

Introduction to QGIS



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Disclaimer:

I make no claims to any software, operating systems, companies, or programming languages.

I only lay claim to the cat pictured below.



Data:

Data was downloaded from the State of Hawaii, Office of Planning.

- <http://planning.hawaii.gov/gis/download-gis-data/>

This data is not warrantied. If you use it and accidentally drive into a volcano or find an ancient tiki idol and are struck by unexplainable bad luck.....well.....you were warned.

A Brief History.....

- Project began in 2002 as a GIS data viewer but has evolved into a fully functioning GIS Desktop that is Open Source
- Before the 2.0 release it was known as Quantum GIS and you will still hear people call it that
- Installation comes in 3 flavors - standalone and advanced for windows and packages for Linux:
- Operating Systems Supported:

Windows Mac Linuxand Android



- *Open Source: GNU General Public License (GPL) “which guarantees end users (individuals, organizations, companies) the freedoms to use, study, share (copy), and modify the software.[1]*

What does it do? A Lot!

- **View data** – vector (SHP, MapInfo, SDTS, OGR[2] Simple Features Library and more); raster (GeoTiff, IMG, ArcInfo Grid, JPEG, PNG and more – anything supported by GDAL); GRASS raster and vector data; online data served as web services (WMS, WMTS, WCS, WFS, WFS-T, etc...)
- **Explore data** – QGIS Browser (think ArcCatalog); on-the-fly reprojections; identify and selection tools; annotation and labeling; edit/view/search attributes; save and restore projects
- **Create, edit, manage and export data** – digitizing vector data (OGR and GRASS formats); create and edit SHP and GRASS data; Georeference images (with plugin); GPS data tools; visualize and download OSM data; Export to PostGIS and Spatialite Databases

[2] "GDAL: FAQ - General". <http://trac.osgeo.org/gdal/wiki/FAQGeneral>. Retrieved 06 November 2013

Intro to QGIS

Main topics covered during the workshop

I. Navigating the Interface

II. Project Configuration

III. Analysis

IV. Print Composer

Intro to QGIS

Main topics covered during the workshop

Topics:

- QGIS Interface
- QGIS Browser
- Saving QGIS Files

Navigating the Interface



Desktop - the main QGIS Interface will look and feel similar to ESRI's ArcMap and several other GIS Desktop Programs.



Browser - the (data) browser can be accessed either from within Desktop as a panel or by using the Browser icon that will open a standalone version. This feature resembles ESRI's ArcCatalog except with more limited functions for reviewing data

Exercise 1

1. On your Desktop, look for the QGIS Desktop icon and double click on it to open. It is recommended you keep QGIS open at all times going forward so you can explore the interface

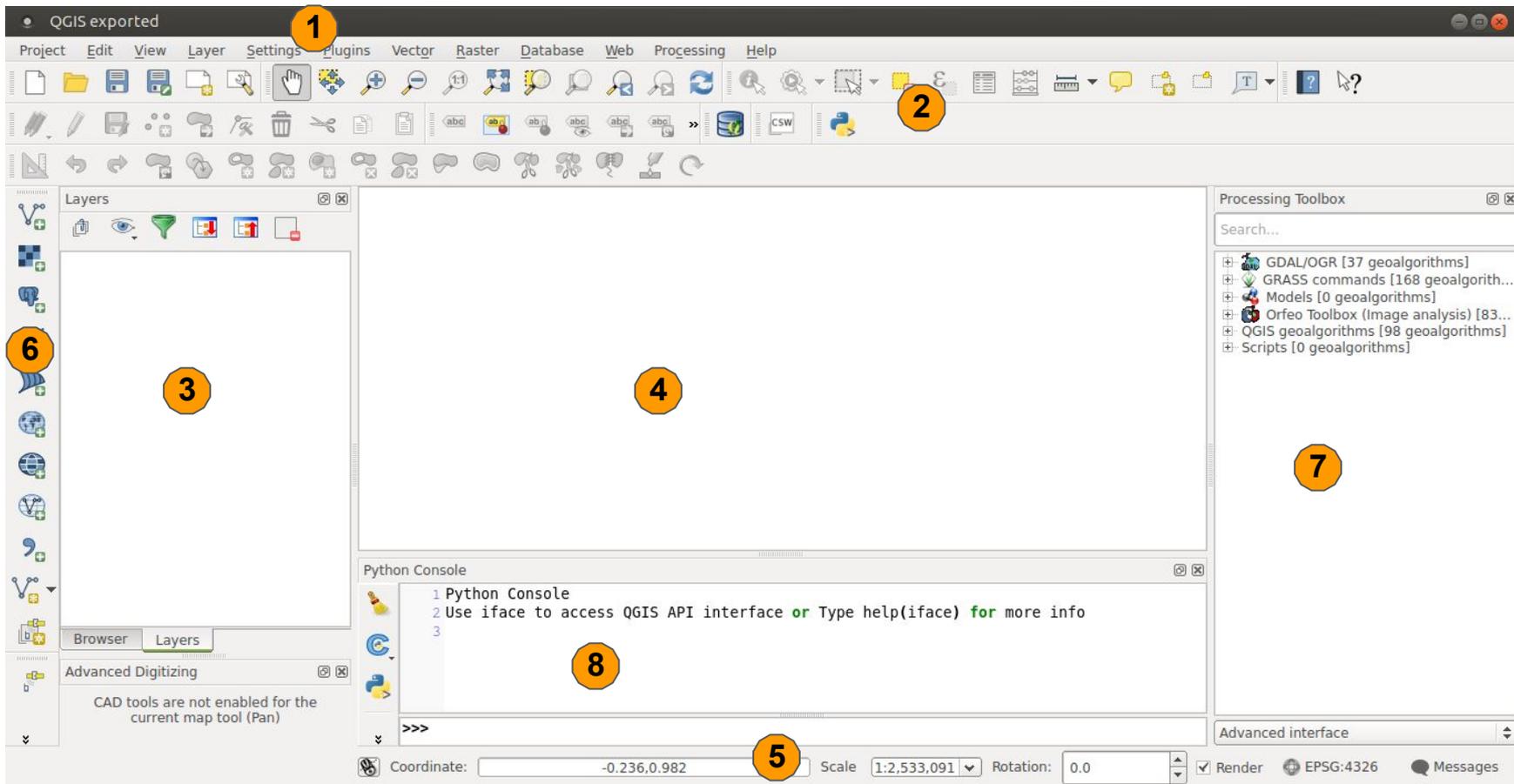
Give it a moment for the splash screen to show up. Times will Vary. Most of you are used to waiting for ArcMap.

Notice that a tip screen pops up with the QGIS Desktop interface. This might provide helpful information as you are getting familiar with the program. You can turn it on/off under Settings > Options > General. Look for tips at startup.



2. Close the tip screen and leave open to follow along.

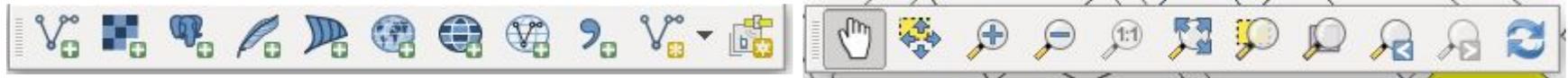
Navigating the Interface: Desktop



QGIS interface is divided in 5 main areas: 1. Menu Bar; 2. Tool Bar; 3. Map Legend (Panel); 4. Map Canvas; 5. Status Bar

Other added features: 6. Manage Layers Bar; 7. Toolbox Panel; 8. Python Console

Navigating the Interface: Layers and Navigation



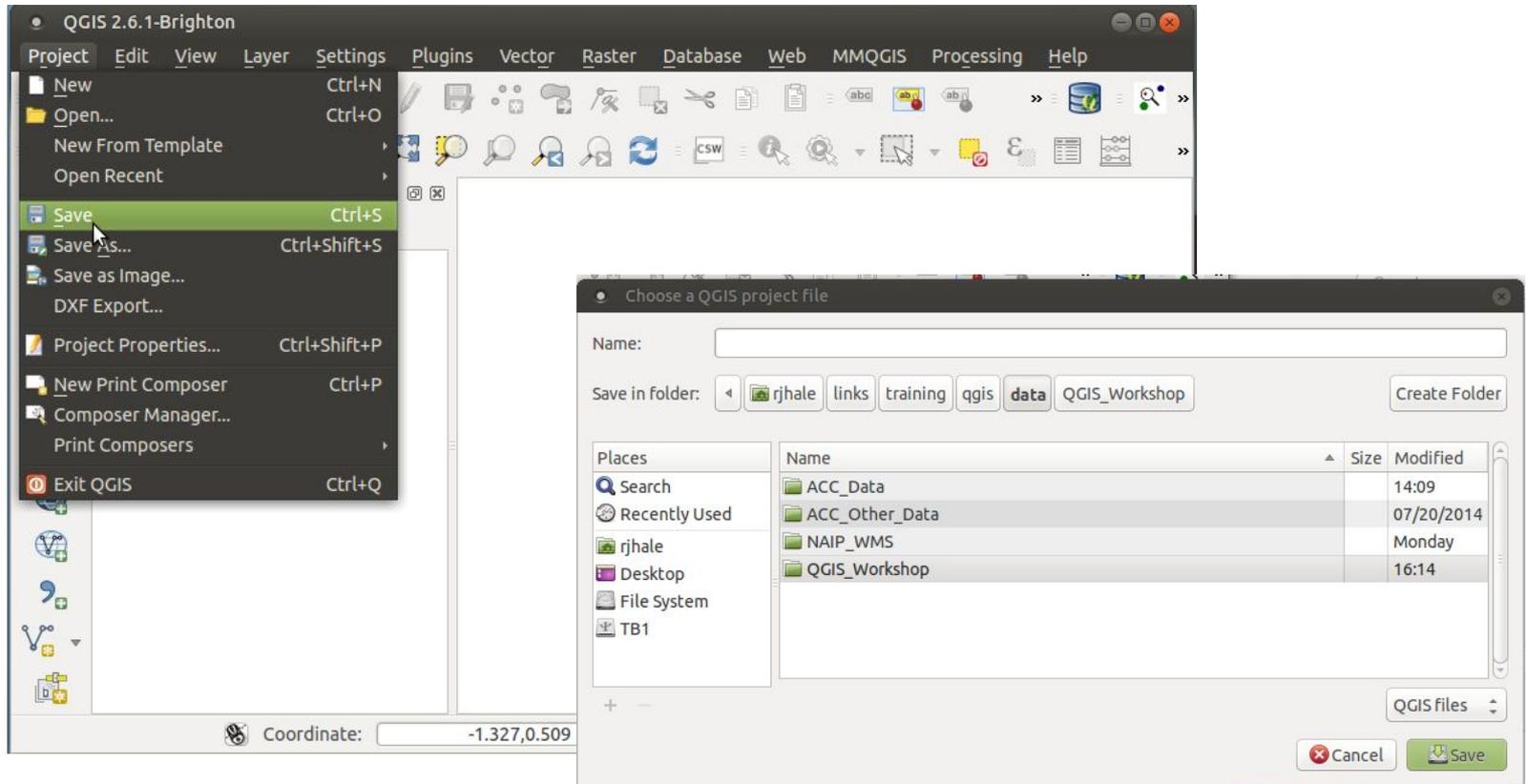
- Add vector Layer
- Add Raster Layer
- Add PostGIS Layer
- Add Spatialite Layer
- Add MSSQL Spatial Layer
- Add WMS/WMTS Layer
- Add WCS Layer
- Add WFS Layer
- Add Delimited Text Layer
- New Shapefile Layer/Spatialite Layer
- Create New GPX Layer
- Pan
- Pan Map to Selection
- Zoom In
- Zoom Out
- Zoom to Pixel Resolution
- Zoom to Full Extent
- Zoom to Selection
- Zoom to Layer
- Zoom to Last Extent
- Zoom to Next Extent
- Refresh

Navigating the Interface: Attributes



- Identify Features
- Run Feature Action
- Select Single Feature
- Deselect Features from All Layers
- Select Features using an Expression
- Open Attribute Table
- Open Field Calculator
- Measure Feature Tools
- Map Tips
- New Bookmark
- Show Bookmarks
- Annotation Tools

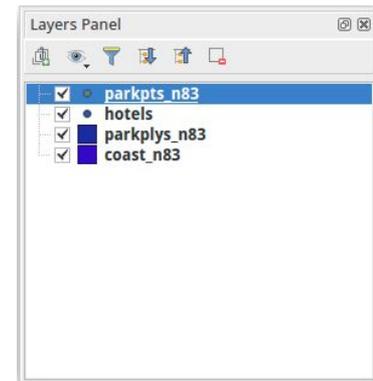
Navigating the Interface: QGS Files



- QGIS can save user sessions
- Project > Save
- Save a .qgs file. Can be opened in a normal text editor

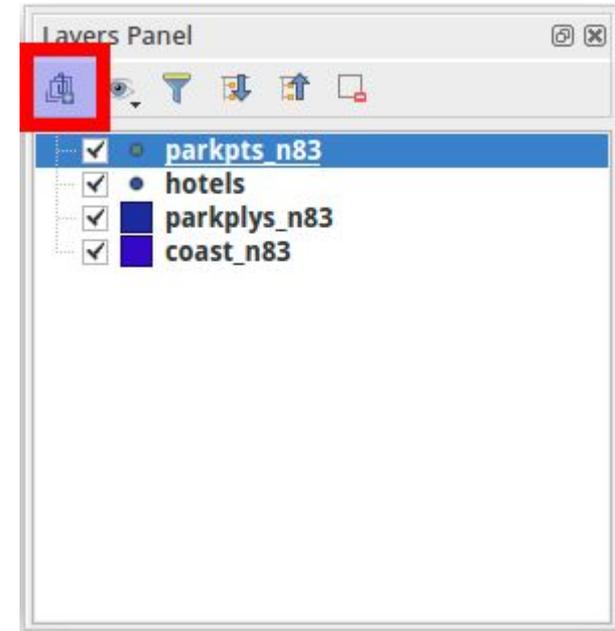
Exercise 2

1. If QGIS isn't open go ahead and open it.
2. Use the “Add Vector Layer” Tool to add the following files (under data):
 - parkpts_n83.shp - Park Point Location
 - parkplys_n83.shp - Park Polygon Locations
 - coast_n83.shp - State Coast Polygon
 - hotels.shp - Hotel Point Locations
3. Use the “Add Raster Layer” Tool to add:
 - Hawaii_Landsat_Mosaic_Bathymetric_Fill_c.tif - In the hawaii_landsat folder
3. Save your qgs project in the QGS directory. Call it exercise2.qgs
4. Explore the Layers Panel Toolbar:
5. You can create groups within the layers panel



