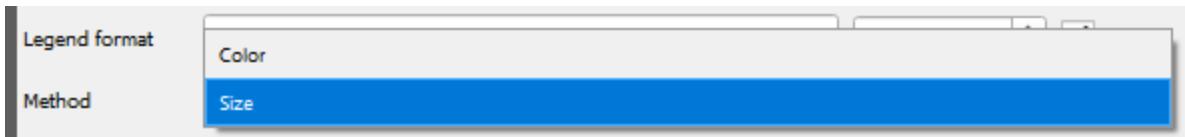
13. To have your town points vary in size depending on the population, select “Graduated” from the symbology method dropdown.



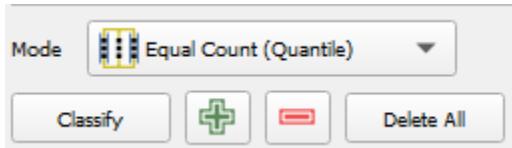
14. This menu will now be shown.

Symbol	Values	Legend
✓ .	30.00 - 246.00	30 - 246
✓ ▲	246.00 - 660.00	246 - 660
✓ ▲▲	660.00 - 1340.00	660 - 1340
✓ ▲▲▲	1340.00 - 3600.00	1340 - 3600
✓ ▲▲▲▲	3600.00 - 10000.00	3600 - 10000

15. Set “Value” to your population field.
 16. Set the symbol to a symbol of your choosing. Triangles work well for showing size difference.
 17. Set the “Method” to Size.



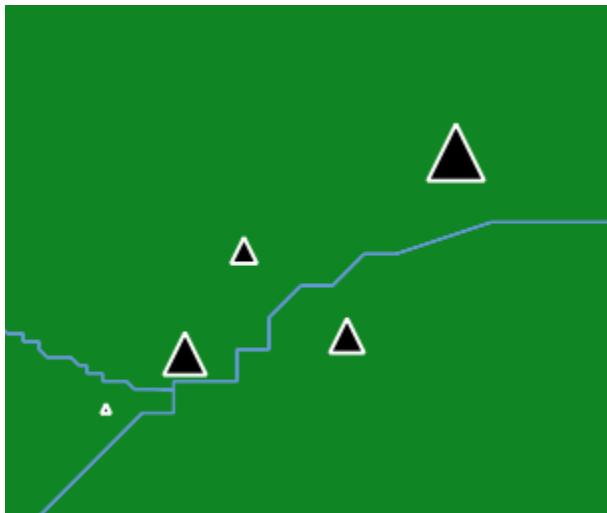
18. Now left-click “Classify” in the bottom left corner. You can change the statistical method by which it’s classified. You can read more [here](#).



19. Now you’ll see that each class of town size you have will be classified by its size.

Symbol	Values	Legend
✓ -	30.00 - 246.00	30 - 246
✓ ▲	246.00 - 660.00	246 - 660
✓ ▲▲	660.00 - 1340.00	660 - 1340
✓ ▲▲▲	1340.00 - 3600.00	1340 - 3600
✓ ▲▲▲▲	3600.00 - 10000.00	3600 - 10000

I recommend playing around with the size of each individual symbol so that they look nice on your map. Do this by highlighting one of the classes and left-clicking “Symbol”.



Drawing Individual Structures

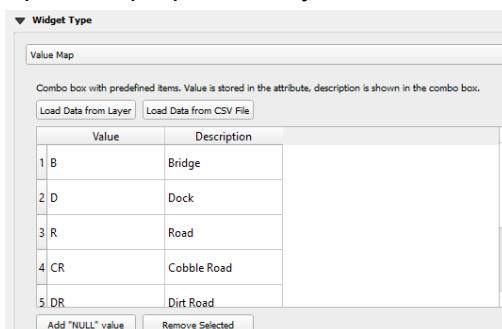
If you want to fully take advantage of vector graphics in QGIS and reach an *insane* level of detail in your map, you can draw in individual buildings and structures. I advise again that you shouldn’t do this unless you plan on using this map for zooming from very high scale to low scales, as it is very tedious.

1. Make the following shapefiles with the following fields:
 - a. Fortifications (Line)
 - i. Type
 - ii. Height (optional)
 - b. Buildings (Polygon)
 - i. Material
 - ii. Family (optional)
 - iii. Occupants (optional)
 - iv. Floors (optional)
 - c. Infrastructure (Polygon)
 - i. Type
2. Highlight these new layers in your “Layers” panel and right click, then group them.



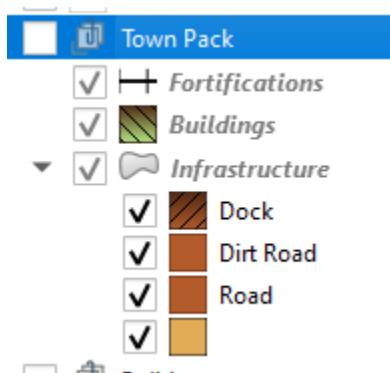
Grouping these layers will help keep them organized. You can also do this for the other layers you've created. For example I have groups for my Grid files, my Political layers, my Water layers, and my Geographic layers.

3. Open the properties of your Infrastructure layer and give it the following [Value Map](#):

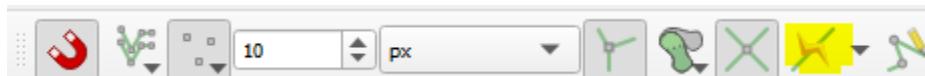


This will be useful when you symbolize each type of infrastructure. You can also feel free to add different types of infrastructure types that may be more relevant to your world.

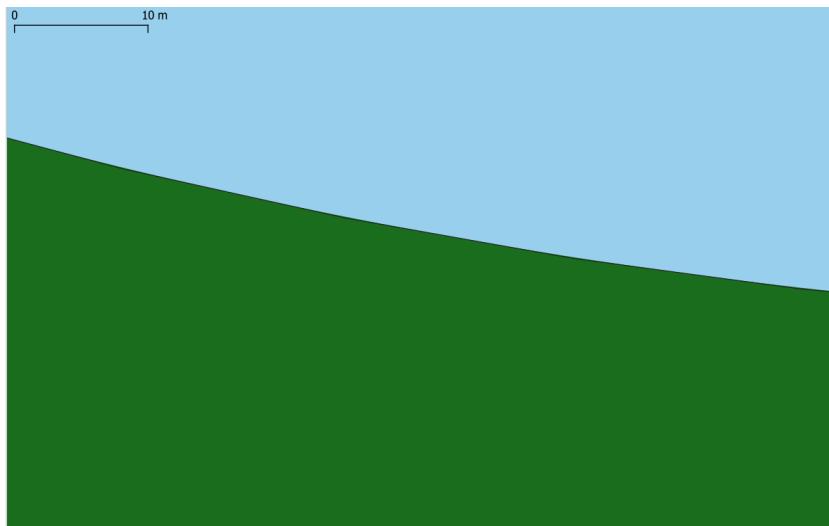
4. This is my symbology I have for all of these, but again feel free to change that to the context of your own world.



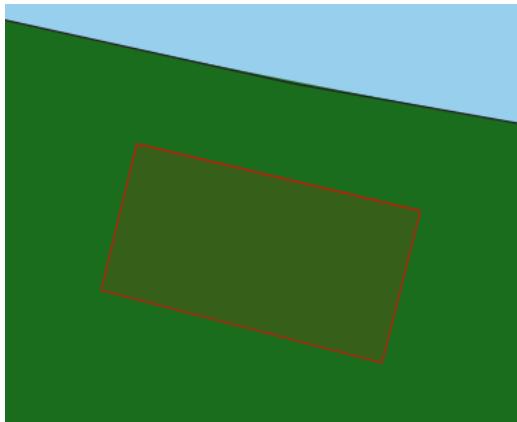
5. Disable Tracing in the Snapping toolbar.



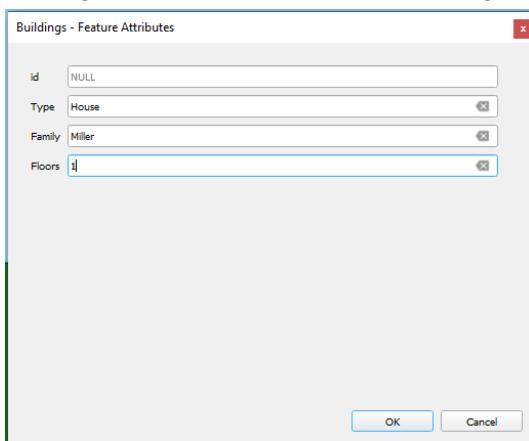
6. Start editing for all three layers.
7. If you haven't already, enable a scale bar by navigating to View→ Decorations→ Scale Bar. Set it to a smaller unit like Feet or Meters.
8. Now zoom in towards where you want to place your buildings-- A LOT.
9. I'll be drawing a nice little shore town here.



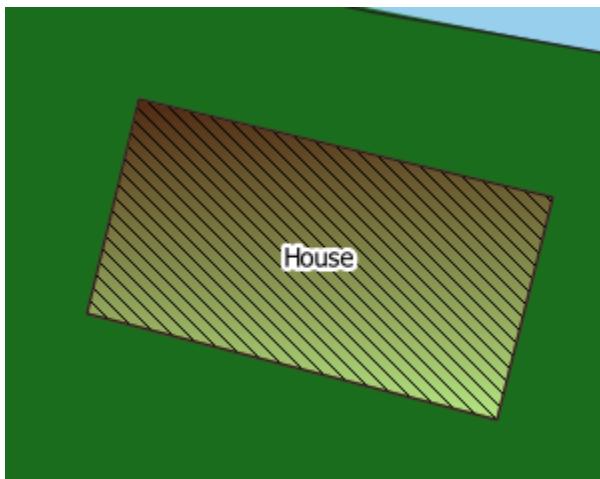
10. Select your “Add Polygon Feature” tool OR a shape from the “Shapes Plugin” toolbar.
11. If you’re using the “Add Polygon Feature” tool, left-click to create nodes in the shape of the building you’re making.



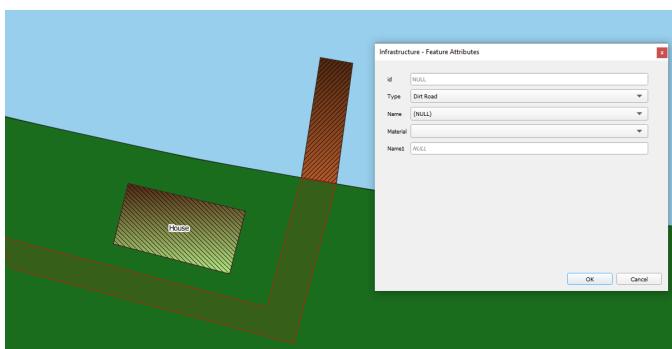
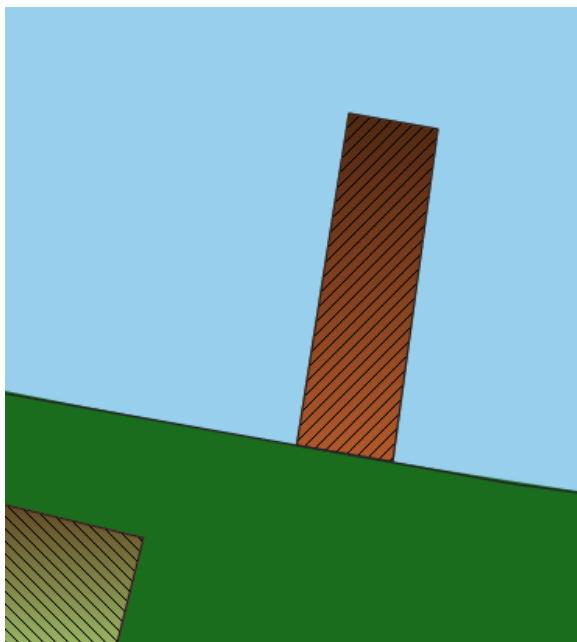
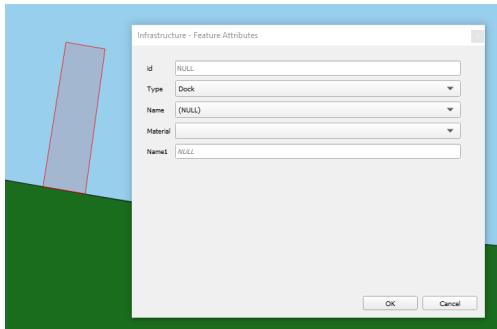
12. And right click to complete it and bring up the Feature Attributes dialogue box.