Exercise 2

6. Create a group by pushing the Highlighted icon
7. Drag and drop your park layers into the New Group
8. Name the Group **Parks (right click on group and rename)**
9. **Save!**
10. Add the <RASTER FILE> Using the Add Raster Icon



Exercise 2

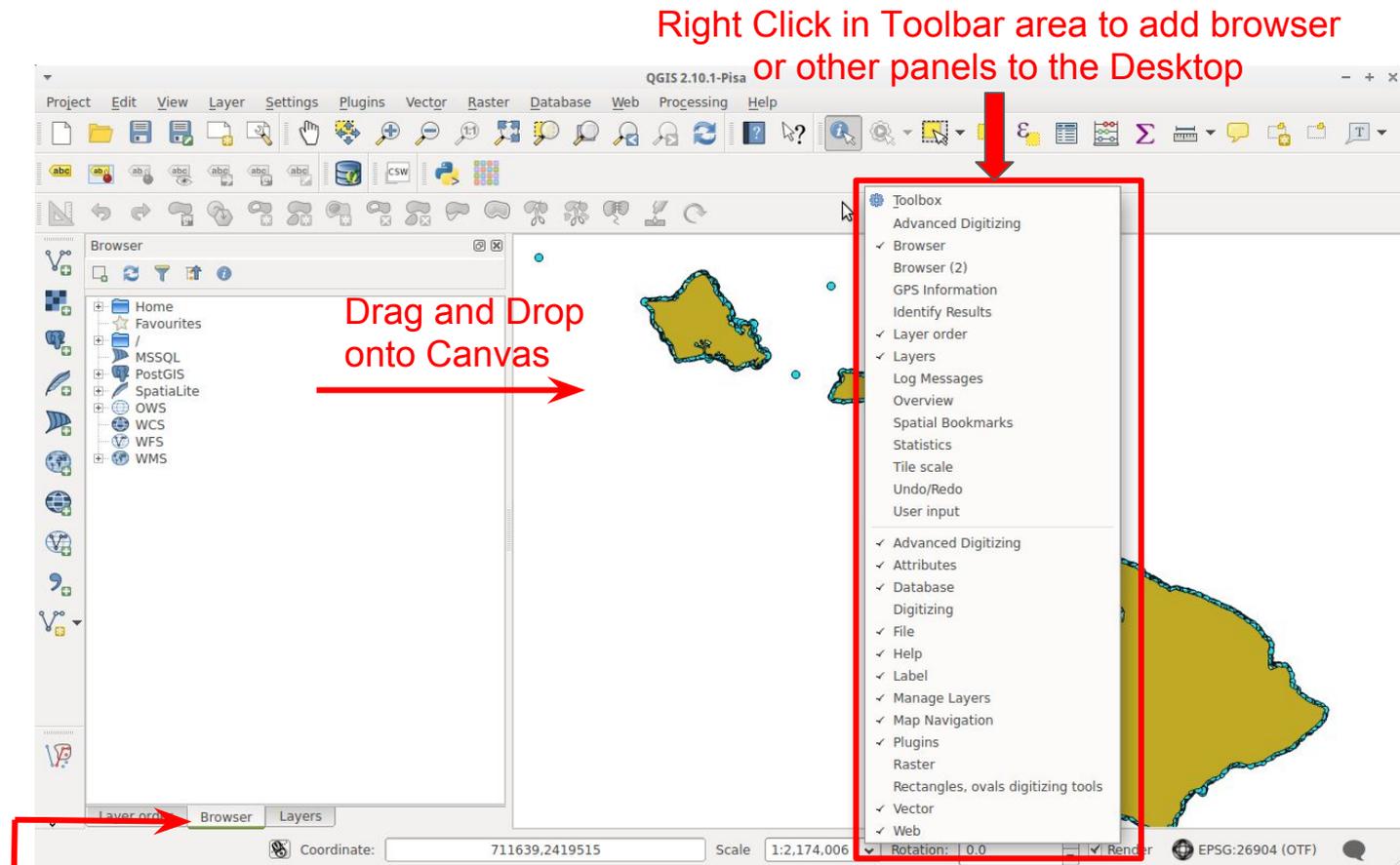
BONUS

1. Open the exercise2A.qgs file in the your *qgs* folder in your class data folder.

How did you fix it? In Arcmap you would get a red exclamation point next to your broken data layer.

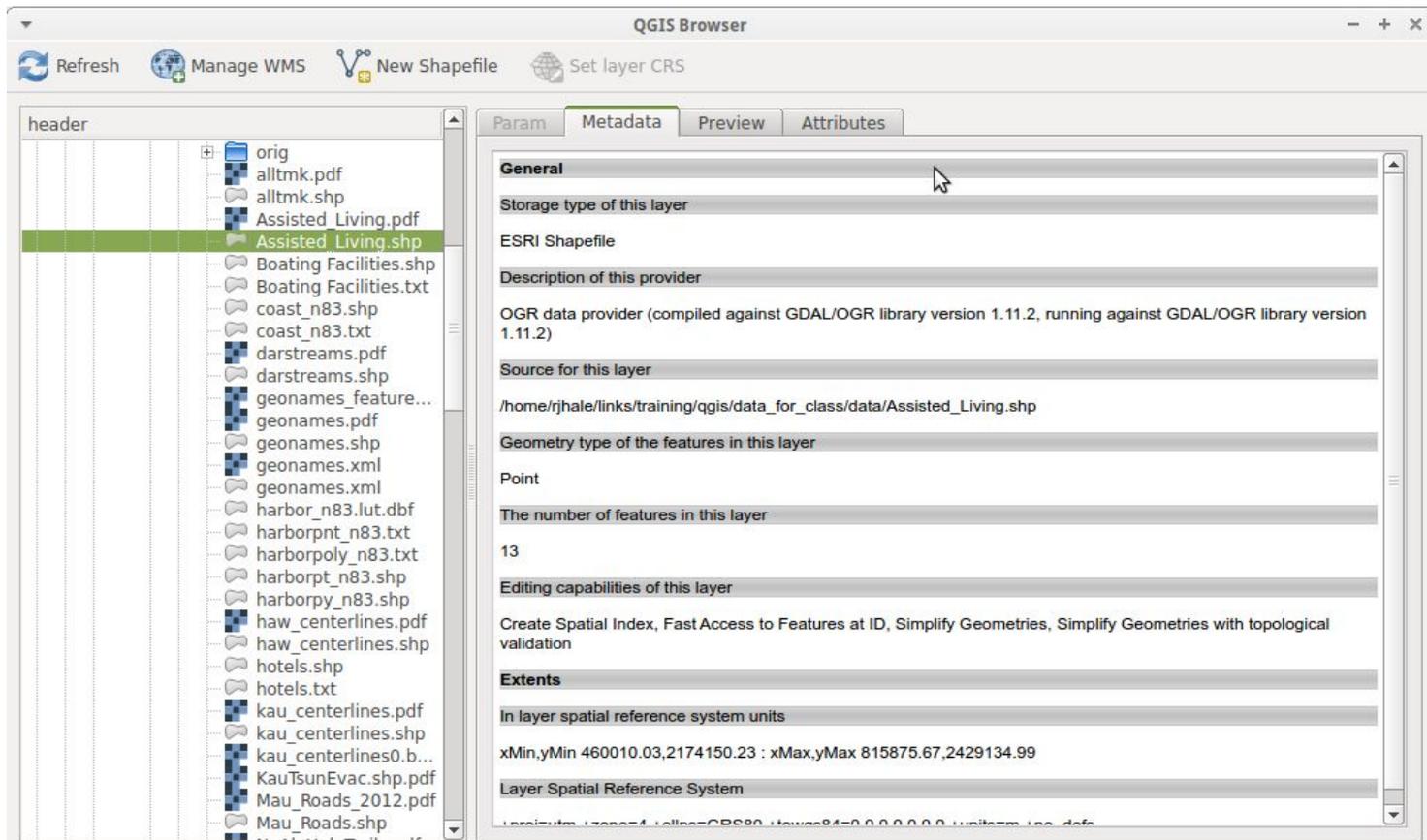
2. Close and don't save it. Open it in Notepad and find the line containing the landsat image (use find). Note you can fix your qgs file manually if needed. Close Notepad without saving the qgs file.

Navigating the Interface: Desktop



From the Manage Layers Toolbar and the Browser Panel you can add Shapefiles, Databases, WFS, WMS, and several other types of files.

Navigating the Interface: Browser



View **metadata**, **attributes**, and a **preview** of vector and raster data. Also, Manage WMS connections and **create new shapefiles**. However, new folders must be created in Windows explorer.

Intro to QGIS

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I. Navigating the Interface

II. Project Configuration

III. Analysis

IV. Print Composer

Project Configuration

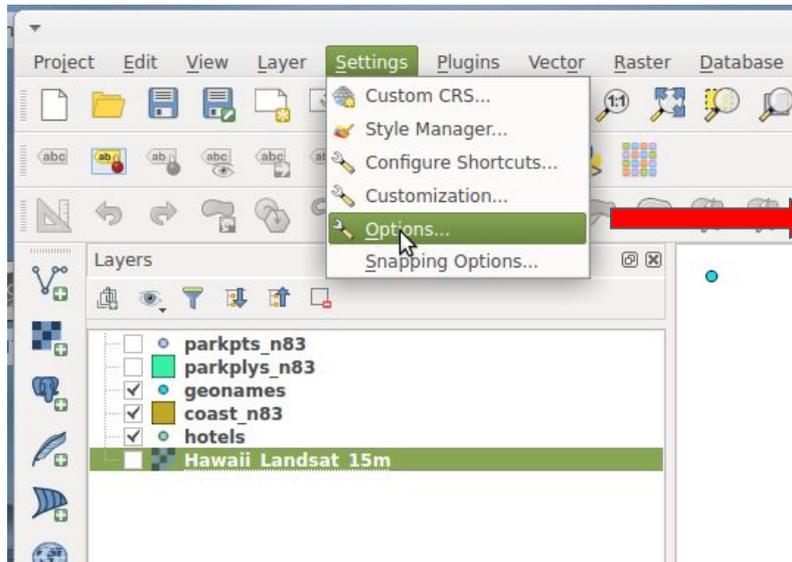
Topics:

- Settings
- Project Properties
- Coordinate Reference Systems (CRS)
- Panels, Toolbars, and Plugins

Exercise 3

1. Open exercise2.qgs. Save it as exercise3.qgs. Go to Settings > Options

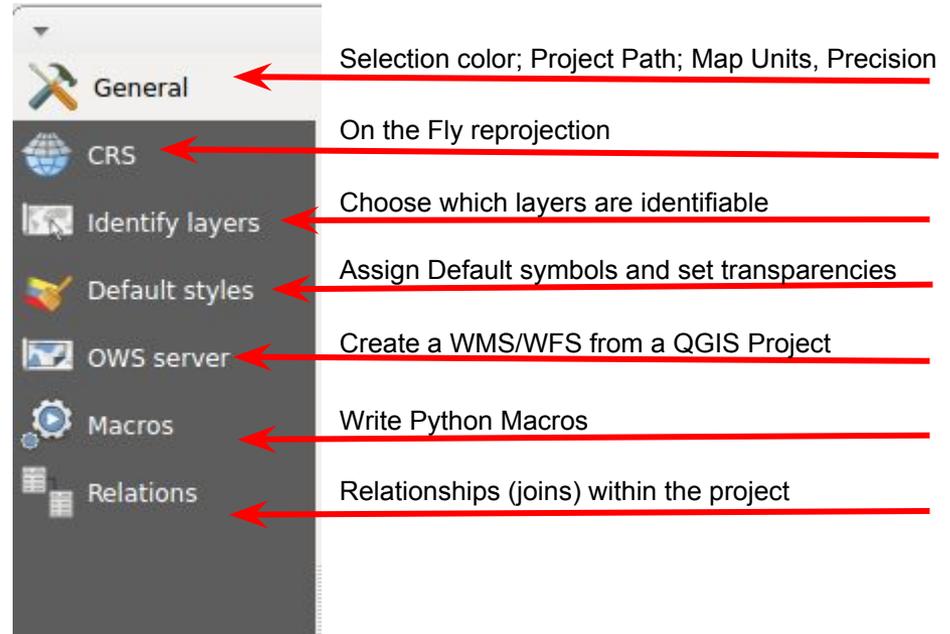
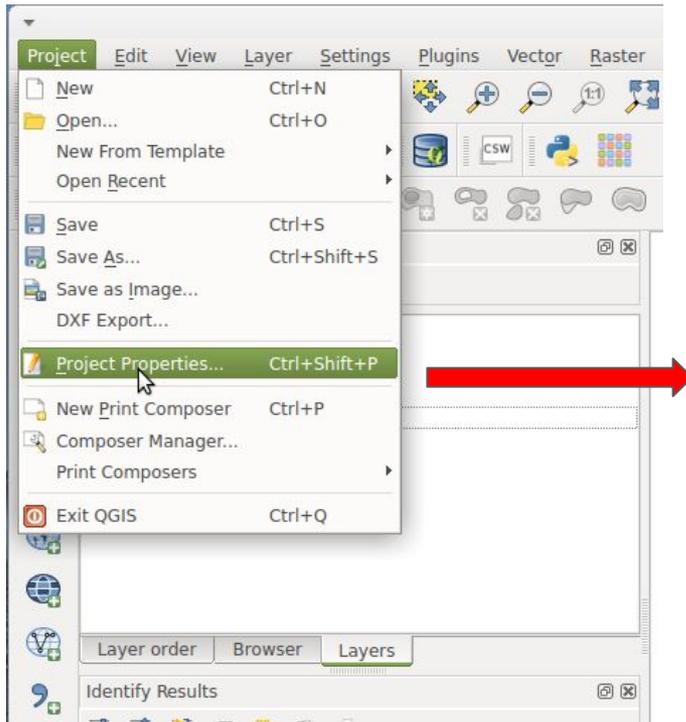
Project Configuration: Settings > Options



These change the default settings for **ALL QGIS PROJECT FILES**

QGIS is extremely customizable!

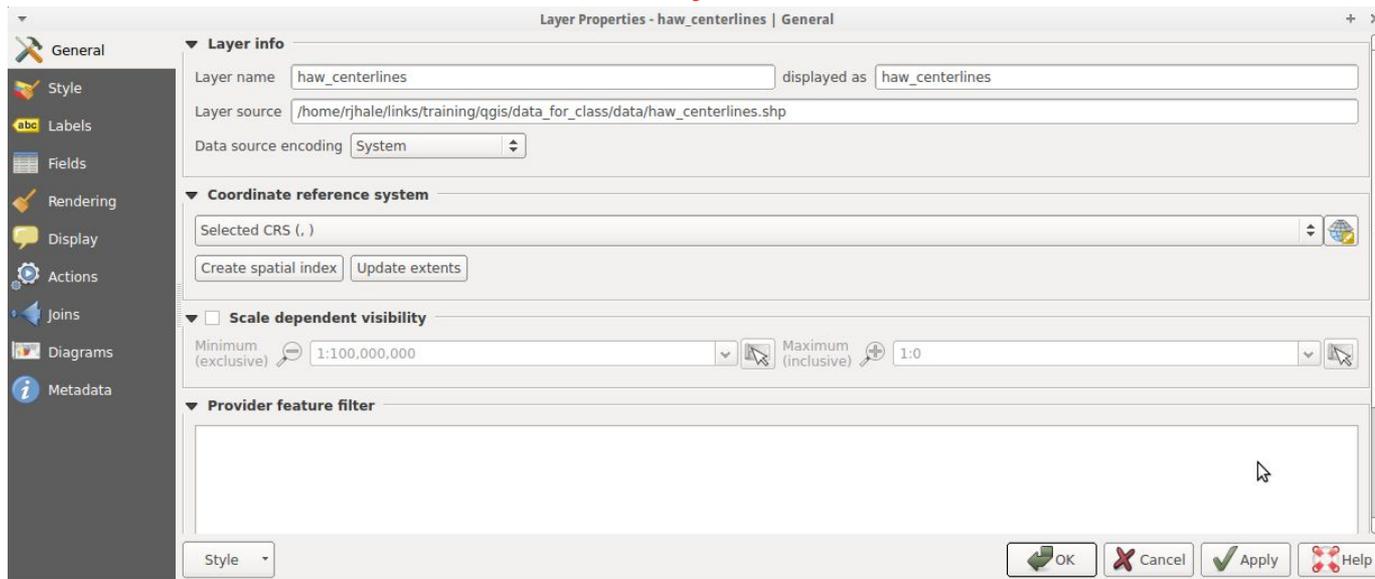
Project Configuration: Project Properties



These change the default project setting for the **CURRENT** QGIS Project

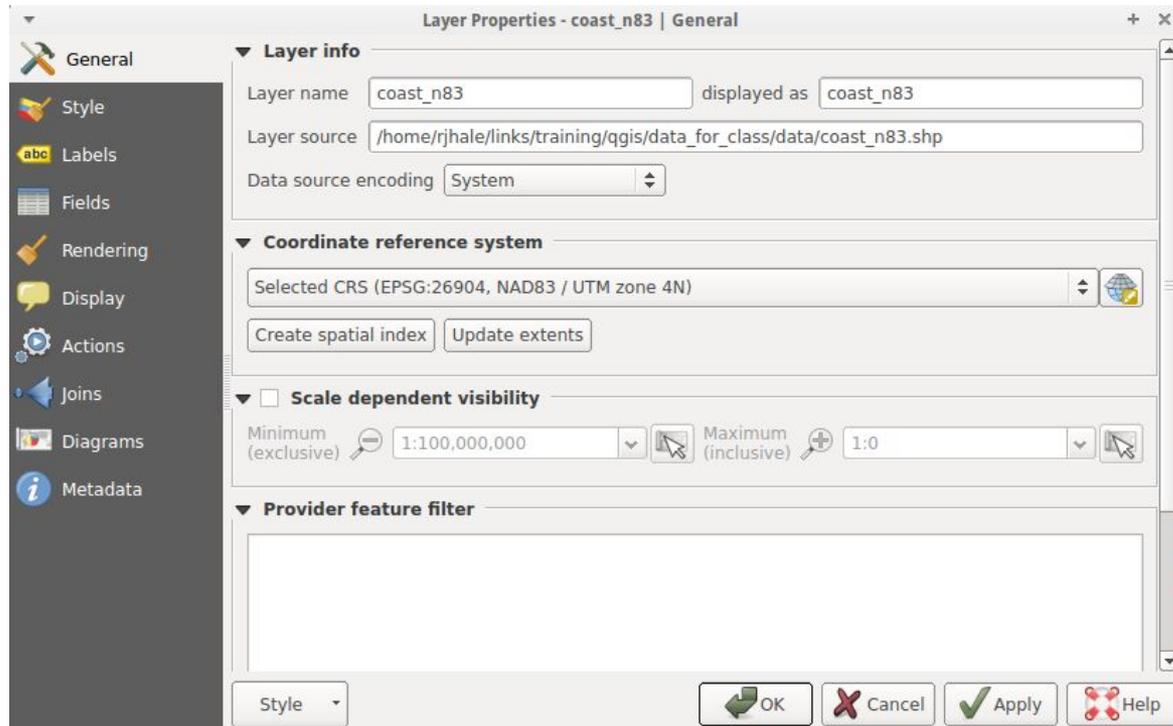
Exercise 3

1. Save exercise2.qgs as exercise3.qgs
2. In exercise 3, add the haw_centerlines.shp to your QGIS session.
3. Does it line up with your imagery?
4. Right Click the Layer and go to Properties > General and look at the **Coordinate Reference System**.



Exercise 3

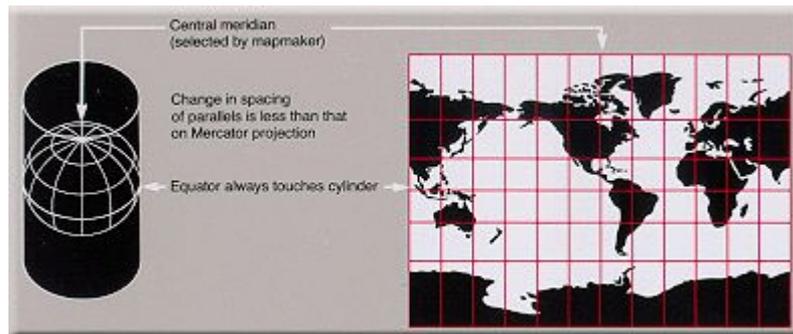
4. Click Cancel
5. Right click coast_83 in the Map Layers panel. Go to Properties > General and look at the Coordinate Reference System.



Project Configuration: CRS (or Projections)

Geographic Coordinate Systems:

Define Locations on a spherical model of the earth



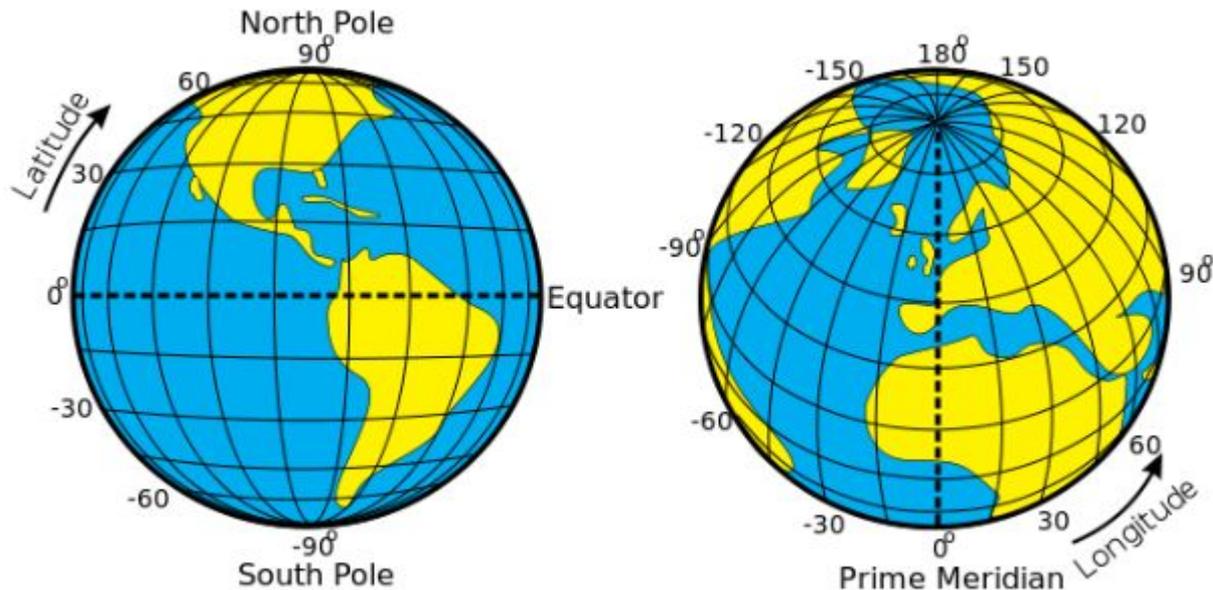
Projected Coordinate Systems:

Define Locations on a flat model of the earth

Project Configuration: CRS

Geographic Coordinate Systems:

- Defines Locations with Latitude/Longitude values
- Latitude runs north and south of the Equator (0° – 90° north and south)
- Longitude runs east and west of the Prime Meridian (0° - 180°)
- Prime Meridian is Greenwich



Exercise 3

6. Open the prj file for haw_centerlines in notepad (or your favorite text editor). It should look something like:

```
PROJCS["NAD_1983_StatePlane_Hawaii_1_FIPS_5101_Feet",GEOGCS
["GCS_North_American_1983",DATUM["D_North_American_1983",SPHEROID
["GRS_1980",6378137.0,298.257222101]],PRIMEM["Greenwich",0.0],UNIT["Degree",
0.0174532925199433]],PROJECTION["Transverse_Mercator"],PARAMETER
["False_Easting",1640416.666666667],PARAMETER["False_Northing",0.0],
PARAMETER["Central_Meridian",-155.5],PARAMETER["Scale_Factor",
0.999966666666667],PARAMETER["Latitude_Of_Origin",18.83333333333333],UNIT
["Foot_US",0.3048006096012192]]
```

7. What do you notice about the projection ? (HINT IT'S DIFFERENT)
IT HAS A PROJECTION.

Exercise 3

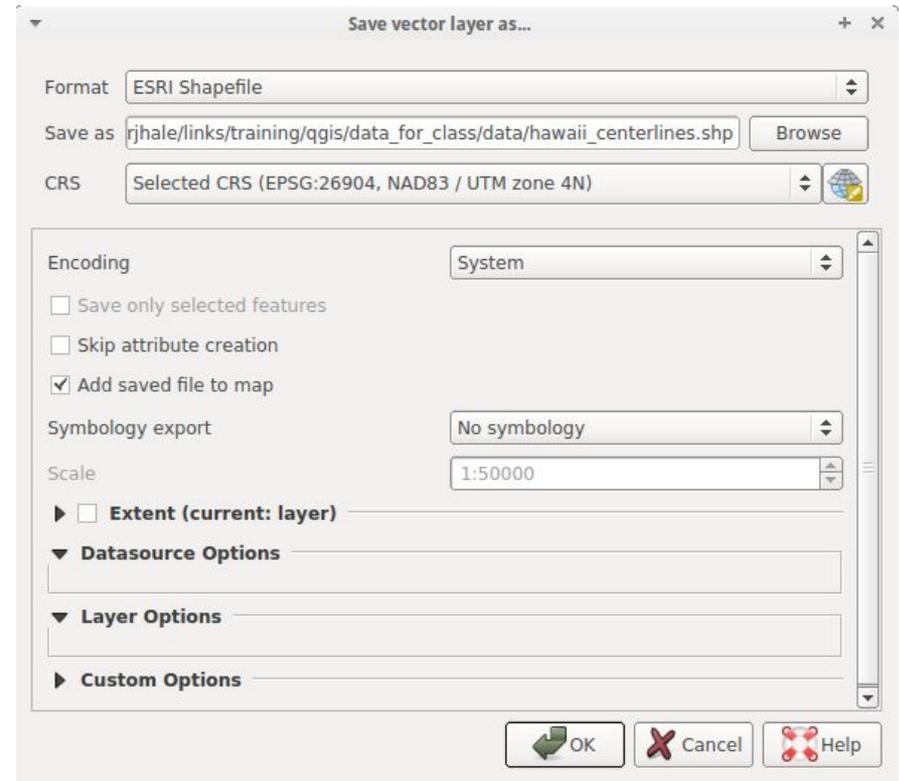
8. Right click on haw_centerlines in the Map Layer Panel and select “Save as...”