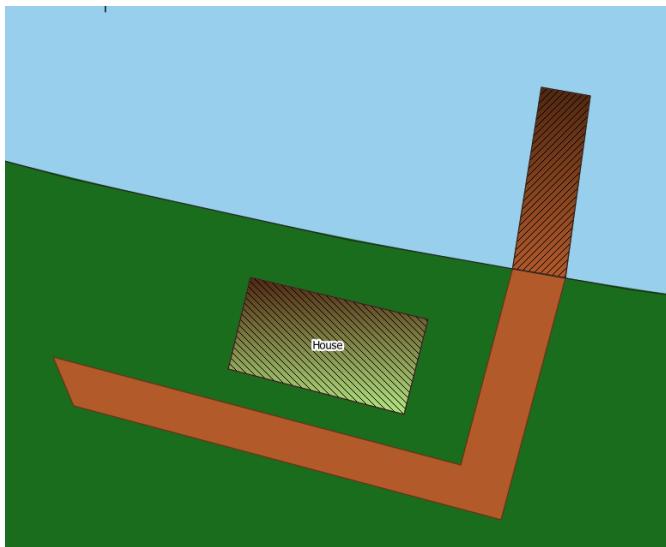


13. Press "OK" to finish your building!

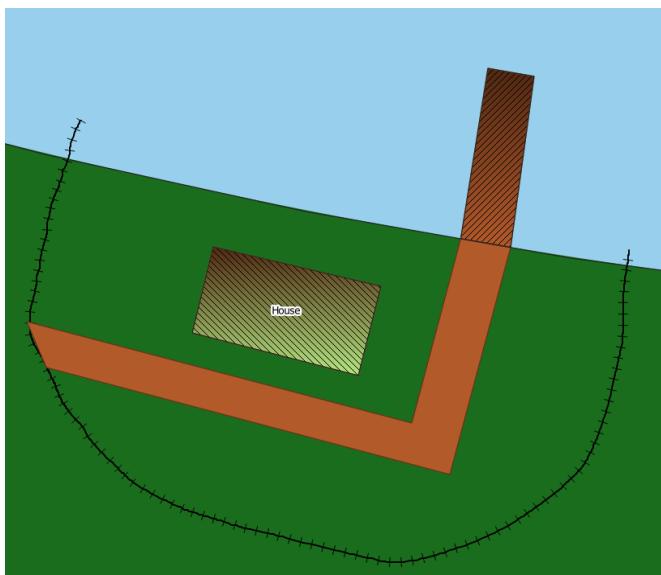
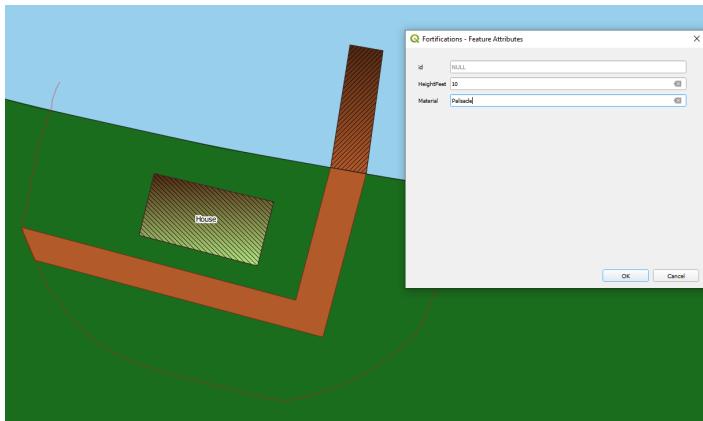


14. I'm going to use the same method to add a road and some docks (this time using my Value Map for symbology)





15. Now I'm going to use the Freehand Editing Tool to add a lovely little palisade wall around my house and dock with the Fortifications Layer.



Setting Scale Dependent Visibility

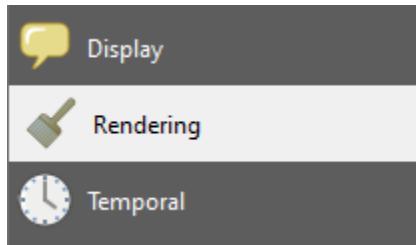
When you zoom back out, you may notice that an ugly label is still there.



In towns where you have a lot of labels, this can become ugly and cluttering.

To fix this, you can set Scale Dependent Visibility for a layer, where it will automatically turn off when you zoom out enough.

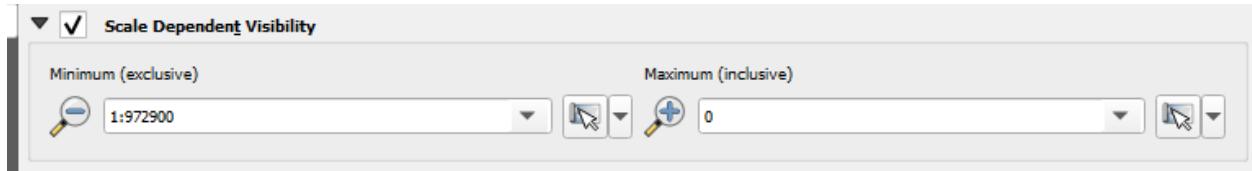
16. Open the Properties of whichever layer you want to have Scale Dependent Visibility on.
17. Navigate to the “Rendering” tab.



18. Toggle “Scale Dependent Visibility”



19. On your map, zoom to the final level of zoom in which you want to see your feature.
Then left-click “Set to current canvas scale” under “Minimum (Exclusive)”

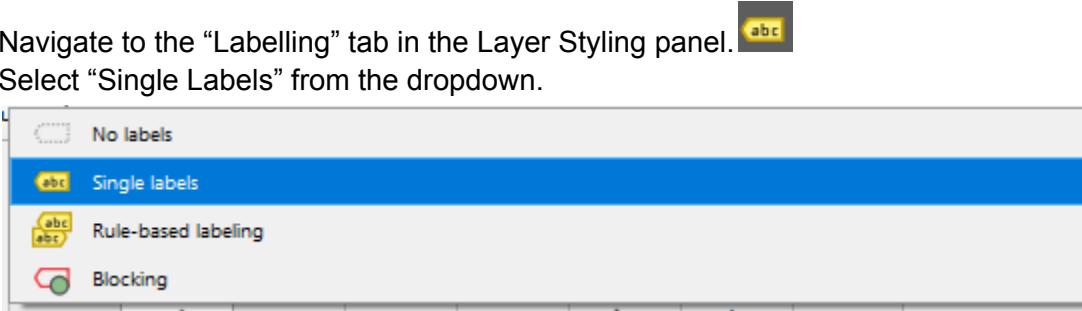


20. Now your features will only show up if you zoom in beyond that scale that you just set!

Module 9: Labelling

Now that you have various features in your map, you may want to label them for display or to keep track of all your places.

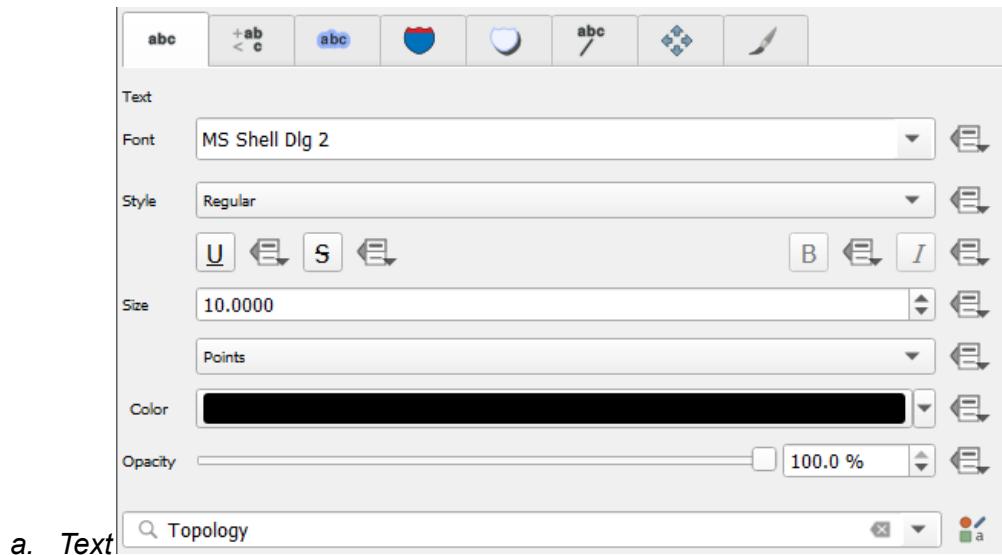
One of the most powerful functions of using GIS to make your maps is through the automatic labelling of your features based on set fields. You can label any kind of geometry. Since this method is universal across most of GIS, already-existing tutorials will explain how to label your features better than I can. Here are the basics:

1. Navigate to the “Labelling” tab in the Layer Styling panel.
2. Select “Single Labels” from the dropdown.

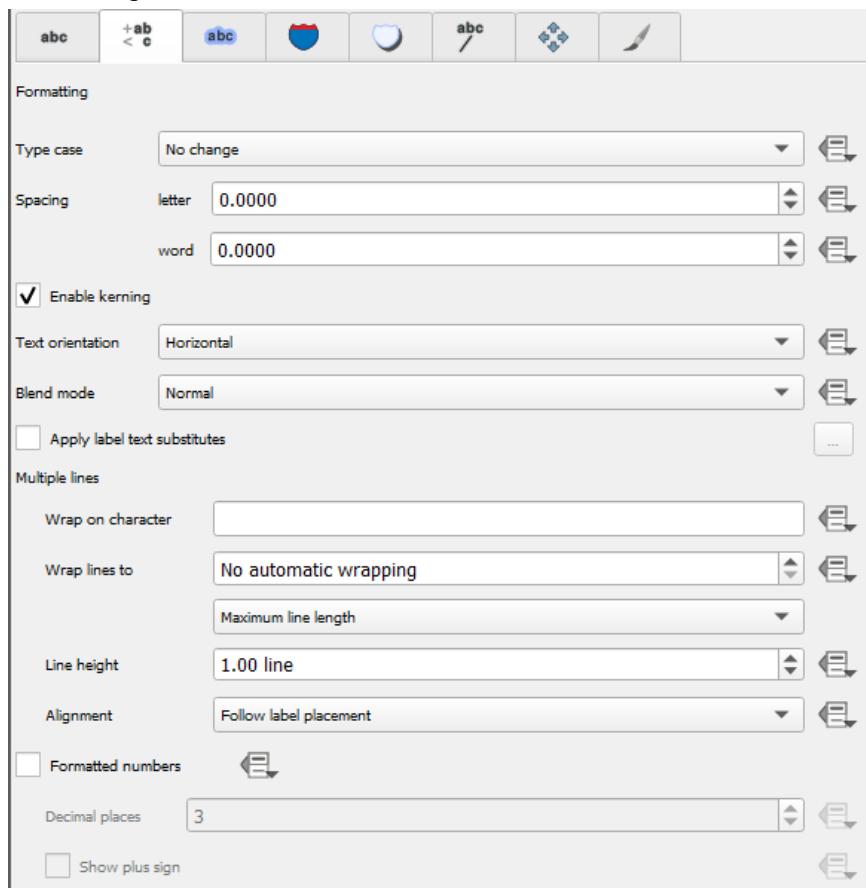
3. Select the field you want your labels to be based on.



4. Now let's look at the different tabs in the Label panel and what they do.

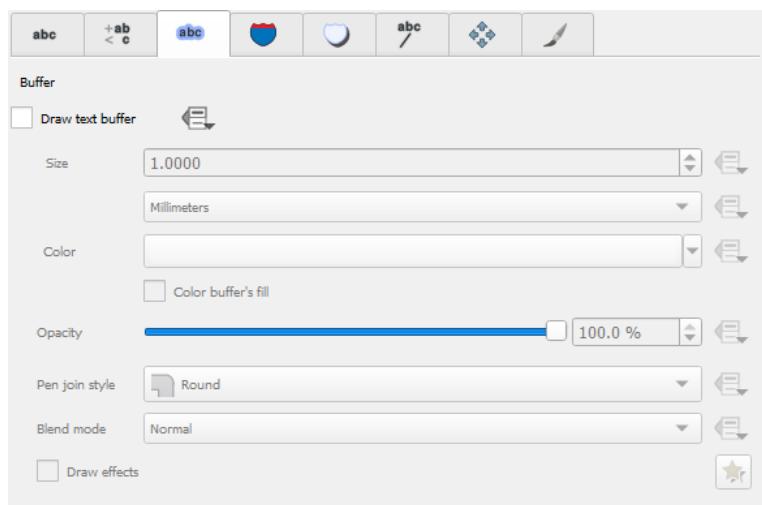


b. Formatting



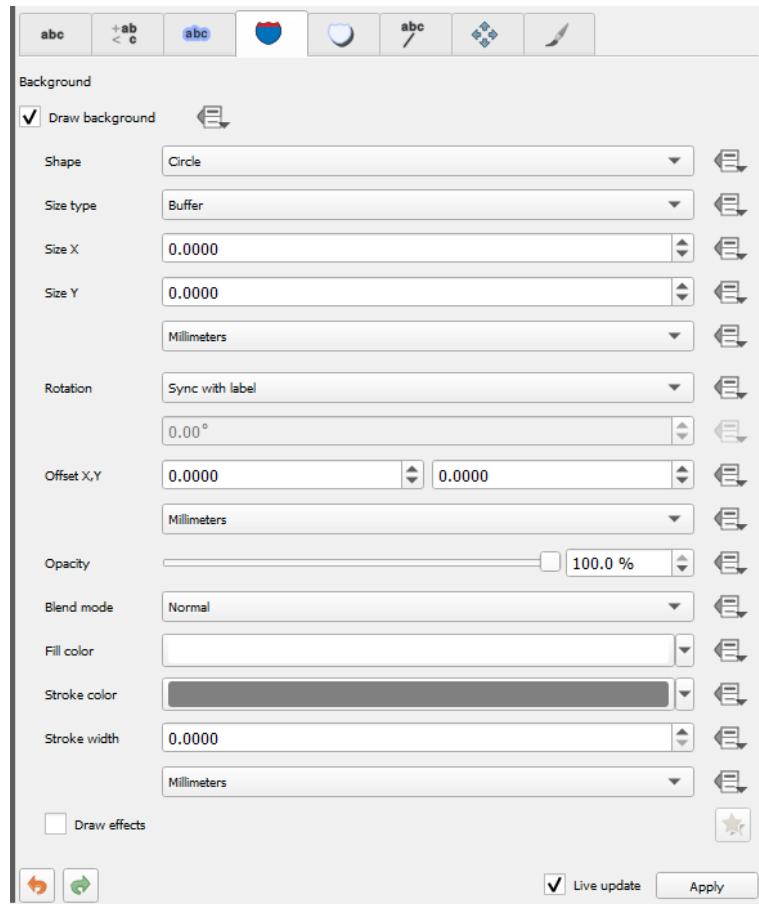
Adjust how your labels are formatted.