9. Save your new file to the data directory and name it hawaii_centerlines.shp

10. Make your CRS to be 26904 by clicking on the “Select CRS” button.

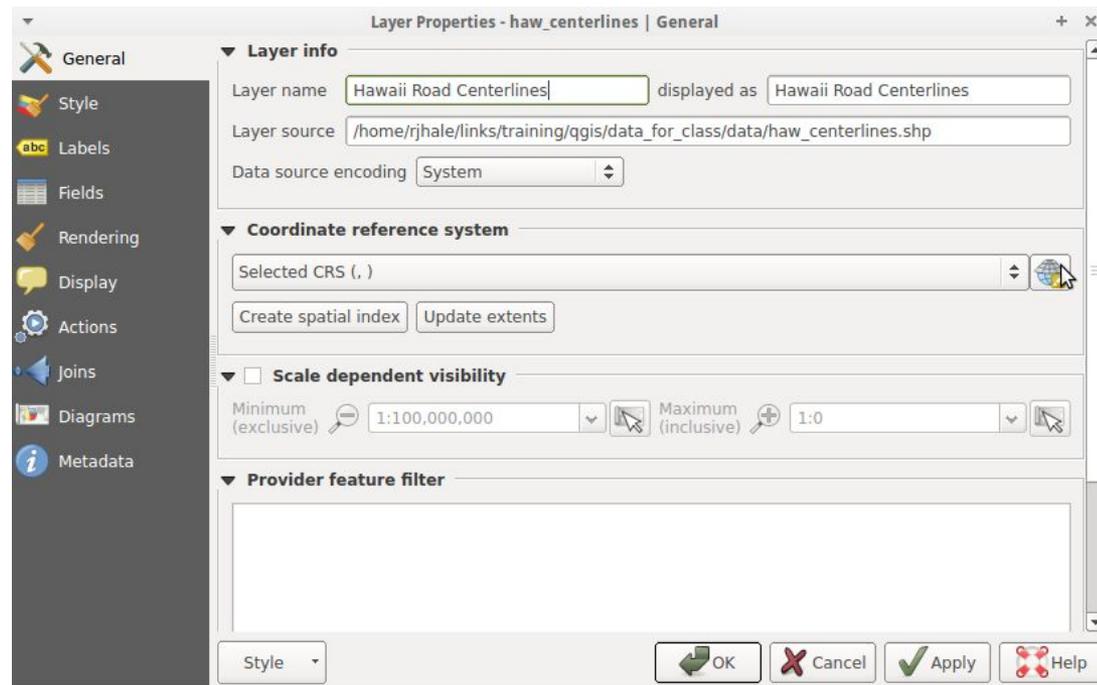
11. Click OK

You just reprojected a shapefile!



Exercise 3

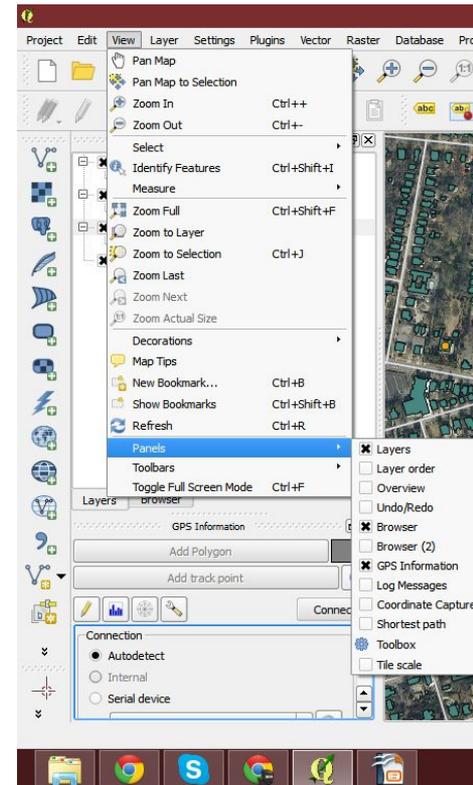
12. Look for your new hawaii_centerlines layer in the map layer panel. Look for it on the map.
13. Right click hawaii_centerlines and go to > Properties > General and rename the layer to Hawaii Road Centerlines



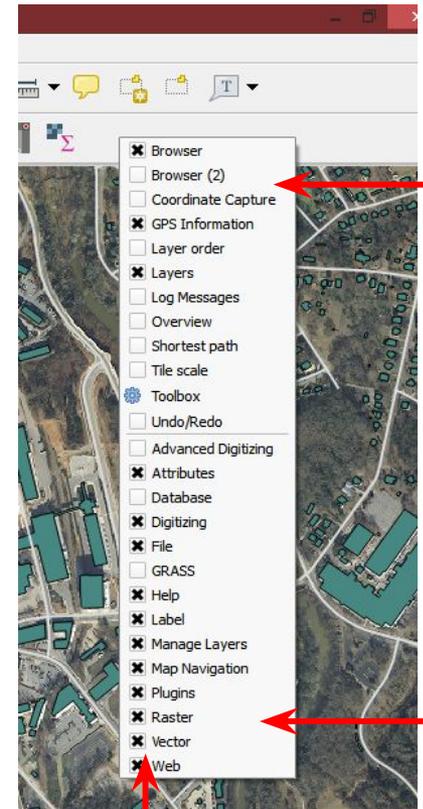
Project Configuration: Panels, Toolbars, Plugins

Panels and Toolbars:

- Turn them on and off by going to View > Panels or Toolbars.
- Panels provide interactive “windows”. Examples: Layers, GPS Information, and toolbox
- Toolbars are a grouping of tools
- Panels/Toolbars can also be added/removed by right-clicking on the toolbar area



Panels on top...



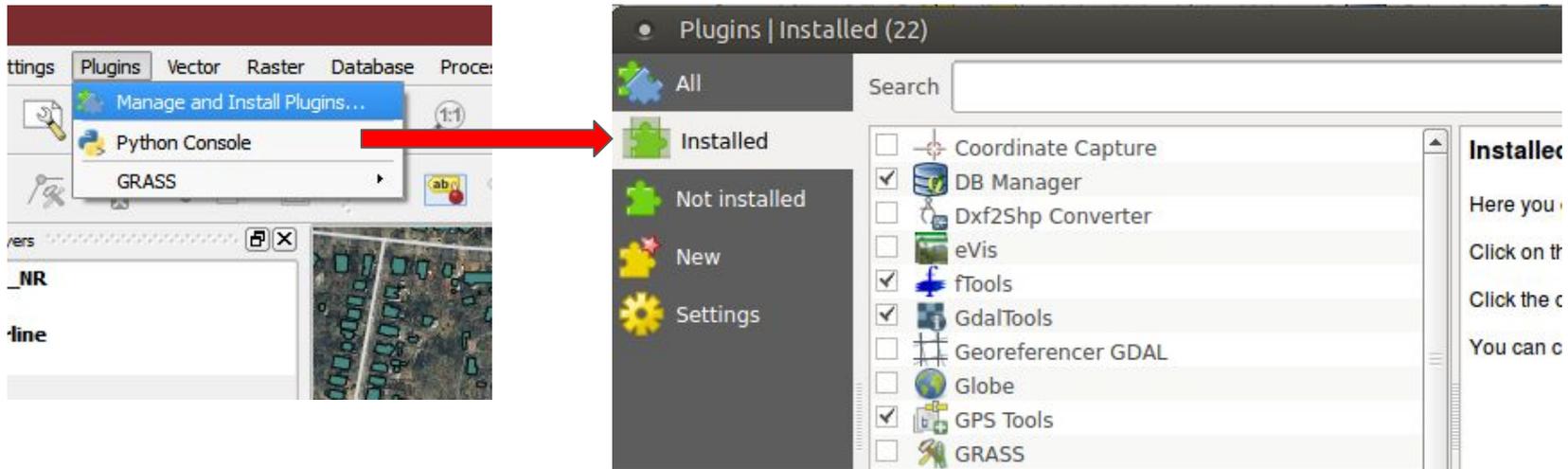
...Toolbars on bottom

Project Configuration: Panels, Toolbars, Plugins

Plugins:

- Plugins are addons that introduce new features or functions to QGIS
- **Adding, removing, activating** and **deactivating** of plugins are all done through **Plugins > Manage and Install Plugins...**
- Implemented as either core or external plugins
- **Core Plugins (Installed)** are developed by the QGIS dev team and included in distribution
- **External Plugins (Get more)** or 3rd Party Plugins are stored in external repositories and maintained by authors
- Within the **Plugin Manager** under **Settings**, choose **Check for updates on startup** and then the frequency to keep them up to date

Project Configuration: Panels, Toolbars, Plugins



Useful Plugins to get you started:

- **Group Stats Plugin** gives you the ability to summarize data layers in tabular format
- **OpenLayers Plugin** gives you access to open data layers to add as backdrops to your maps. Examples include OpenstreetMap, Google Maps, Bing Maps and more.

Exercise 4

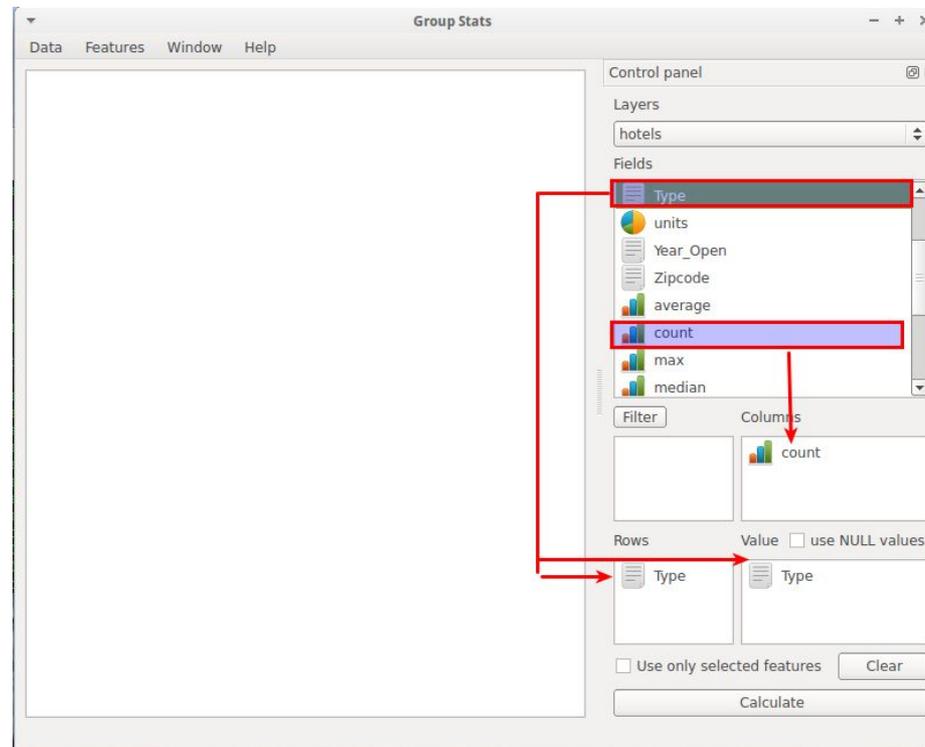
1. Save exercise3.qgs as exercise4.qgs
2. Go to Plugins > Manage and install plugins > Plugins. Scroll down the list to find or type in search “OpenLayers Plugin”. Click and install the plugin.
3. Install the “Group Stats Plugin”. Notice you get a new icon on the desktop > The icon for the Group Stats Plugin is a small square with a light blue background, featuring a green circular arrow and a white document icon.
4. Go to Vector > Group Stats > Group Stats. Some of you may be familiar with the Frequency functionality in ArcGIS Desktop. You may also be familiar that it is locked by license level.

So what if you wanted to summarize some data in QGIS? You have been asked to summarize the types of Hotels in the Hawaiian Islands.

Exercise 4

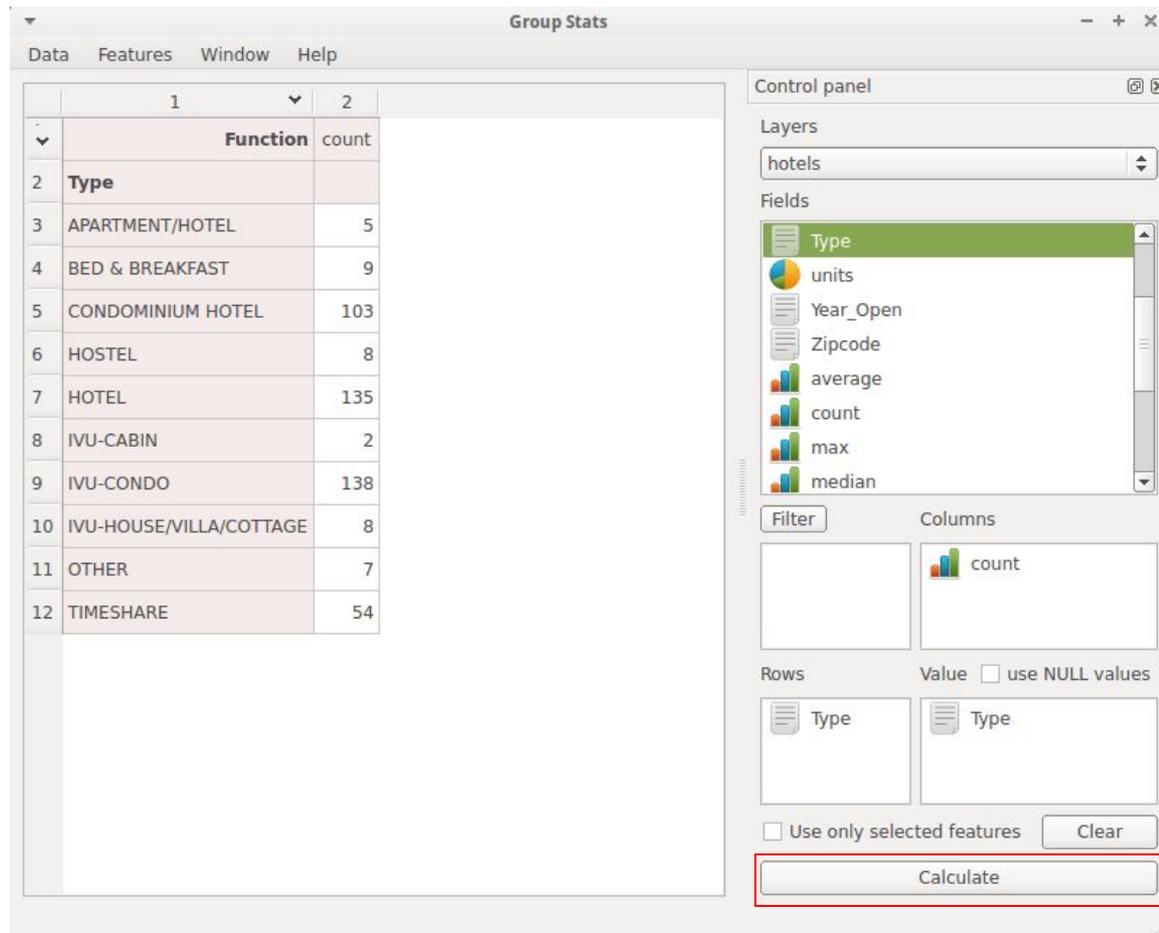
5. Open Group Stats.

6. You want to count the types of Hotels. Drag the Count Function into columns. Drag Type into Rows and Value. This will allow you to count the Types of Hotels and Display the Types in Rows.



Exercise 4

7. Click Calculate



The screenshot shows the 'Group Stats' dialog box. The main table displays the following data:

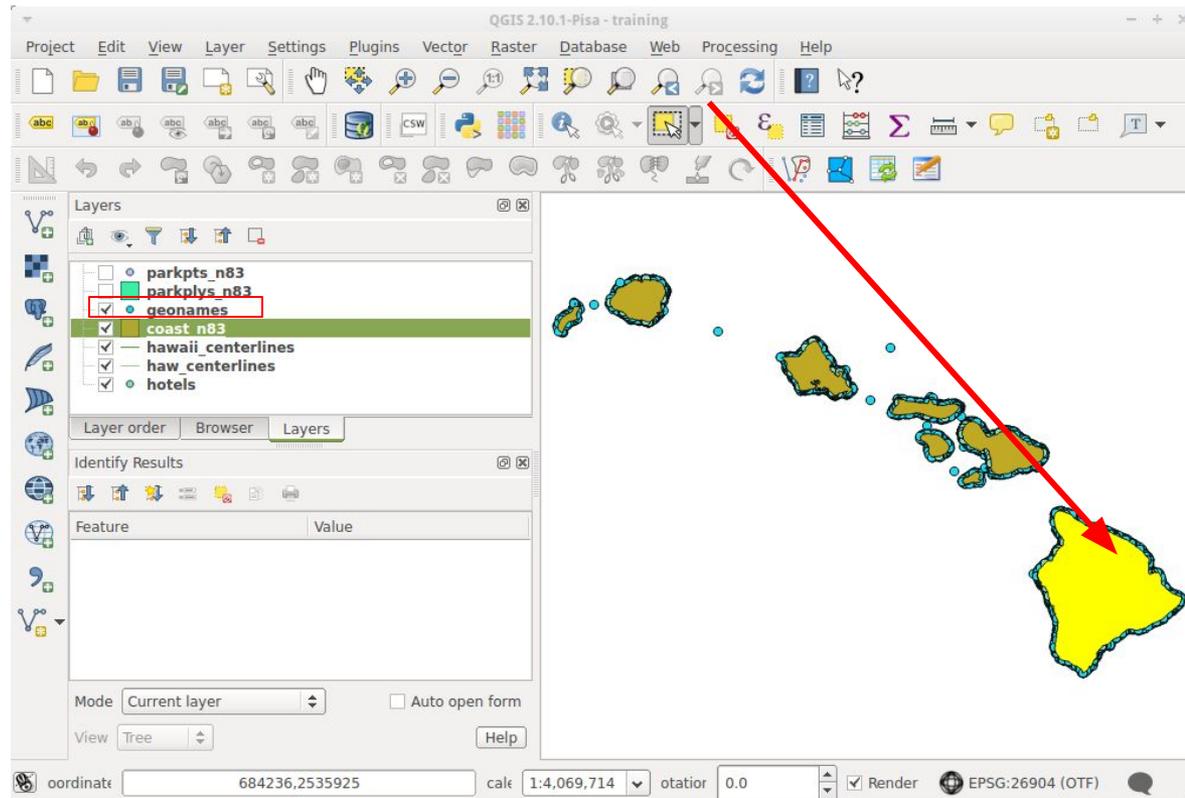
Function	count
APARTMENT/HOTEL	5
BED & BREAKFAST	9
CONDOMINIUM HOTEL	103
HOSTEL	8
HOTEL	135
IVU-CABIN	2
IVU-CONDO	138
IVU-HOUSE/VILLA/COTTAGE	8
OTHER	7
TIMESHARE	54

The right-hand control panel is configured as follows:

- Control panel: hotels
- Fields: Type (selected), units, Year_Open, Zipcode, average, count, max, median
- Filter: (empty)
- Columns: count
- Rows: Type
- Value: use NULL values
- Use only selected features:
- Buttons: Clear, Calculate (highlighted with a red box)

Exercise 4

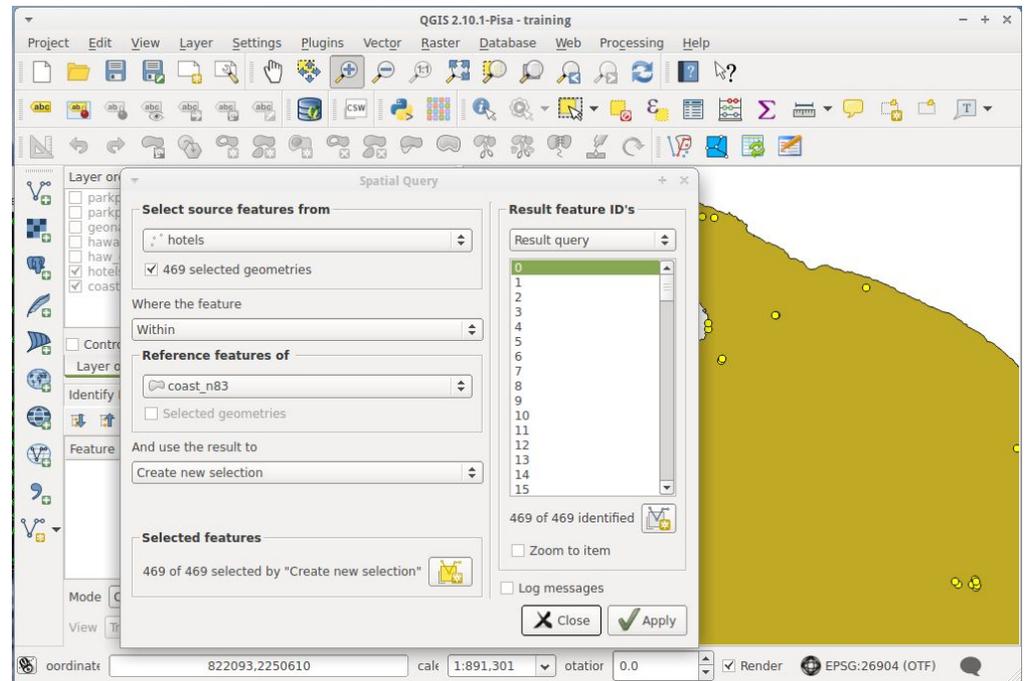
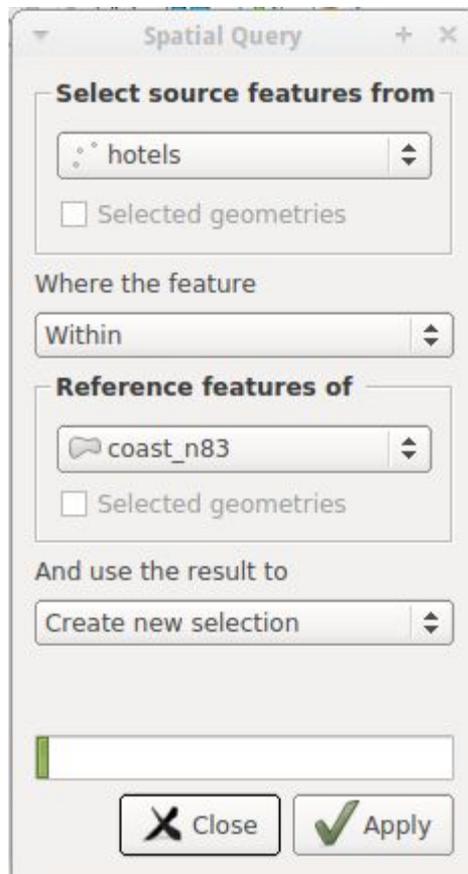
8. Enable the Spatial Query Plugin.
9. Select Hawaii using the select tool (hint highlight coast_n83 in your map layers).



Exercise 4

10. Go to Vector > Spatial Query > Spatial Query

11. Select all the Hotels that fall within the island of Hawaii.



Exercise 4

8. Take a look at the Plugins Menu. Look at Advanced Digitizing, Group Stats, Topology, Azimuth and Distance Plugin, AutoTrace, and finally Spatial Query

Note:

- Plugins can be poorly documented!
- Some plugins can change your canvas projection!
- Plugins extend the functionality of QGIS!
- Most (if not all) are written in Python!
- Sometimes they break between QGIS Upgrades!
- Overall they are a great addition to QGIS!

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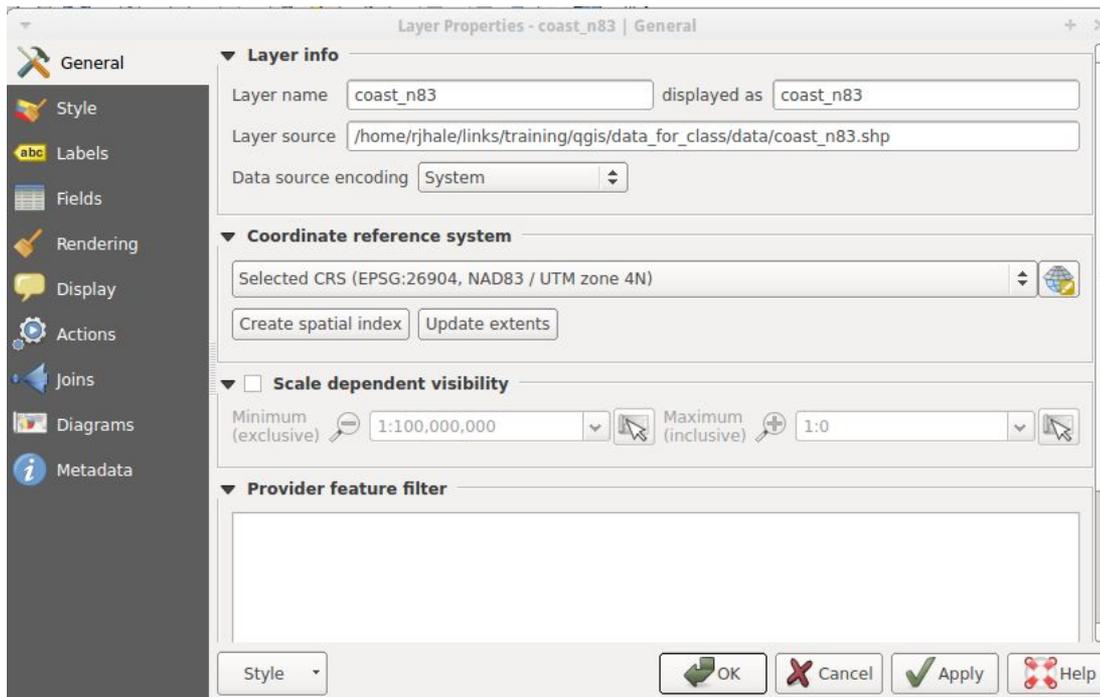
Analysis

Topics:

- Data Layers
- Editing
- Symbolizing Layers
- Geoprocessing
 - GRASS
 - SAGA
 - GDAL