c. Buffer



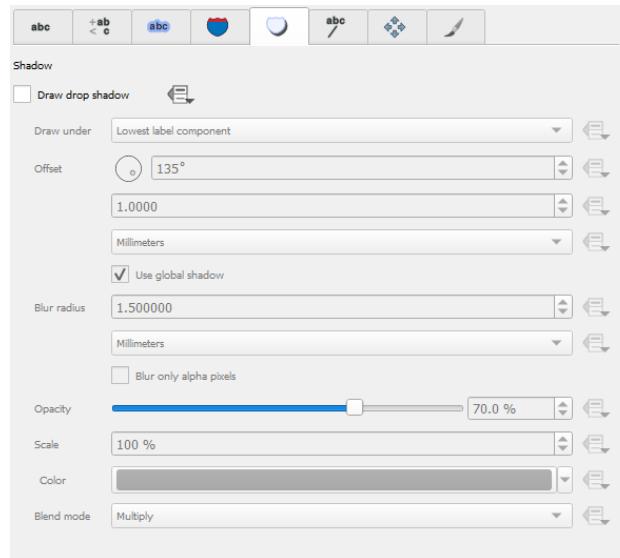
One some maps your labels may not be clear, depending on how many layers you have. You can use this tab to put a buffer behind the text, making them more visible.

d. Background



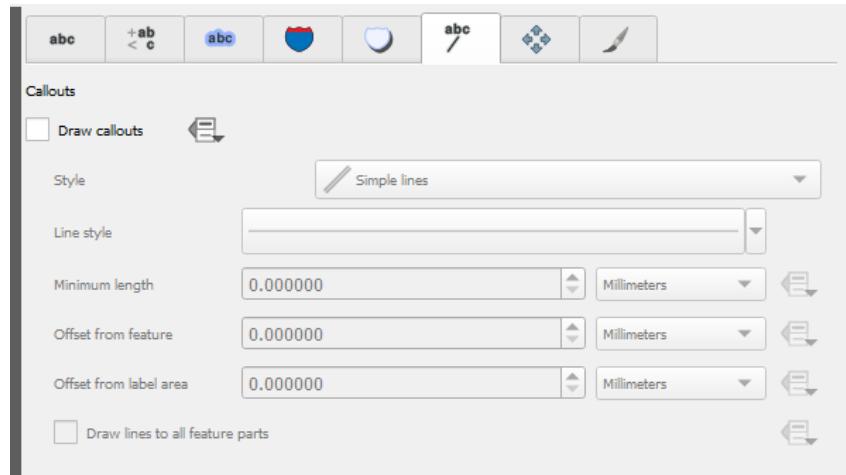
Similar to the Buffer, you can draw shapes and even insert objects and pictures behind your layer to aid in visibility or aesthetics.

e. Drop Shadow



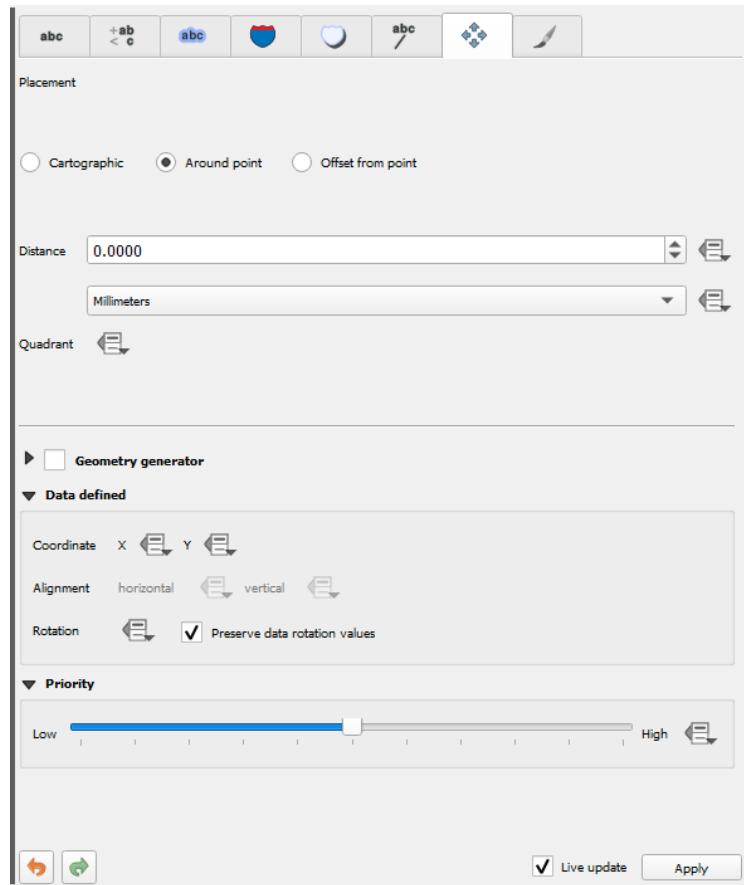
Insert a drop shadow under your label. Assists in visibility and aesthetics.

f. Callouts



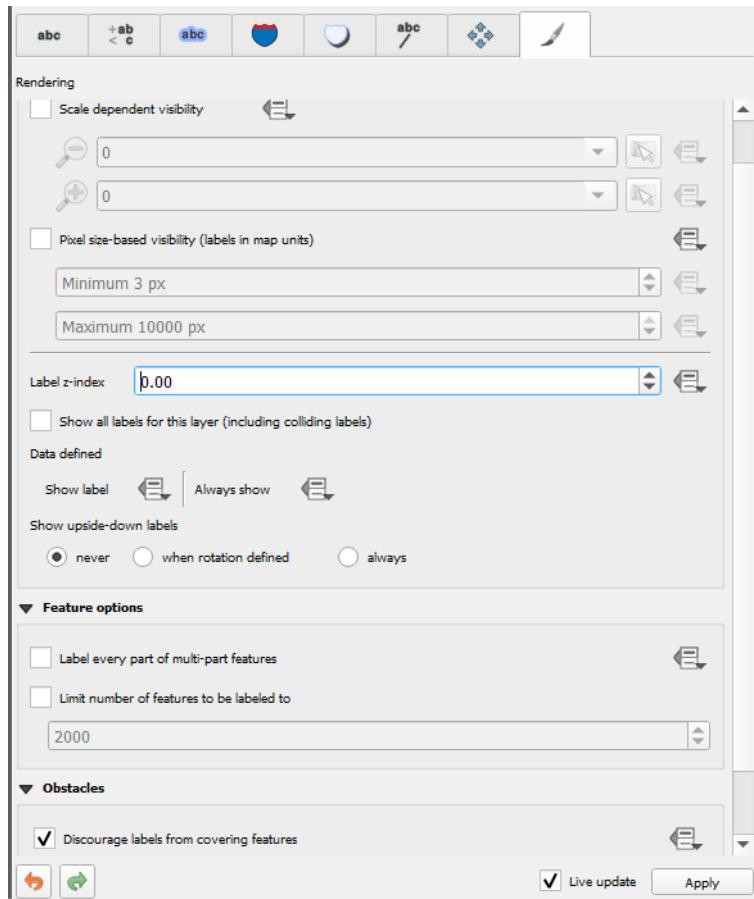
If your map is crowded, you may need to have a callout somewhat offset from your feature to show where it is.

g. Placement



This is one of the more important tabs for labelling. This will control how your labels are placed in relation to each other.

h. Rendering



Another important tab, *Rendering* lets you control when and where labels are rendered. Setting your rendering settings can help avoid labels cluttering your map.

There's your overview of the labelling panel! Labelling is a great way to identify features on your map. Here are some great tutorials:

[4.2. Lesson: The Label Tool](#)

[3.2. Lesson: Labels — QGIS Documentation documentation](#)

[Labelling features in QGIS with more than one column \(YouTube\)](#)

[Labeling - QGIS Quick Start Guide](#)

Module 10: The Fake Raster Method

During this whole tutorial, we've been working with Vector GIS, which stores geospatial information inside vector graphics. However, there's a whole nother dimension of GIS that's just as powerful: Raster, which stores geospatial information inside pixels, which form a grid. Each cell in this grid contains information about the land it covers. So if a raster cell has a resolution of 1 kilometer, that means that it will show information about a 1 square kilometer area on your map. GIS has found hundreds of ways to use rasters to portray information. A raster map which you've likely seen the most is satellite imagery, but there's a lot more. In this tutorial, we'll learn how to make a vector grid and then edit it to act and look like a raster map. This is because custom-editing raster images in QGIS is way too time consuming and tedious, and from the research I've done, nearly impossible. That is why I use the "Fake Raster Method", where I make a vector graphic look like a raster map.

You can method for nearly everything that rasters do, including:

- Elevation maps
- Biome maps
- Landuse/Landcover maps
- Rainfall and other climate maps
- Language maps
- Various statistical maps.

You can read more about raster and its uses here:

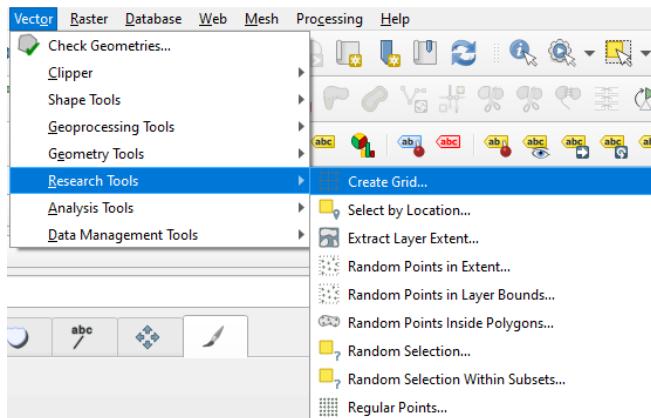
[Introduction to Raster Data – Introduction to Geospatial Concepts](#)

In this module I'll be switching from the tutorial map project I've been using to my personal project, so you'll see that the layers will be named differently and that the shapes will be different. This is just because creating and editing the grids is a computer-intensive process, and I already have them created in my personal project.

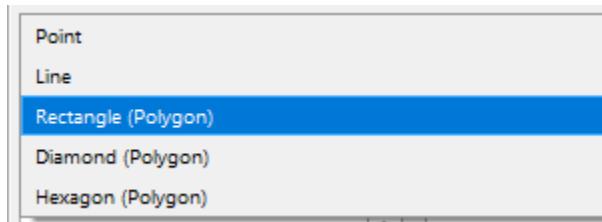
Making your Vector Grid

Note: This GeoProcess can be VERY taxing on your computer's memory, depending on how much it has and the resolution you set for your grid. If you built a gaming PC you should be fine, but a standard laptop may have trouble executing this process. Mitigating factors here are the size of your grid and how coarse (large cells) or fine (small cells) it is. If your world is about the size of our Earth, you can play it safe by specifying 10km cells.

1. Navigate to Vector → Research Tools → Create Grid in your Menu Bar



2. Set the "Grid Type" to "Rectangle"



**Note: If you're making a D&D Map you can select Hexagon and make a 5 foot grid over a very small extent*

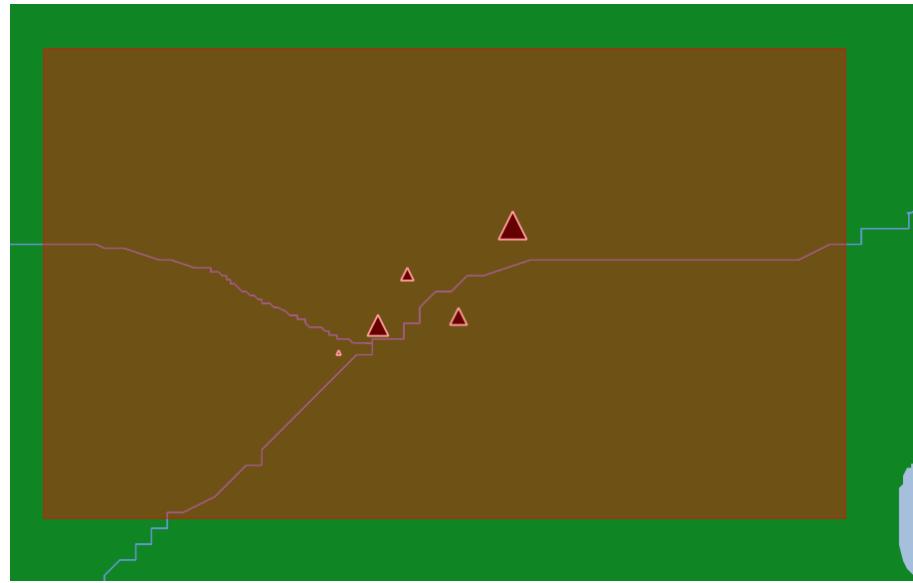
3. Set your grid extent by either:

- a. Drawing it on the map-- this is more suitable for smaller grids/extents.



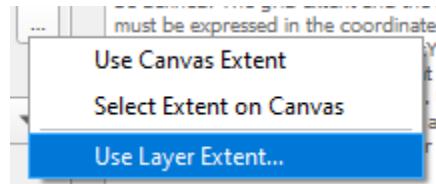
- i. Select your grid extent by left-click dragging your cursor across the map. Doing so will make a red rectangle appear, showing the extent you're

picking.

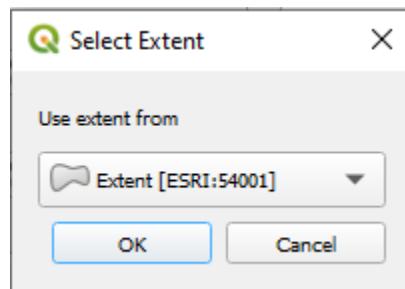


- b. Calculating the grid size based on a layer's extent. This is better for when you want your grid to cover your whole world. The trade off is that this will take more processing power and time.

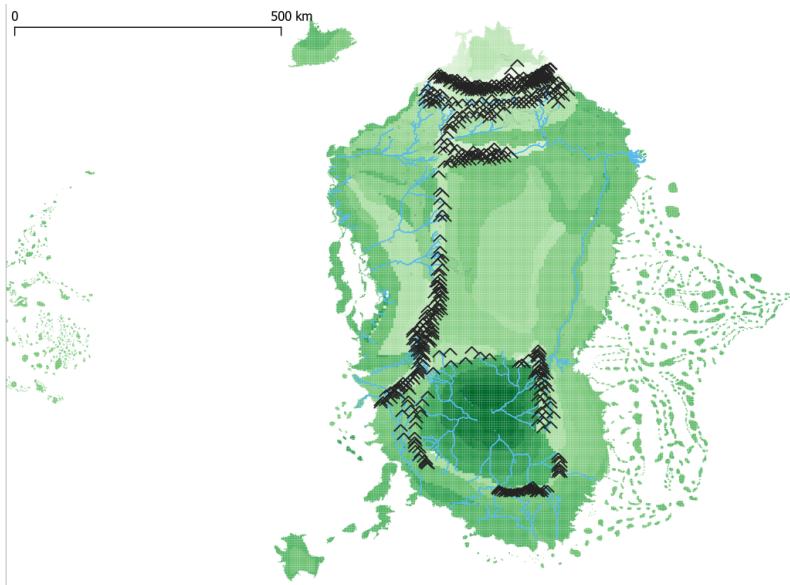
- i. Select “Use Layer Extent”



- ii. From the pick list, select your “Extent” layer and press “OK”.

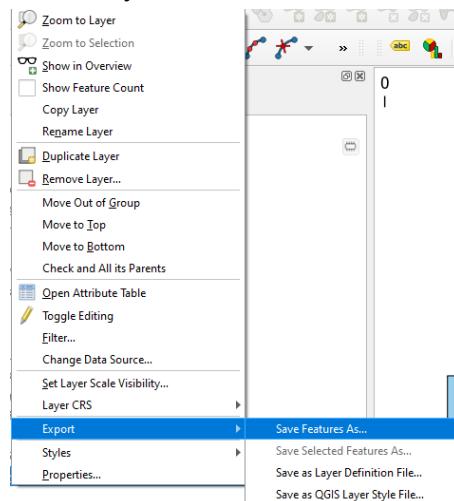


- 4. Select your Grid Size with the Horizontal/Vertical spacing controls. These control how tall and how wide your grid cells would be. For example, here is my topographic map from my personal project:



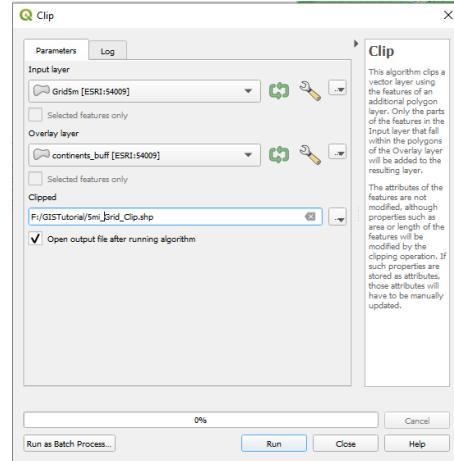
Each of the cells in this “Fake Raster” are 5km by 5km. My friend has a 24 core CPU and 64 GB of RAM on his computer, and was able to create this 5km grid in five minutes.

5. Select the Grid CRS. It should be the same as the rest of your layers. In this tutorial we have been using World_Plate_Carree.
6. Select your output. Save it to a shapefile with a general name like “5Km_Grid”. After you run the process you can export this layer into separate shapefiles for your different fake-raster layers.
 - a. You can do this after Step 8 as well. Simply right-click on your grid layer and navigate to Export → Save Features As. You can then copy this file as many times as you’d like.



7. Press “Run”. This may take a while depending on your computer.
8. If you want your grid to render faster, and are mostly concerned with what’s going on land, clip it to your continents layer. This will remove all of the cells in the ocean where you won’t need them.

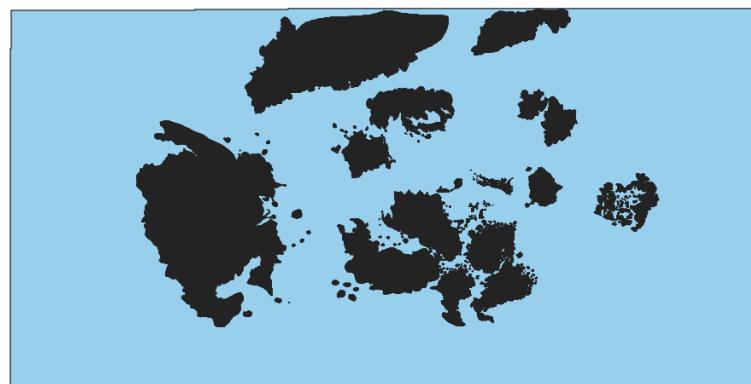
- Navigate to Vector → Geoprocessing → Clip
- Set the Input layer to be your grid layer
- And set the Overlay layer to be your Continents or Landmass layer
- Set your output layer in “Clipped”



- Here's an example of what happens should you choose to run this process:
 - Here is the 5 Mile grid in my personal project, before I clipped it, it had been rendering for about five minutes before I took this screenshot:



- Here is the 5 Mile grid in my personal project after I clipped it, it took under a minute to render:



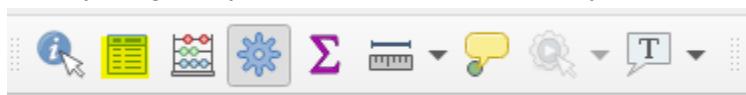
Editing your Vector Grid

Luckily, editing a vector grid is *VERY* easy. All you need to do is select your desired cells, then put in their value in your attribute table. You can streamline this even more by defining a value field for the layer. In a value map, you can add a coded value which automatically changes. For example:

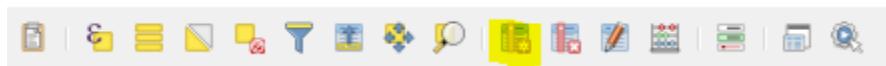
Value Map for Biomes	
Input Value (or what you type into the attribute field)	Output Value (or what will show up in the attribute table/your legend)
1	Temperate Grassland
2	Temperate Forest
3	Steppe
4	Taiga
5	Tundra
6	Tropical Rainforest
7	Tropical Shrubland
8	Desert

Creating a Value Map

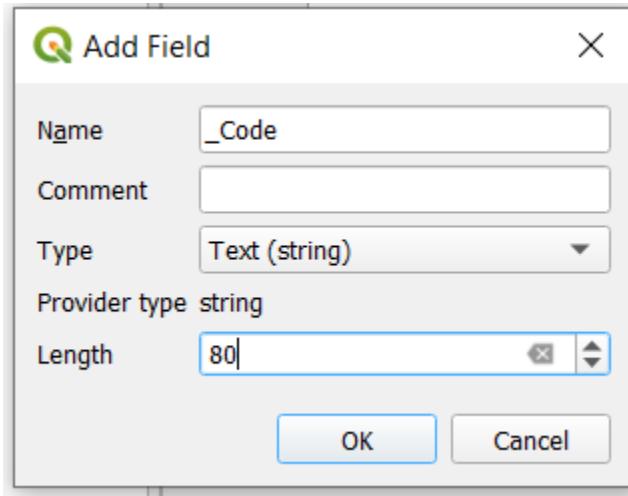
9. Toggle editing on your grid layer
10. Open your grid layer's attribute table (this may take a minute if it wasn't clipped)



11. Add a new field

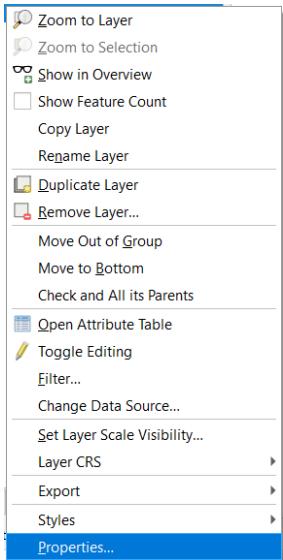


- a. Give your field a name like *blank_code* (*biome_code*, *elev_code*), set the data Type to string, and set the field length to 80



- b. Press "OK"

12. Open your Layer Properties by right-clicking on your layer in the "Layers" panel and left-click "Properties"



13. Navigate to the "Manage Custom Forms and Field Editor Configuration" tab



14. Select the field you just made

Available Widgets

- ▼ Fields
 - 1.2 fid
 - 1.2 id
 - 1.2 left
 - 1.2 top
 - 1.2 right
 - 1.2 bottom
 - 123 BiomeCode
- ▼ Relations
- ▼ Other Widgets
 - QML Widget
 - HTML Widget

15. Set your widget type to “Value Map”

	Value	Description
1	1	Ice Cap
2	2	Tundra
3	3	Taiga
4	4	Semi-Arid Desert
5	5	Hot and Dry Desert

16. Now you can either load in your Value Map from a CSV file

a. Making a CSV is easy. Most spreadsheet programs (Excel, Google Sheets, Libreoffice Calc) will let you export your spreadsheet as a .csv

17. Or you can manually enter it in. You don't have to use numbers-- you can also use abbreviations.

18. When you have all your codes in left-click “OK”.

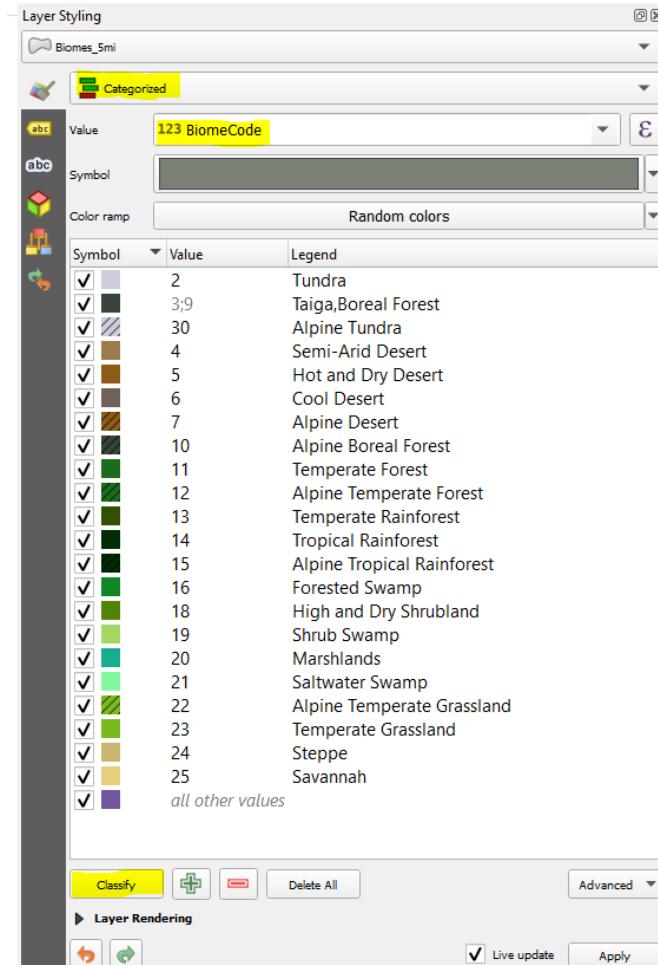
19. Making a value map will ensure consistency in your layer.

20. To make sure you know where you're entering values for, set a palate for your layer based on the Value Map you just made, or turn on labelling to be for the _____ Code.

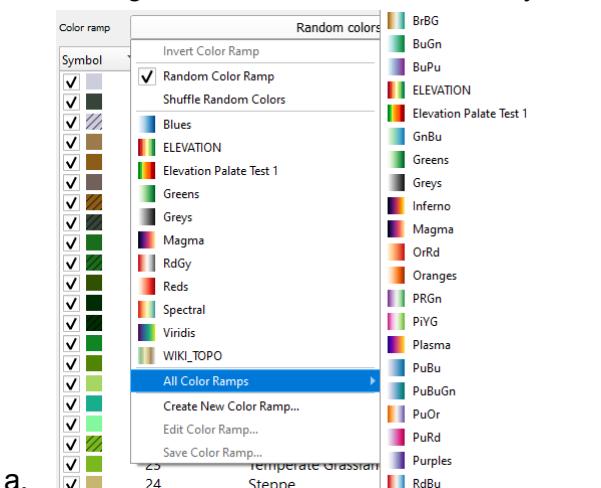
Symbolizing your layer based on your value map

Symbolizing your layer now is easy and will help you keep track of the cells that you've already entered values for

21. Navigate to the “Layer Styling” panel for your grid layer.
22. Set the symbology method to “Categories”
23. Now left-click “Classify”. Since you’ve already defined your value map, the list will populate even if you haven’t assigned any actual values to any cells.