Exercise 5

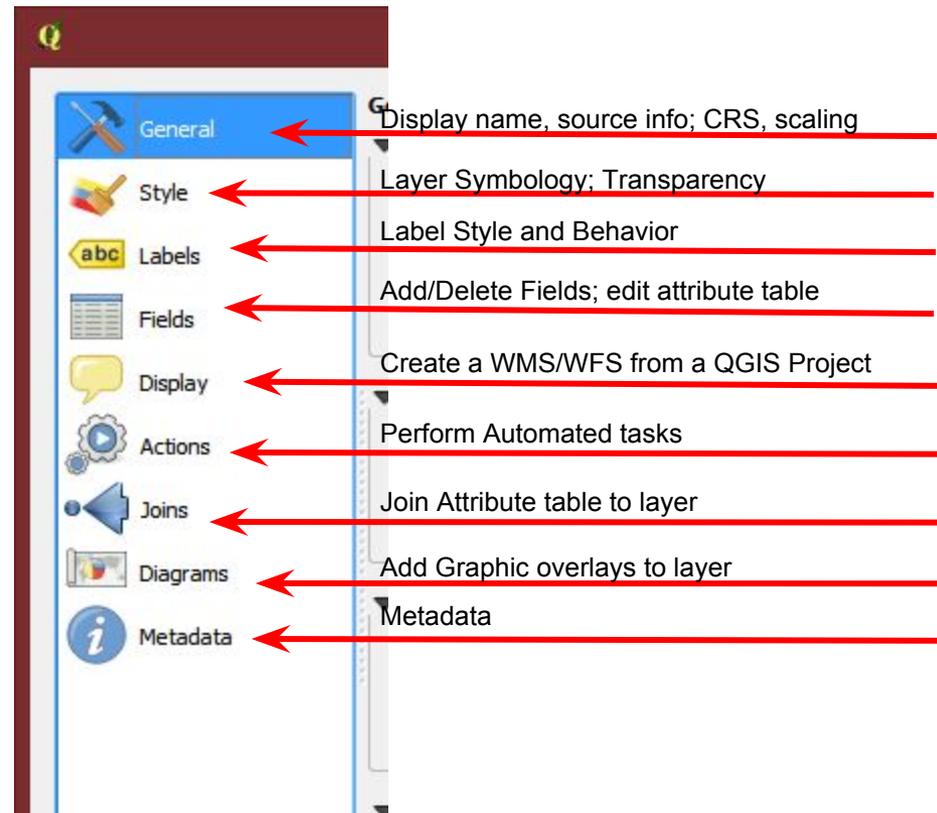
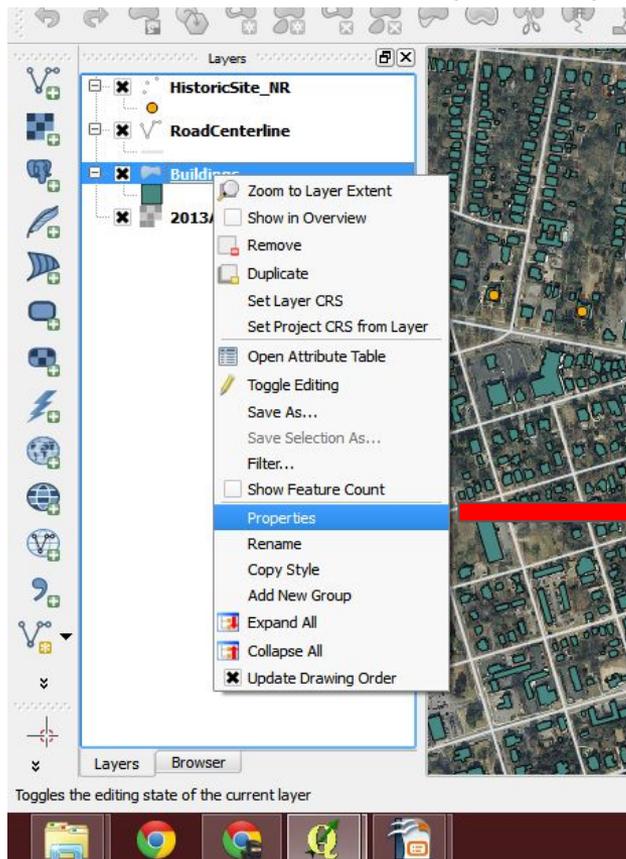
1. Open exercise4.qgs and save it as exercise5.qgs
2. Right click coast_n83 and go to properties



Analysis: Data Layers - Vector

Vector Layer Properties:

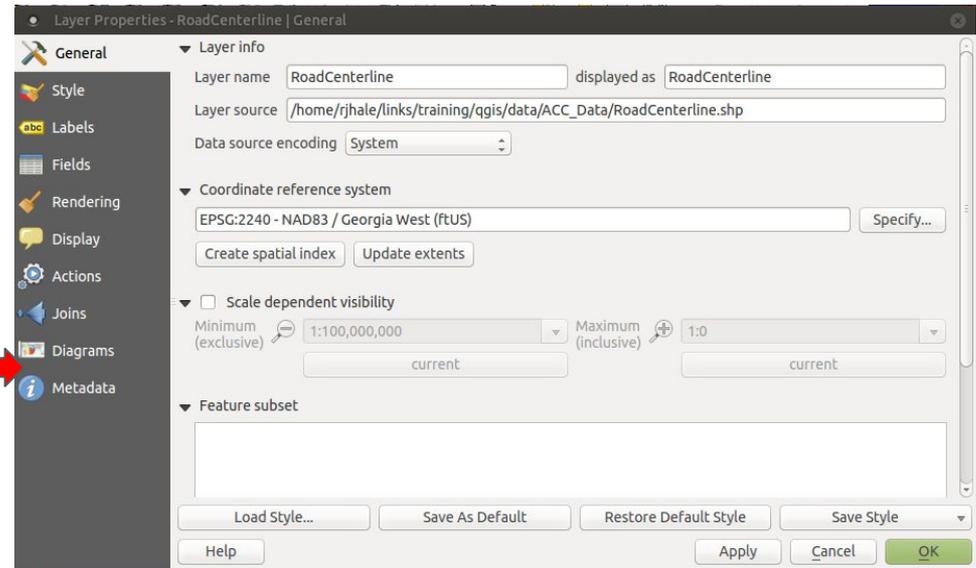
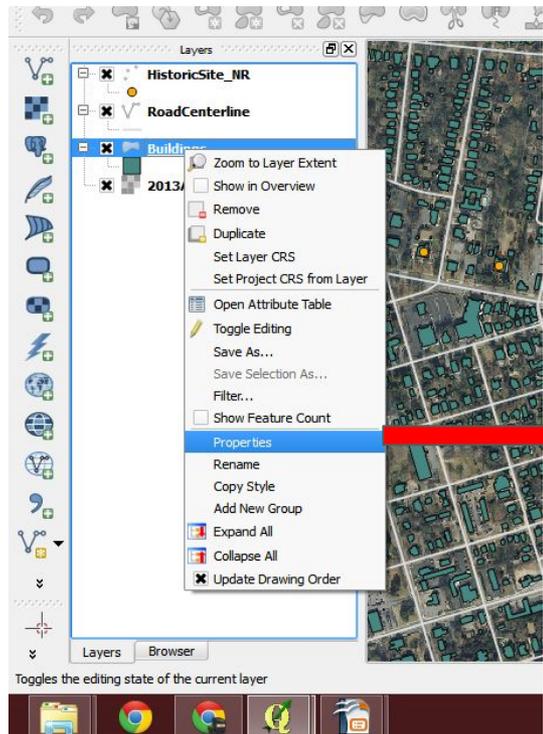
This provides information about the layer as well as the ability to label and customize the layer's symbology.



Analysis: Projections

Data projections:

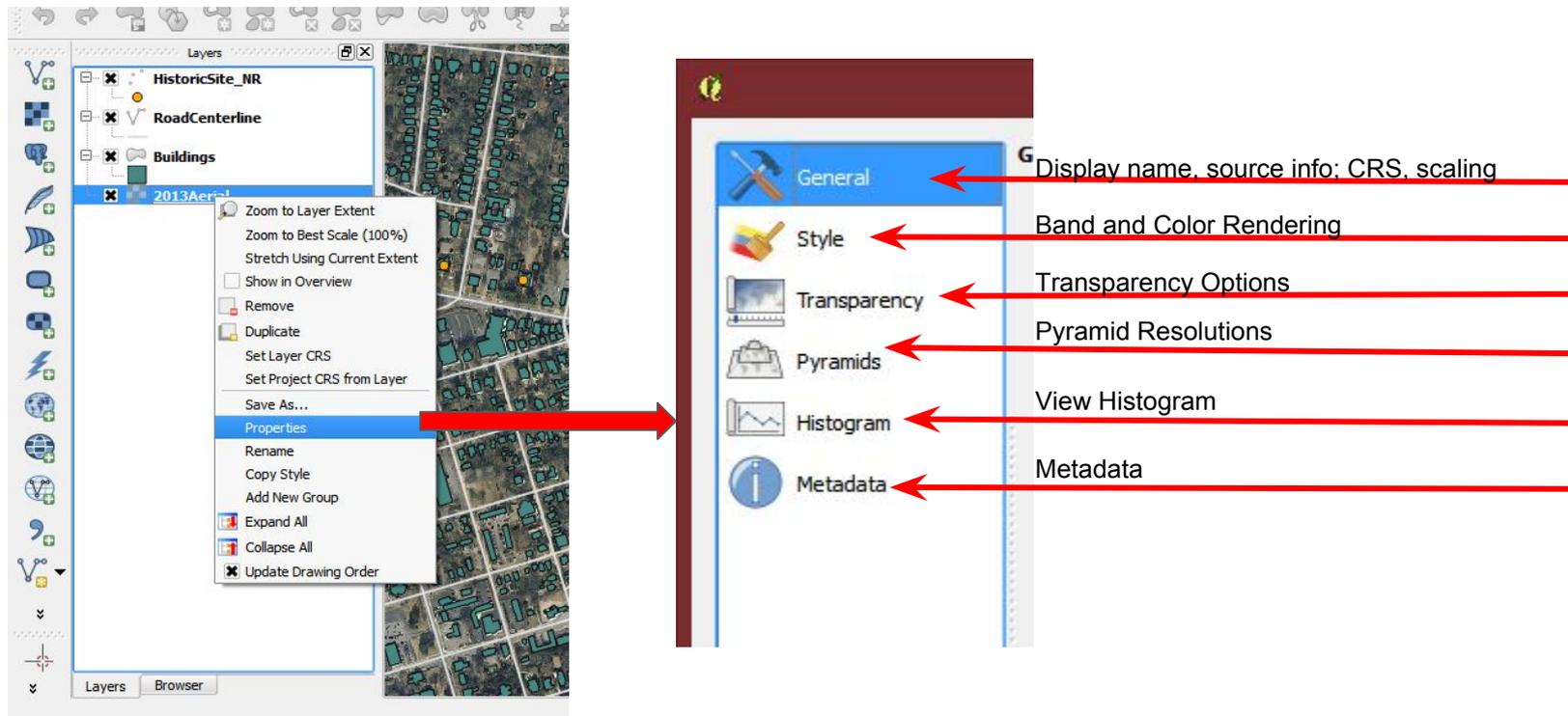
To jump back to projections. All Vector/Raster Data has a projection or CRS. The quickest way to check projections is to Right Click the data Layer > Properties > General



Analysis: Data Layers - Raster

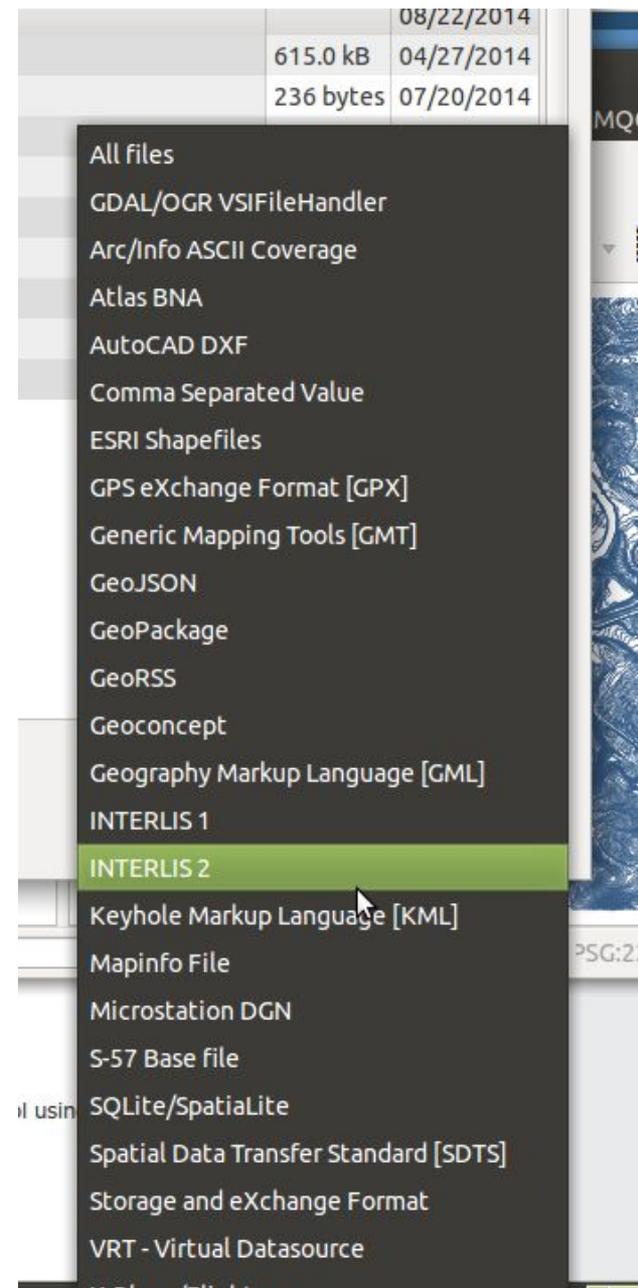
Raster Layer Properties:

This provides information about the layer as well as the ability to set pyramid levels, adjust appearance, and view the histogram.