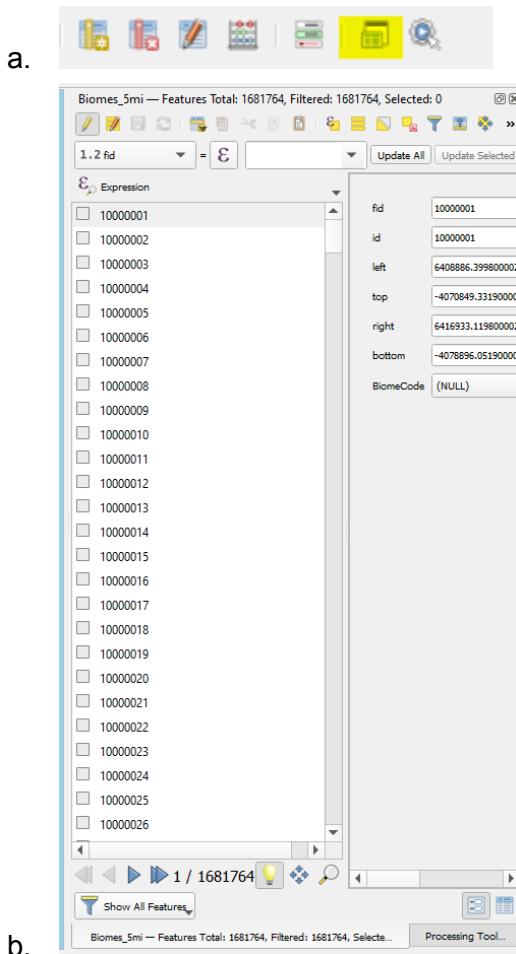
24. See [Manually Choosing Each Symbol](#) to individually change these symbols. You can also select a gradient for *continuous data*, by choosing a color ramp:



Entering in Values

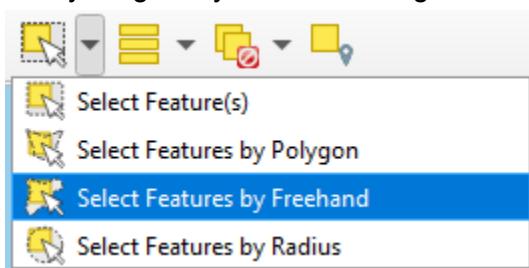
To edit a large amount of values, we will use the Attribute Table's Field Calculator.

25. Keep your attribute table open. You can even dock it to your display

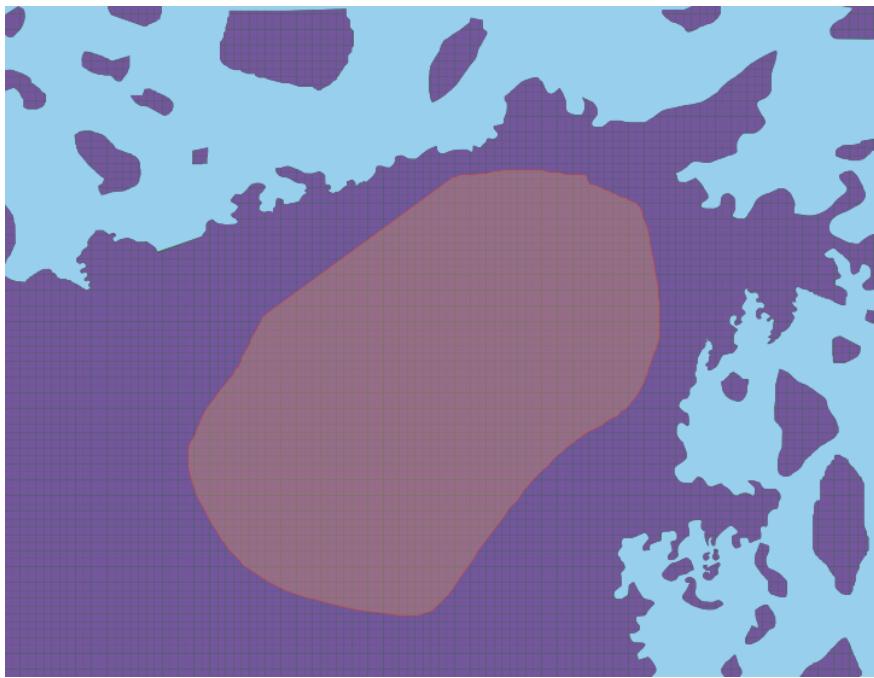


b.

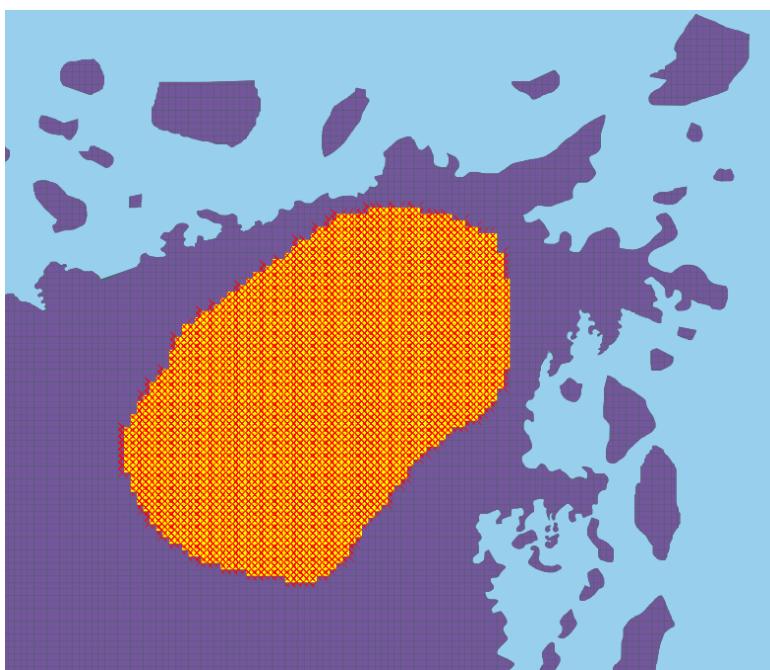
26. With your grid layer still in editing mode, select “Freehand Selection”



27. Select the pixels that you want to represent one biome, or one elevation type

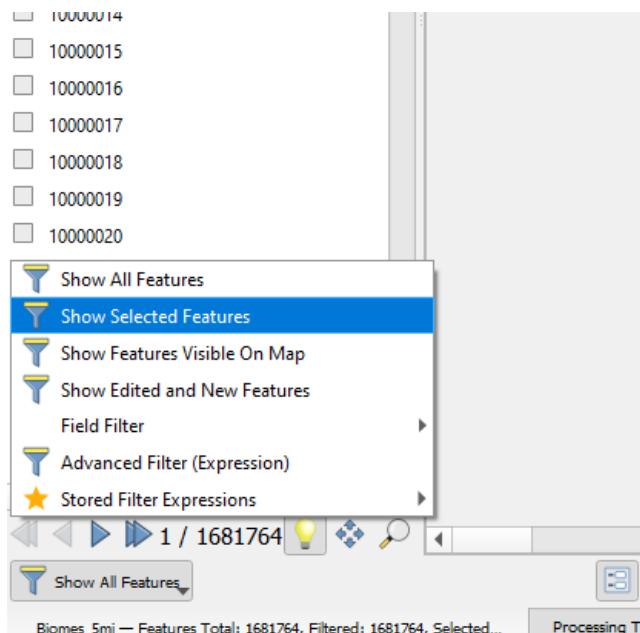


The selection area

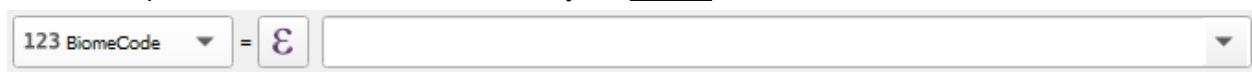


The selected cells.

28. In your attribute table, filter how many features are displayed by selecting “Show selected features”



29. Set the dropdown on this calculation bar to your _____ Code Field.

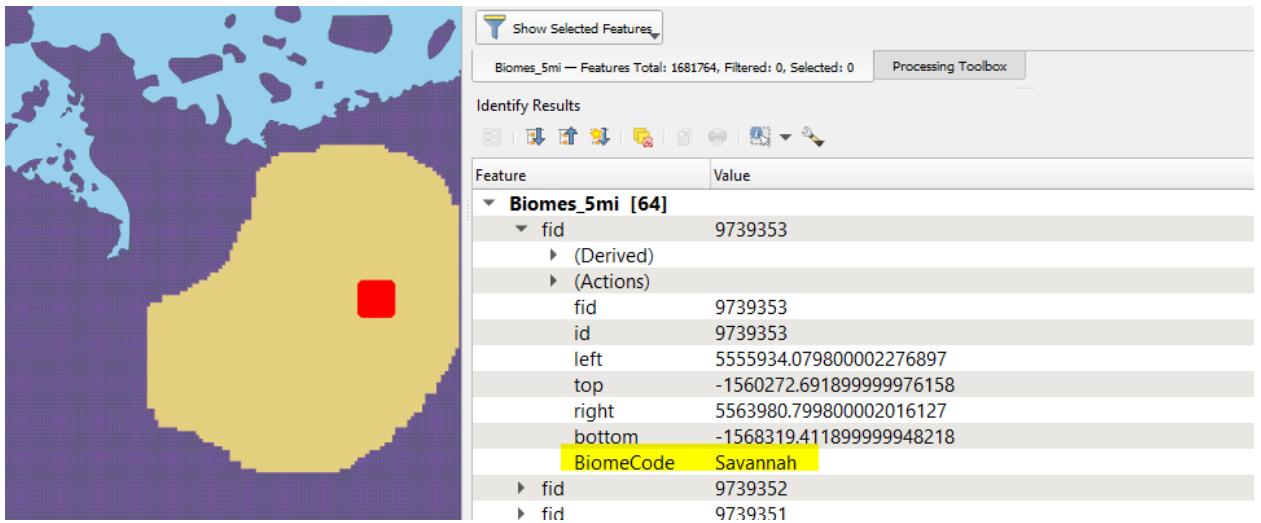


30. And in the white bar type in the code associated with the value I want. I want to make this area a Savannah biome, so I'm going to enter the number 25.

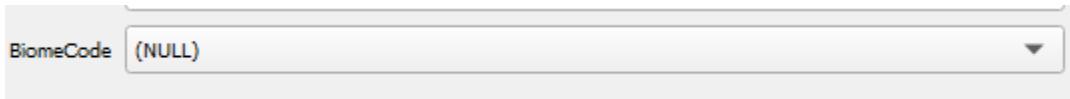
31. Now left-click “Update Selected”



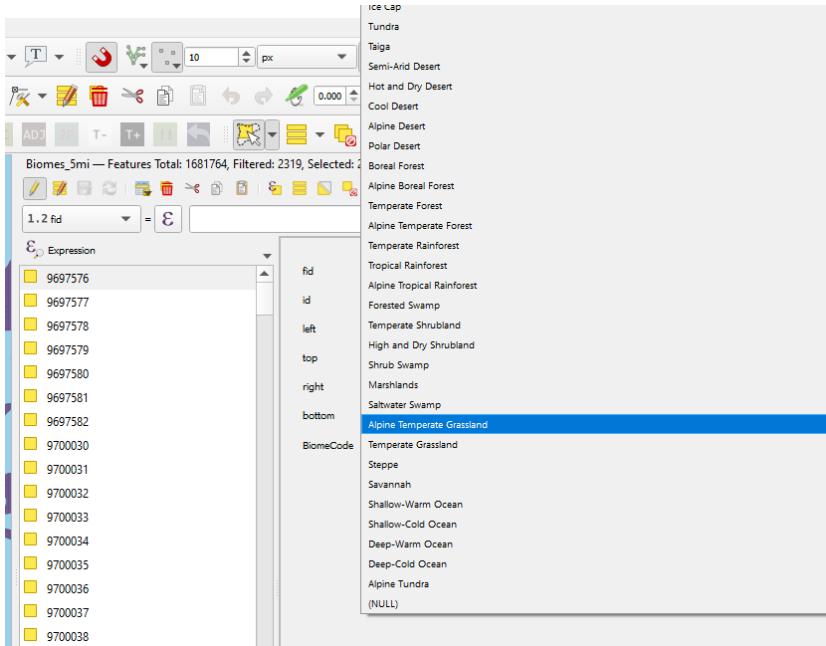
32. It may take a minute, but now all the fields that you selected will be represented by that number.



33. If you want to change just one feature, select it and then click your “_____Code” dropdown



34. And select your desired biome, elevation bin, etc!



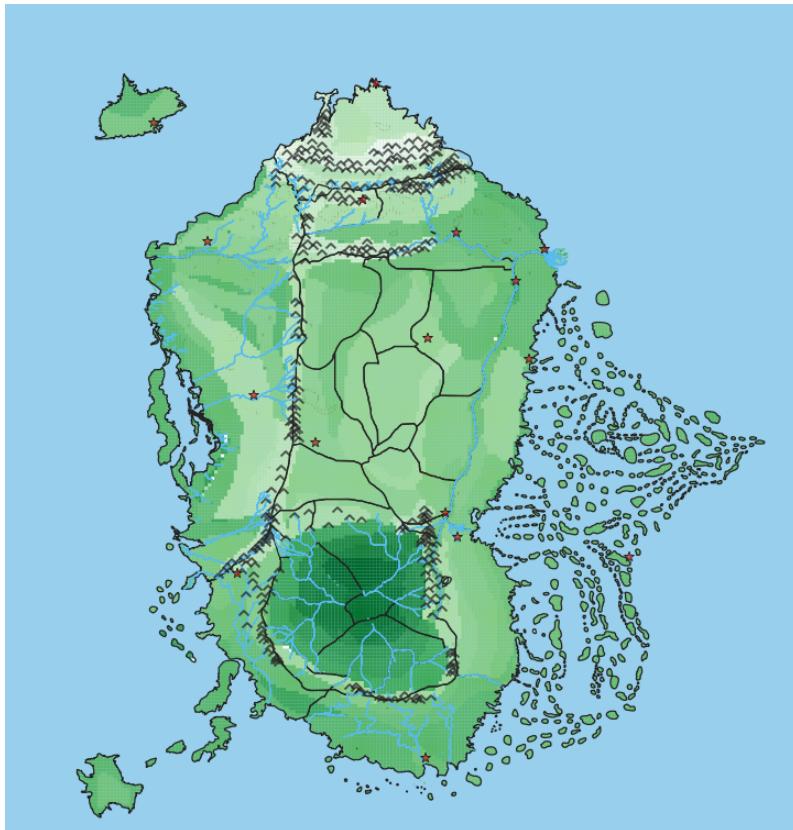
35. Repeat this process with all the pixels and layers you'd like, and be sure to save your layer edits often!

Module 11: Map Compositions

Preparing your Layers for your Map Composition and Creating a Layout

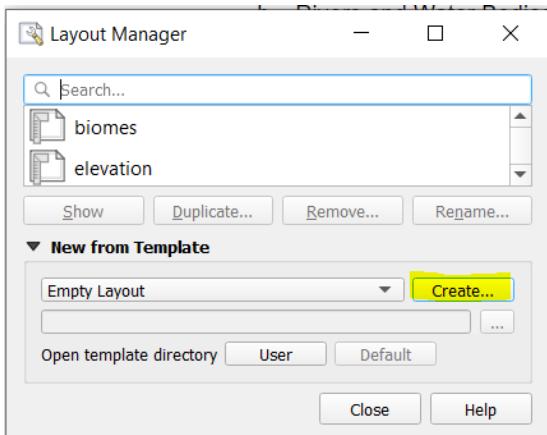
Now you have a whole bunch of layers! Let's make a pretty map!

1. Start by turning off any layers that you don't want to show up in your map, by "unchecked" them in the "Layers" Panel. I'm using the following layers in my map:
 - a. Political Boundaries
 - b. Rivers and Water Bodies
 - c. Capital Cities
 - d. Mountains
2. Set the symbology of each layer so that they complement each other well on the map.

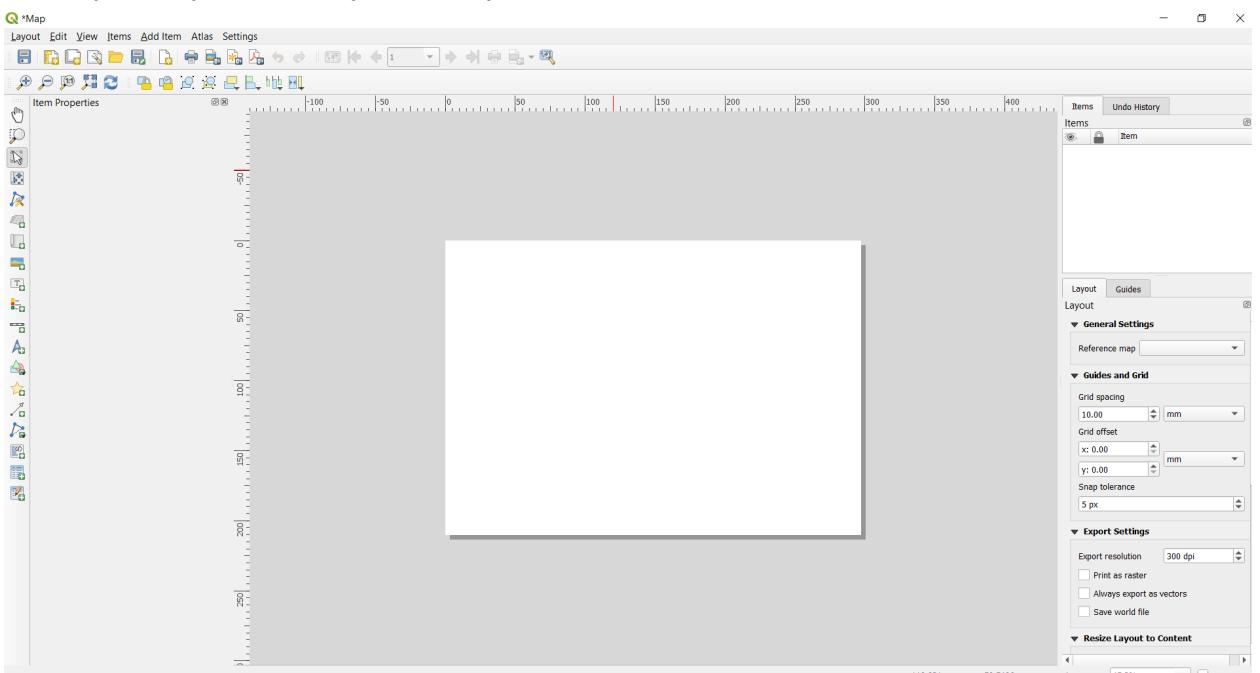


3. Now open your "Layout Manager" 

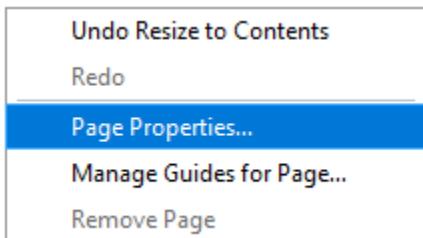
4. Create a new Layout



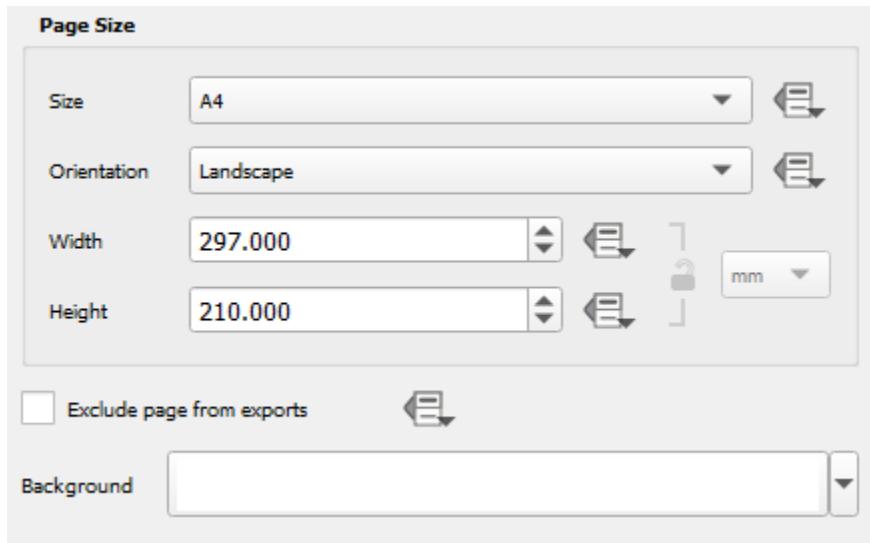
5. This is your Layout, where you make your map composition:



6. By default, your map composition will appear in size A4 and Landscape orientation. If you want to change this, right click on the blank map and click “Page Properties”



Here you can choose between a variety of page sizes, between Portrait and Landscape Orientation, and even choose a background color for your map.



Adding your Map

7. Left-click “Add Map” and then drag across the screen the area you want your map to cover.



- As you drag, a red rectangle will show where your map will appear



- And when you release the left button on your mouse, your map will render in that area.



You can use the white squares to resize your map frame.

10. You can adjust the scope of this map frame by adjusting your map canvas in QGIS. Find the scale and positioning your want for your features, then press “Set Map Extent to Match Canvas Extent” or “Set Map Extent to Match Canvas Scale”



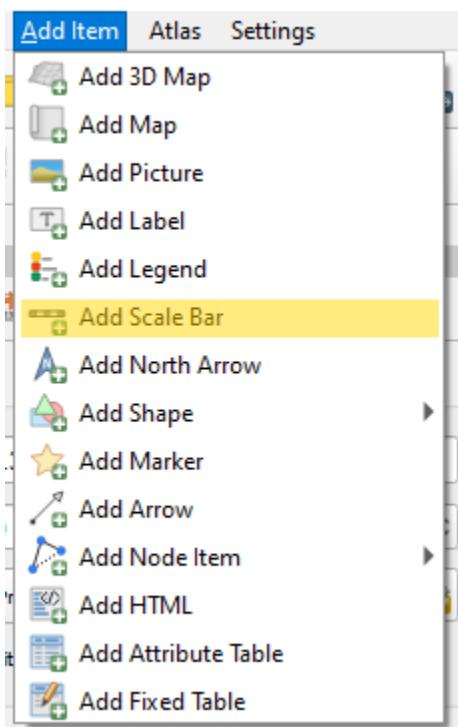
You may need to tinker with your zoom and extent a little before you find one that you like.

Adding your Map Elements

Map elements are important contextual clues that will help your audience better understand your map. These include Scale Bars, North Arrows, Legends, Inset Maps, and even shapes, labels, and callouts. At the very least, every map should include a Scale Bar and Legend.

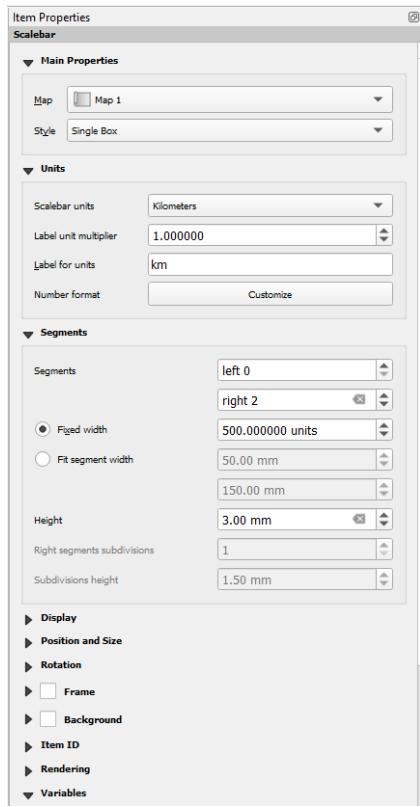
Adding a Scale Bar

11. Navigate to “Add Item”, then Left-Click “Add Scale Bar”



12. Left click and drag your cursor over the area where you want your scale bar to be, and just like when you added your map, a scale bar will render when you release.

13. If you left-click on your rendered scale bar, its properties will show up in your “Item Properties” panel.



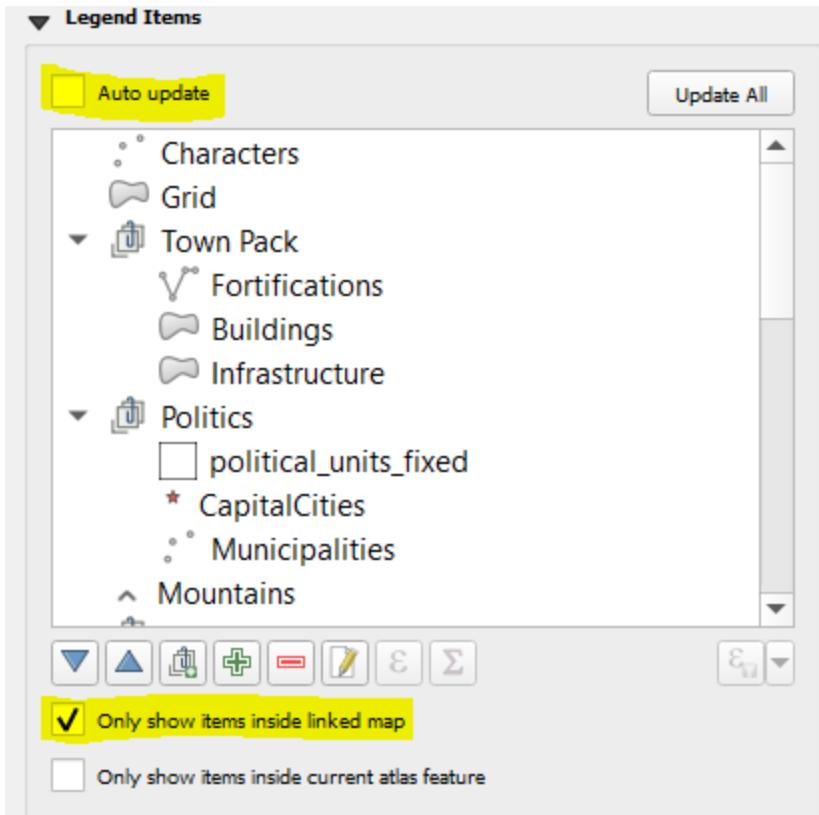
In this panel, you can set which map your scale bar is based on, what the scale bar looks like, how long it is, and how it's displayed.

Adding a North Arrow

14. Again navigate to the “Add Item” menu, and this time select “Add North Arrow” from the list.
15. Drag it over the area you want it to be, and release.
16. Just like with the scale bar, you can adjust where the properties of the North Arrow by left-clicking it.

Adding and Configuring your Legend

17. Add Item → Add Map Legend
18. In the Item Properties for your Legend, untoggle “Auto Update”. This will give you direct control over which items are in the legend.
19. Also toggle “Only show items inside linked map”.



20. You can also edit individual legend items by highlighting them in this “Legend Item” tab and then clicking “Edit Selected Item Properties”.
21. Use the “Columns” dropdown to add more columns to your legend, giving it more space.

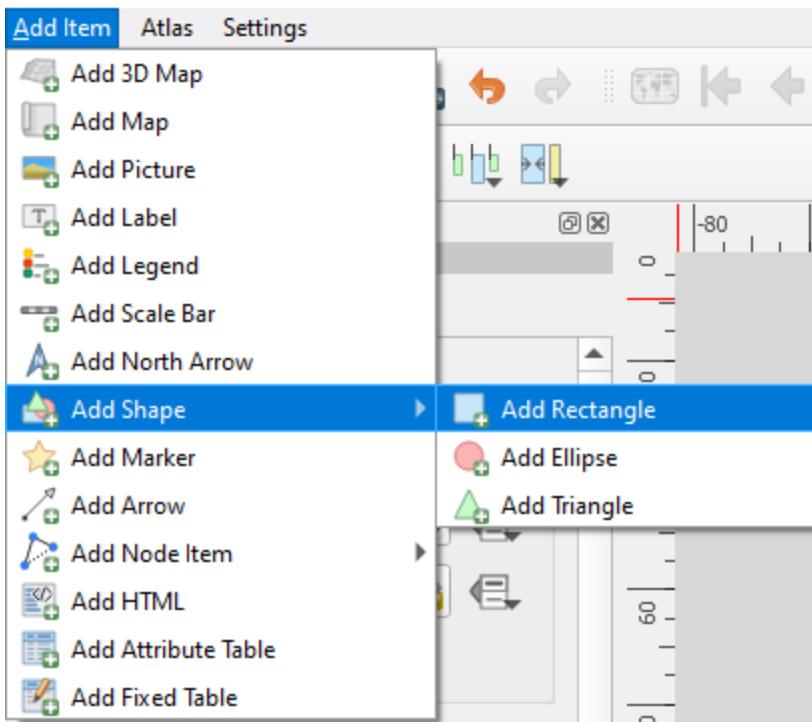
Adding an Inset Map

If your map is just a small region in the world, it may help to add an inset map to show where this area is on a larger scale.