Analysis: Data Formats

- Vector Layer Examples (OGR vector formats)
 - ESRI Shapefile
 - Spatialite (SQLite)
 - GPX
 - Google KML
- Raster Layers
 - GeoTiff
 - PNG
 - JPEG
 - ESRI Grid
 - Erdas IMG
- Web Services
- Delimited Text Layer
- ESRI's Geodatabase
- Databases: Oracle, SQL Server, PostGIS,

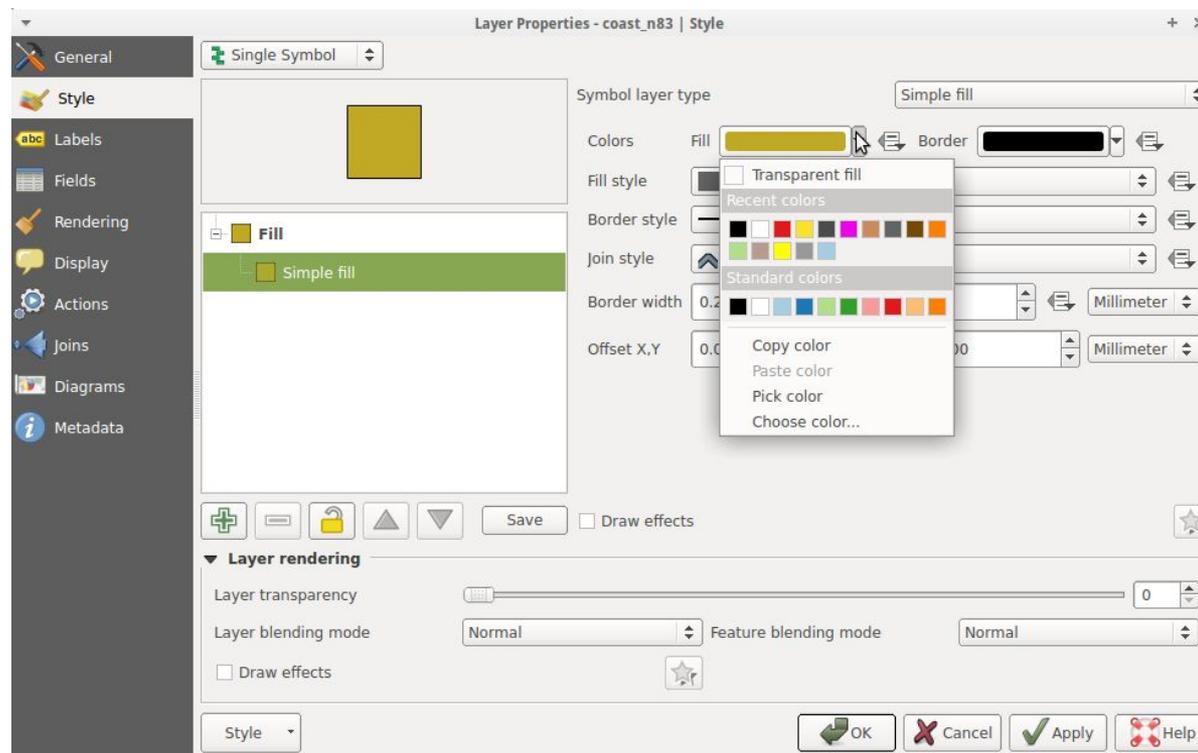


Exercise 5

1. Right click on Hawaiian Road Centerlines and go to > Properties.
2. Resize or move the Layer Properties window so you can see the data in the Map Canvas. Select Style then from Saved styles, select Residential. Change the width to 0.5. Click on Apply.
3. Click on Labels and click on the box next to Label this layer with. Click on the dropdown menu next to it and select FULLNAME then click on Apply to see the change in the Map Canvas.
4. In the same Label window, click on Buffer and click on the box next to Draw text buffer. Next, go to Rendering and scroll down until you see Merge connected lines to avoid duplicate labels. Click on OK.
5. Also turn on scale-based visibility. Set the Maximum to be 24000. Hit Apply. Save your QGIS file!

Exercise 5

6. Right Click coast_n83 and go to properties. Change the name to Coasts under the General Tab.
7. Go to the Styles Tab. Change the Fill.



Exercise 5

8. Save The style under the style button. Save your style by going to Style > Save Style > QGIS Layer Style File

Note: When you save a style QGIS will pick that style when you add this data to a new QGIS session. It's very similar to ArcMap's lyr files.

Analysis: Digitizing Tools



Digitizing Tools:

- Current Edits
- Toggle Editing
- Save Layer Edits
- Add Feature (points, lines, polygons)
- Digitize Curves
- Move Feature(s)
- Node Tool
- Delete Selected
- Cut Features
- Copy Features
- Paste Features

Analysis: Digitizing Tools



Advanced Digitizing Tools:

- Undo
- Redo
- Rotate Feature(s)
- Simplify Feature
- Add Ring
- Add Part
- Delete Part
- Reshape Feature
- Offset Curve
- Split Features
- Merge Selected Features
- Merge Attributes of Selected Features
- Rotate Point Symbols

Exercise 6

1. Save exercise5.qgs as exercise6.qgs
2. Be sure to turn on or add
Hawaii_Landsat_Mosaic_Bathymetric_Fill_c.tif to your QGIS
Project.
3. Go to Layer > Create Layer -> New Spatialite Layer

Analysis: Spatialite

Spatialite is an **open source** library intended to extend the SQLite core to support fully fledged Spatial SQL capabilities.

SQLite is intrinsically simple and lightweight:

- a single lightweight library implementing the full SQL engine
- standard SQL implementation
- no complex client/server architecture
- a whole database simply corresponds to a single monolithic file (no size limits)
- any DB-file can be safely exchanged across different platforms, because the internal architecture is universally portable
- no installation, no configuration

Spatialite is smoothly integrated into SQLite to provide a complete and powerful Spatial DBMS (mostly OGC-SFS compliant).

Exercise 6

4. Make a polygon layer!

Pick a database name

Pick a layer name

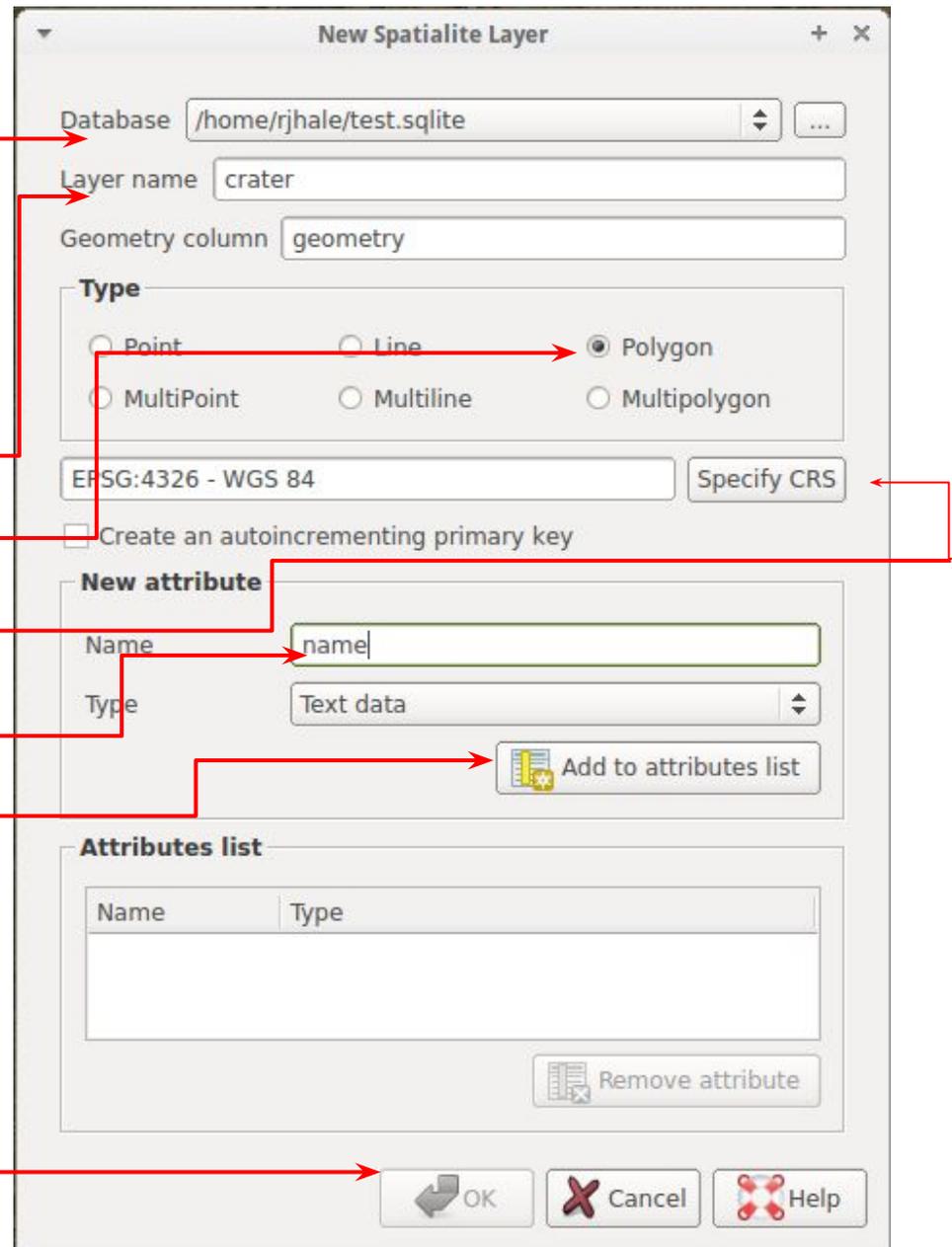
Pick a type

Pick a CRS

Add one field - it's required

Click add attribute to list!

Click OK



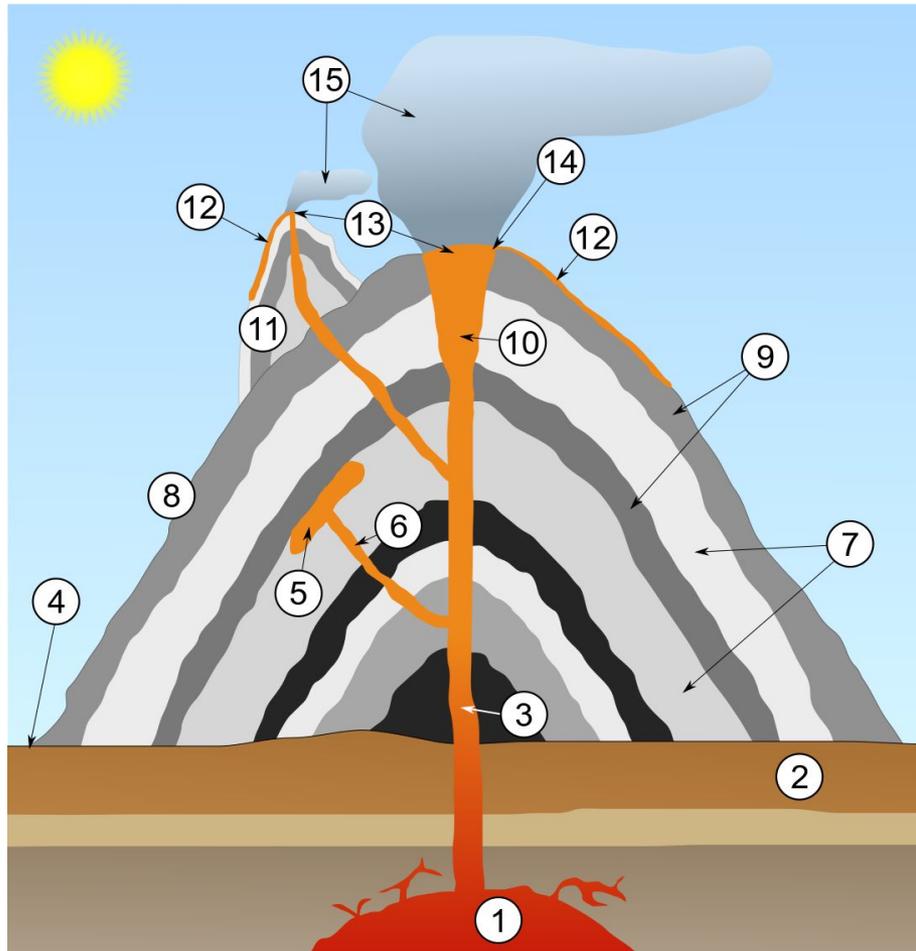
The screenshot shows the 'New Spatialite Layer' dialog box with the following fields and buttons:

- Database: /home/rjhale/test.sqlite
- Layer name: crater
- Geometry column: geometry
- Type: Polygon (selected)
- CRS: EPSG:4326 - WGS 84
- Buttons: Specify CRS, Add to attributes list, Remove attribute, OK, Cancel, Help

Red arrows indicate the following actions:

- Arrow from 'Pick a database name' to the Database field.
- Arrow from 'Pick a layer name' to the Layer name field.
- Arrow from 'Pick a type' to the Polygon radio button.
- Arrow from 'Pick a CRS' to the CRS dropdown.
- Arrow from 'Add one field - it's required' to the Name field in the 'New attribute' section.
- Arrow from 'Click add attribute to list!' to the 'Add to attributes list' button.
- Arrow from 'Click OK' to the OK button.