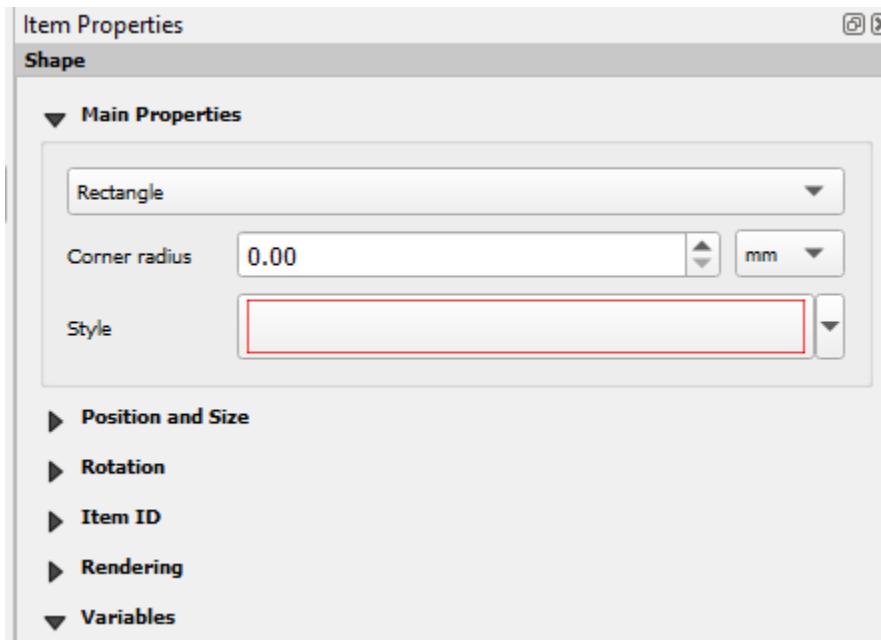
22. Select “Add Map” again and drag it over a smaller area in your screen.
23. Before you set the scale and extent to match your map canvas, make sure that this new inset map is highlighted instead of your main map (it will be called “Map 2” in your Items List)



24. Adjust the scale and extent so that a larger view of your world is shown.
25. You can even draw a shape around your inset map showing the focus of your current map by navigating to Add Item → Add Shape → Add Rectangle



26. Once you draw it, you can change how it's displayed by clicking "Style"



Adding a Title

27. Before you export this map, be sure to give it a descriptive title!
28. Add Item → Add Label
29. Draw the area you want it around
30. Now set the text of the label in your Item Properties panel



Exporting your Map

In QGIS, you can export your map composition in many formats. PDF, JPG, PNG, SVG, etc...



31.

The leftmost button will print it.

The second to left button will open a dialogue for you to export it as an image.

The second to right button will open a dialogue for you to export it as a SVG

The rightmost button will open a dialogue to export your map as a PDF.

Module 12: Wrapping your Map to a 3D Globe

Many people find it useful to view their maps on a globe-- to get a feel for scale, distance, area, and direction without having those features be distorted by whichever projection you use.

So far, I've found two ways to effectively do this. Both of these methods will allow you to rotate, zoom, and adjust the lighting on your globe.

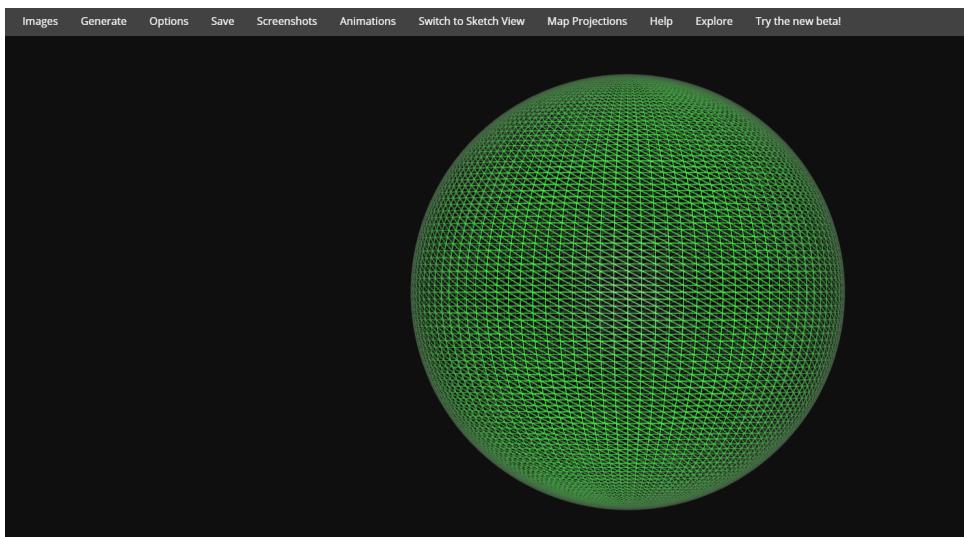
Method A: Map to Globe

MaptoGlobe.com is a great website to project your map onto a three-dimensional globe. It's fairly simple to use, but has some constraints.

- a. Your map must be a raster image.
- b. This image must be in an equirectangular (Plate Carree) projection

However, you can upload several of these maps which will be layered and composited together, making a very realistic globe if you so desire.

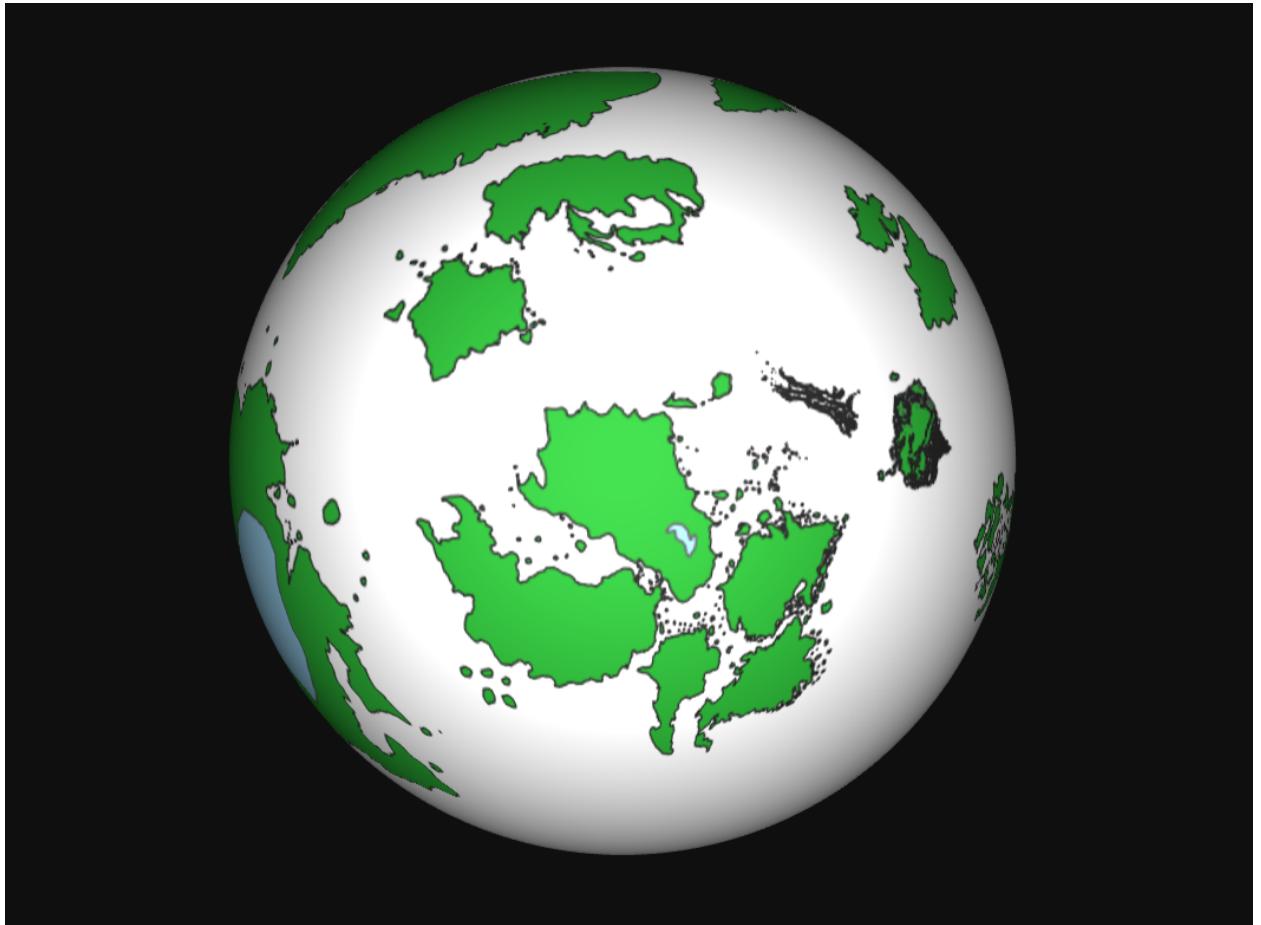
1. Go to MaptoGlobe.com and click "Images", the left-most button



2. Upload your desired images. You only need the "Surface" image to continue.

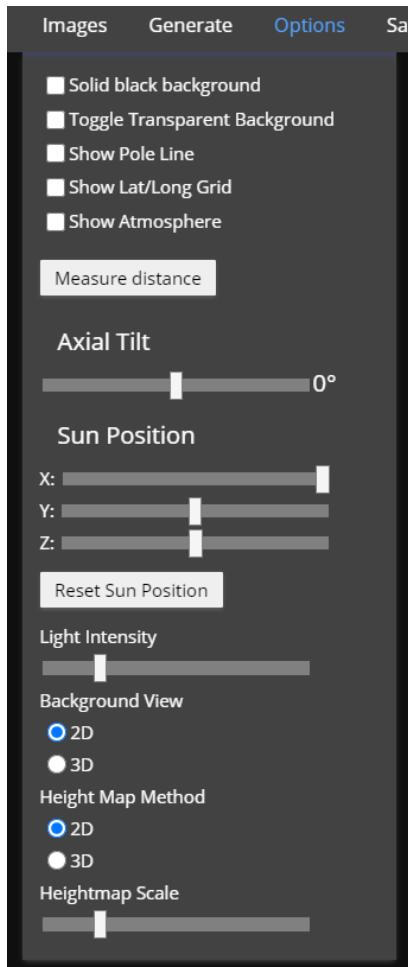


3. When you upload it, you'll be immediately brought to the globe view to view your map projected onto a globe.

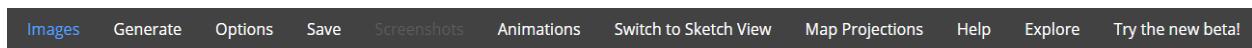


(This is just a quick screenshot I made off my vector, I didn't have my oceans layer enabled)

4. In the options menu, you can adjust a variety of settings, including the lighting, various visual decorations, and how you want heightmap data to be displayed. You can also measure distance in this menu.



5. Looking at the other tabs (they're not as relevant to this tutorial):

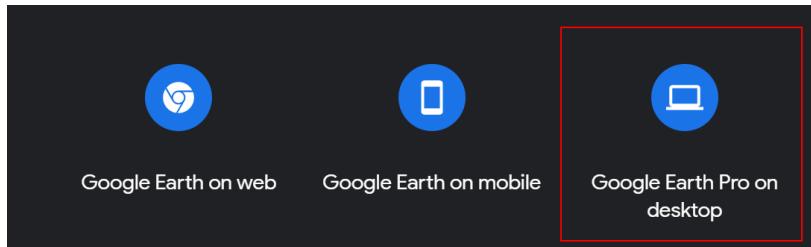


- Generate will randomly generate a map based on some settings you input
- Save will save your map and settings
- You can use Animations to create gifs and videos of your planet rotating.
- Sketch view lets you draw your own map in the website.
- If you go to the Map Projections tab, you can display your map in a variety of different projections. Keep in mind that this slide won't reproject a vector file, it'll just show you what your map looks like in different projections.

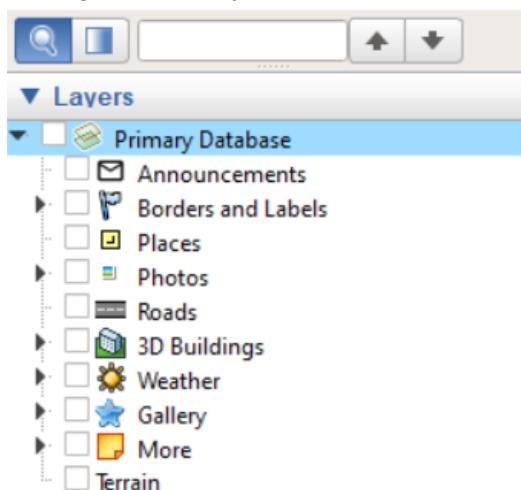
Method B: Using Google Earth Pro

Google Earth allows you to insert your own GIS files in any projection, which it then wraps around its globe. While this feature is meant for overlaying data on top of their satellite imagery, you can use this method to put your own world on a globe. The constraint here is that your world will need to be the same size as earth however, or you will risk distortion.

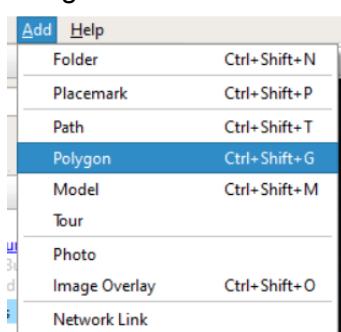
1. If you do not already have Google Earth Pro installed on your computer, follow this link: <https://www.google.com/earth/versions/> and select the option for “Google Earth Pro on Desktop



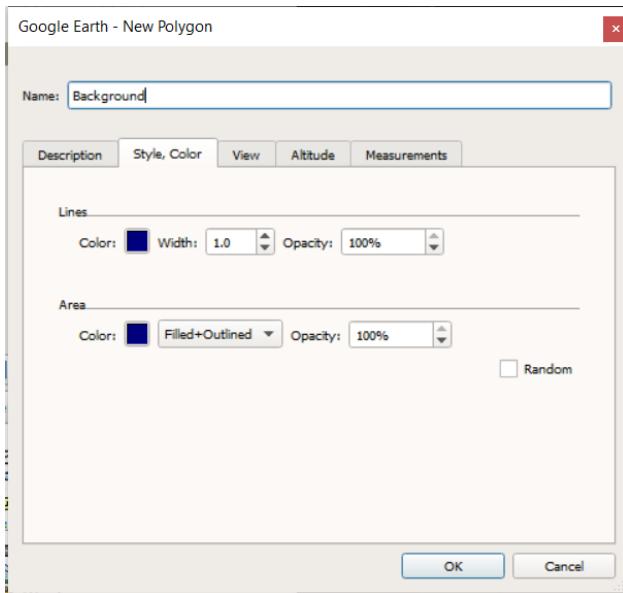
2. When you open Google Earth, you'll see that the satellite imagery is on. While you can't turn that off, I found a trick to help you get a blank blue planet.
3. First, go to the Layers menu and turn off every layer.



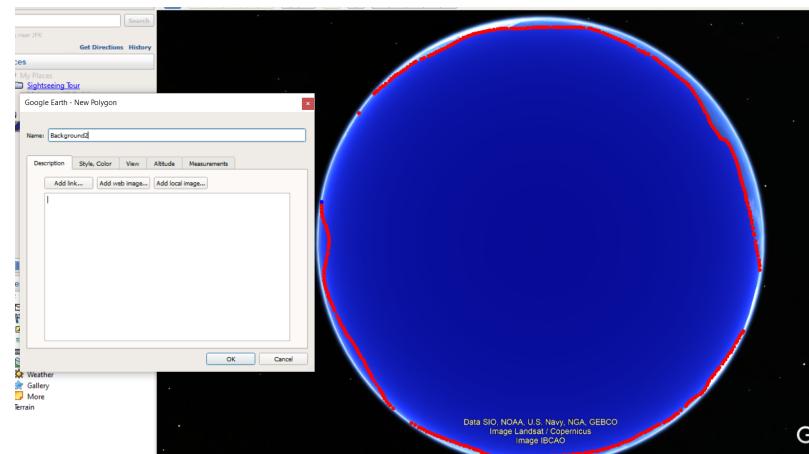
4. Now the only layer left will be the satellite imagery. While you can't disable that layer, you can cover it with a polygon.
5. Navigate to the Menu Bar and select Add → Polygon



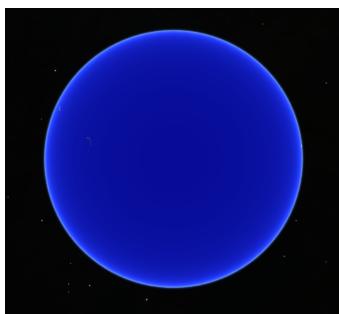
6. Navigate to the “Color” tab and set your lines and fill to a dark blue.



7. Carefully click and drag around the perimeter of the planet. Just like in QGIS, you'll see a preview of what your polygon will look like. To delete a vertex you just made, right-click.

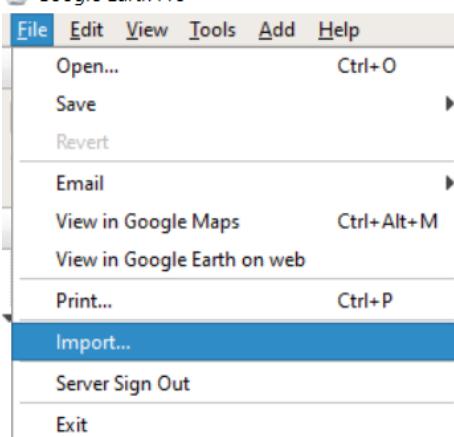


8. Now repeat this process on all the other areas. Since I'm still getting used to this I was a little sloppy and it took about 10 polygons to completely cover the earth.
9. After some patching, you will now have a blank planet!



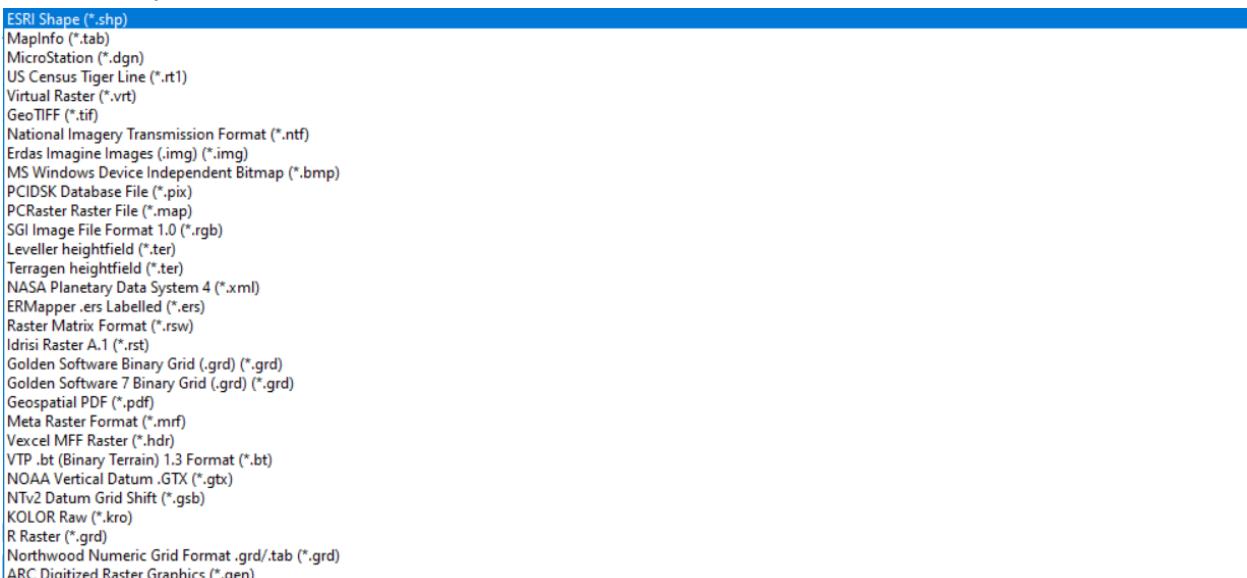
10. Now let's add some layers!

11. File → Import



12. Navigating here will open the file explorer.

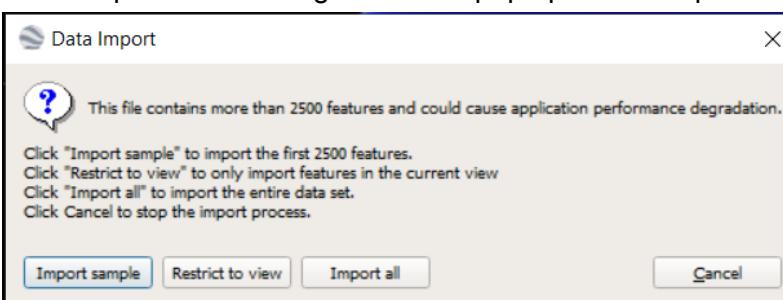
13. Set the file type to ESRI Shapefile



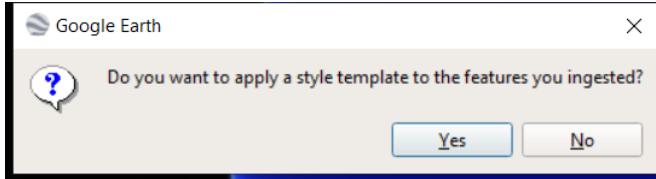
(You can also add georeferenced rasters)

14. Now select your Continents layer. Google Earth doesn't let you manipulate the viewing order of your layers, so you'll need to select them in order of bottommost-topmost layer.

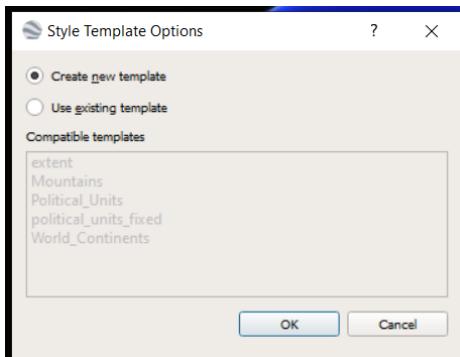
15. Press "Open". This dialogue box will pop up. Click "Import All"



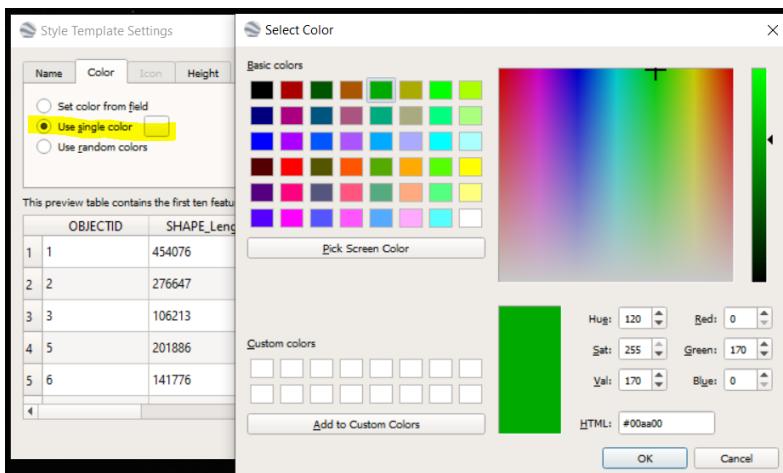
16. Press "Yes" to set the symbology for this layer.



17. Create New Template

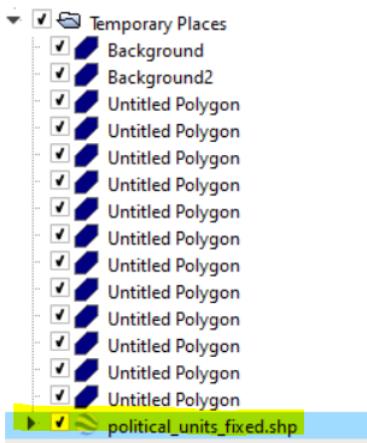


18. Navigate to the “Color Tab”, select “Use Single Color”, and choose a forest green.

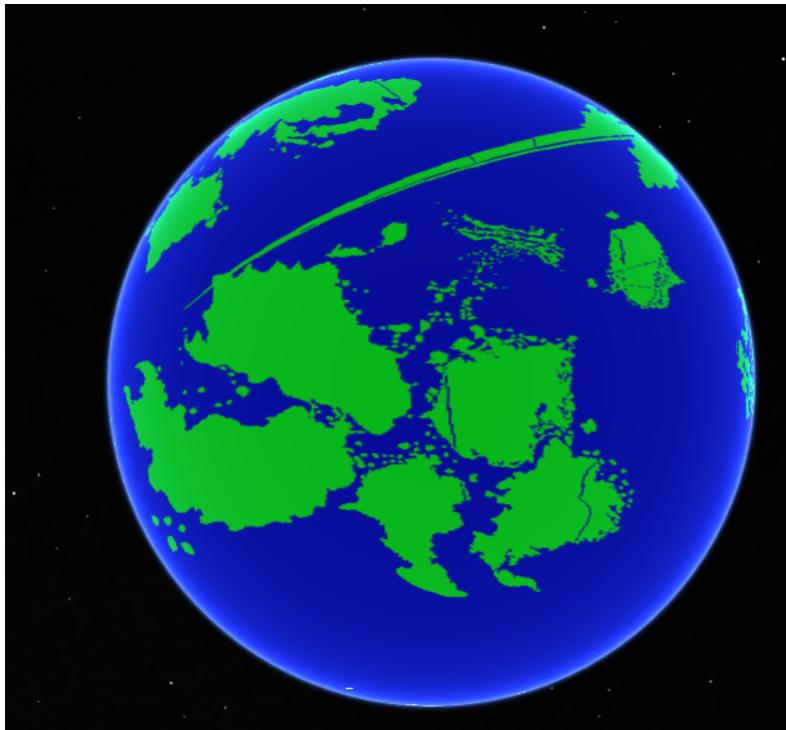


19. Confirm all your options by pressing “OK”, then give your template a name when the dialogue prompts you to.

20. In your layers tab, toggle the checkbox for the layer and it will become visible!



21. And you can now view your world overlaid on earth!



Since this is vector you can zoom in to your heart's content!

In this image you can also see where I messed up in the dimensions of my world-- there is severe distortion which I will need to address as I work more on this.

Feedback

If you have the time, please consider taking five minutes to fill out this assessment of this tutorial, so I can improve it :)

[Link to Google Form](#)