Exercise 6

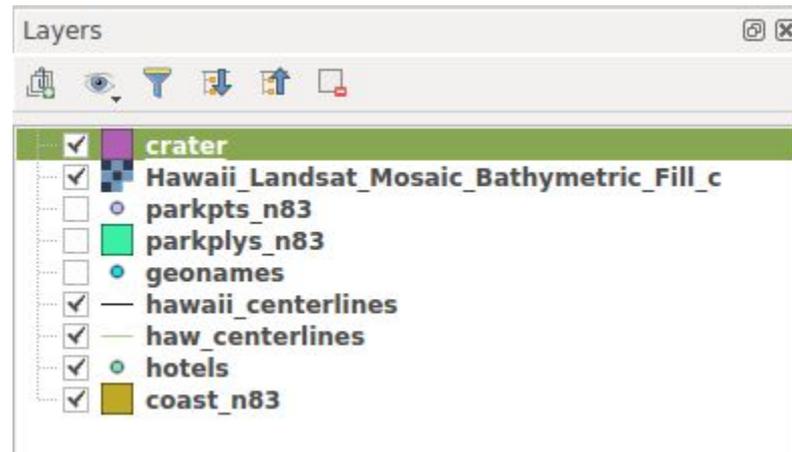


1. Large magma chamber
2. Bedrock
3. Conduit (pipe)
4. Base
5. Sill
6. Dike
7. Layers of ash emitted by the volcano
8. Flank
9. Layers of lava emitted by the volcano
10. Throat
11. Parasitic cone
12. Lava flow
13. Vent
14. Crater
15. Ash cloud

The main Volcano is Mauna Loa

Exercise 6

5. Select your crater layer in the Map Layer Panel

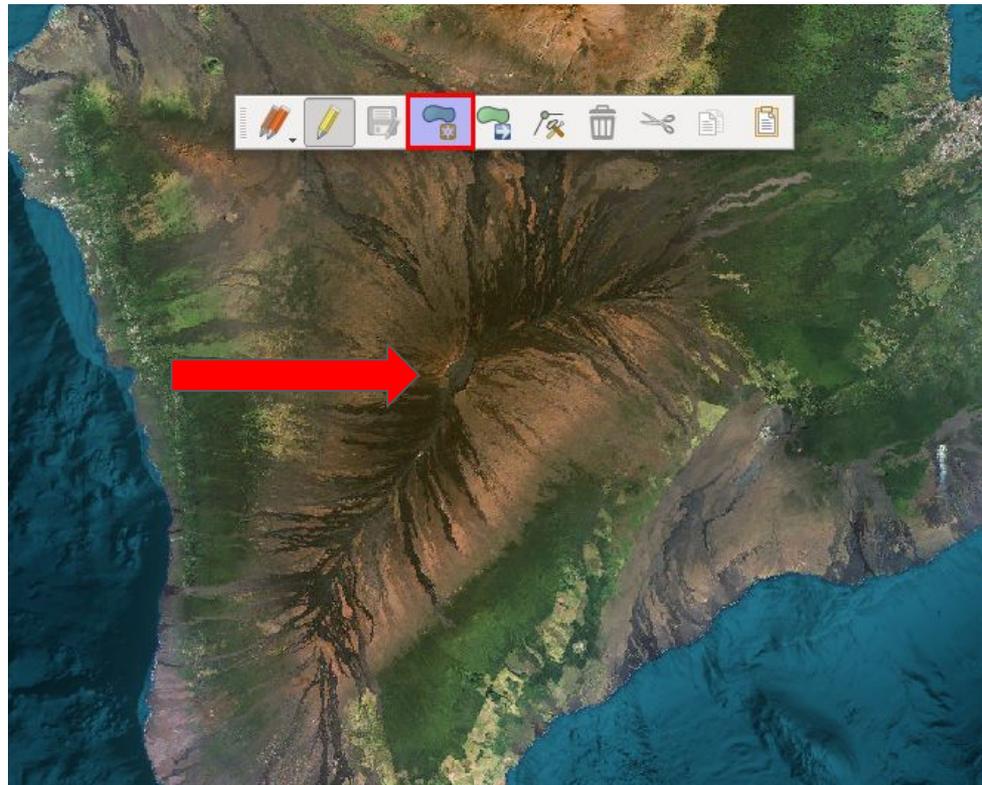


6. On the digitizing toolbar click “Toggle Editing”



Exercise 6

7. Digitize a polygon around the main crater on Hawaii.

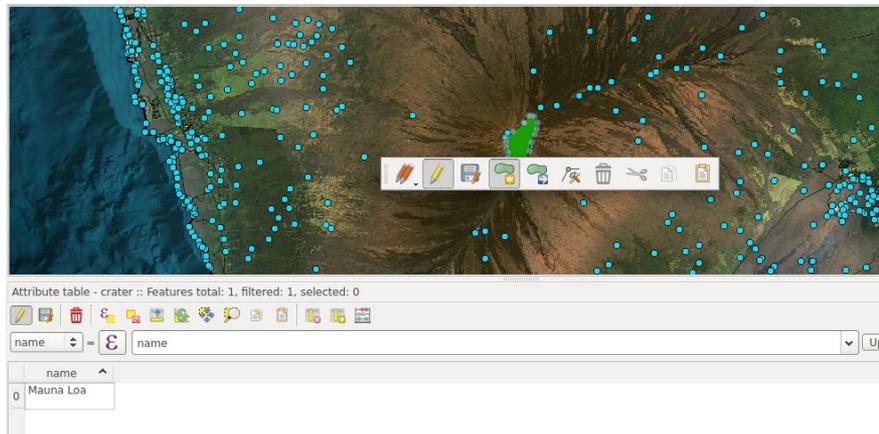


Exercise 6

8. Once you digitize your polygon - Record a name. Click OK



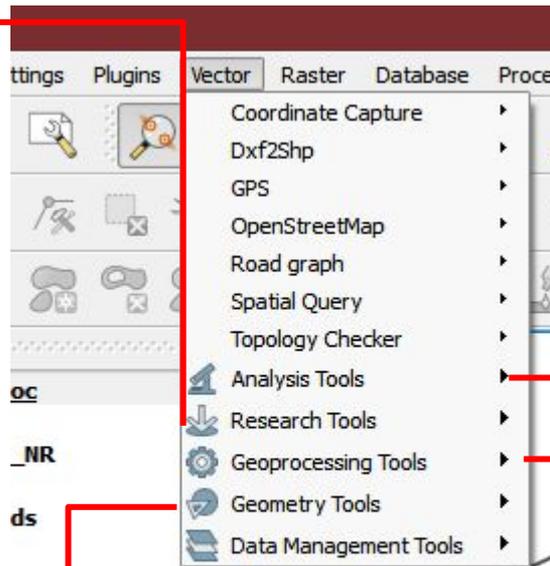
9. Right click your crater layer and open the attribute table



Analysis: Vector Geoprocessing

- Random selection
- Random selection within subsets
- Random points
- Regular points
- Vector grid
- Select by location
- Polygon from layer extent

- Check geometry validity
- Export/Add geometry columns
- Polygon centroids
- Delaunay triangulation
- Voronoi Polygons
- Simplify geometries
- Densify geometries
- Multipart to singleparts
- Singleparts to multipart
- Polygons to lines
- Lines to polygons
- Extract nodes



The screenshot shows the 'Vector' menu with the following items:

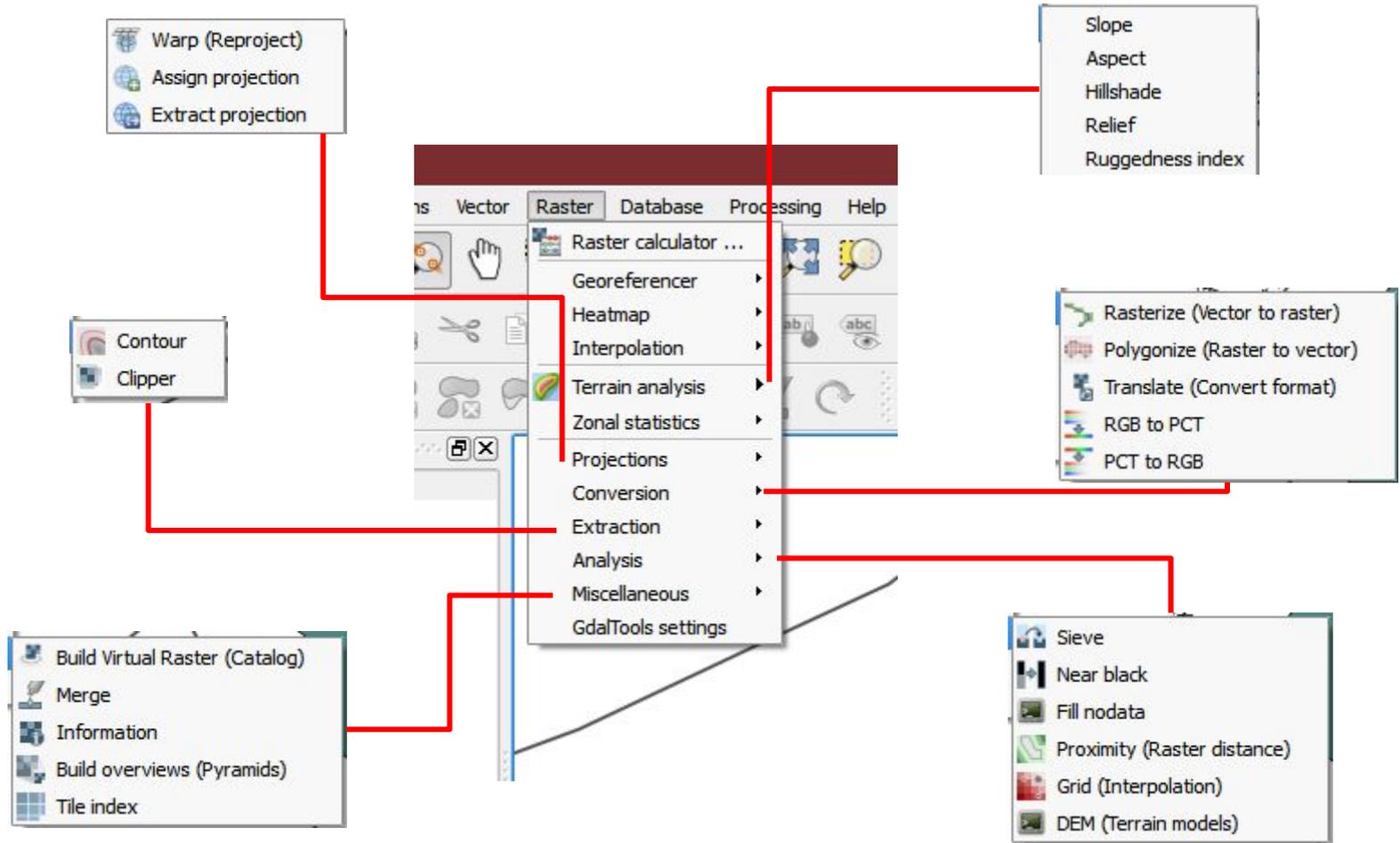
- Coordinate Capture
- Dxf2Shp
- GPS
- OpenStreetMap
- Road graph
- Spatial Query
- Topology Checker
- Analysis Tools
- Research Tools
- Geoprocessing Tools
- Geometry Tools
- Data Management Tools

- Distance matrix
- Sum line lengths
- Points in polygon
- List unique values
- Basic statistics
- Nearest neighbour analysis
- Mean coordinate(s)
- Line intersections

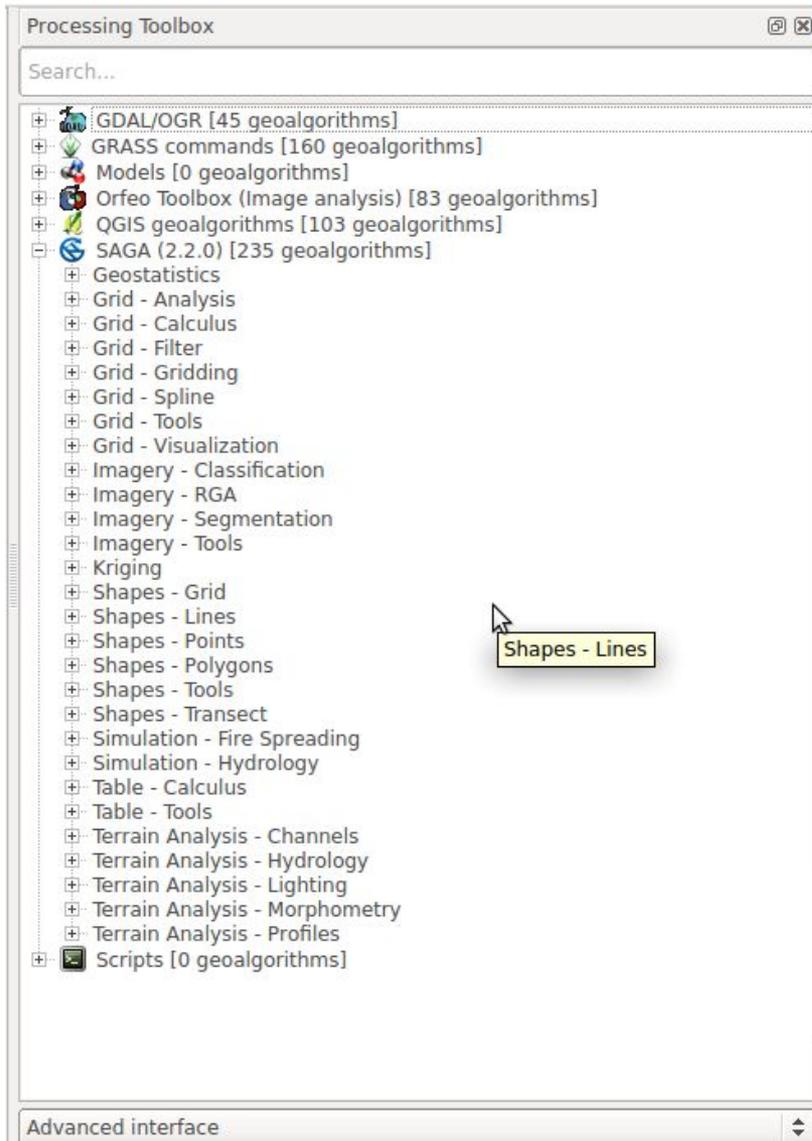
- Convex hull(s)
- Buffer(s)
- Intersect
- Union
- Symmetrical difference
- Clip
- Difference
- Dissolve
- Eliminate sliver polygons

- Define current projection
- Join attributes by location
- Split vector layer
- Merge shapefiles to one
- Create spatial index

Analysis: Raster Processing



Analysis: Processing Toolbox



Equivalent to Spatial Analyst

Provides seamless access to multiple software tools like:

- GRASS
- SAGA
- GDAL
- LAS TOOLS
- ORFEO
- QGIS Core Functionality

Processing Models can be built very similar to ArcGIS's Model Builder

Don't forget PYTHON!

Intro to QGIS

Main topics covered during the workshop

I. Navigating the Interface

II. Project Configuration

III. Analysis

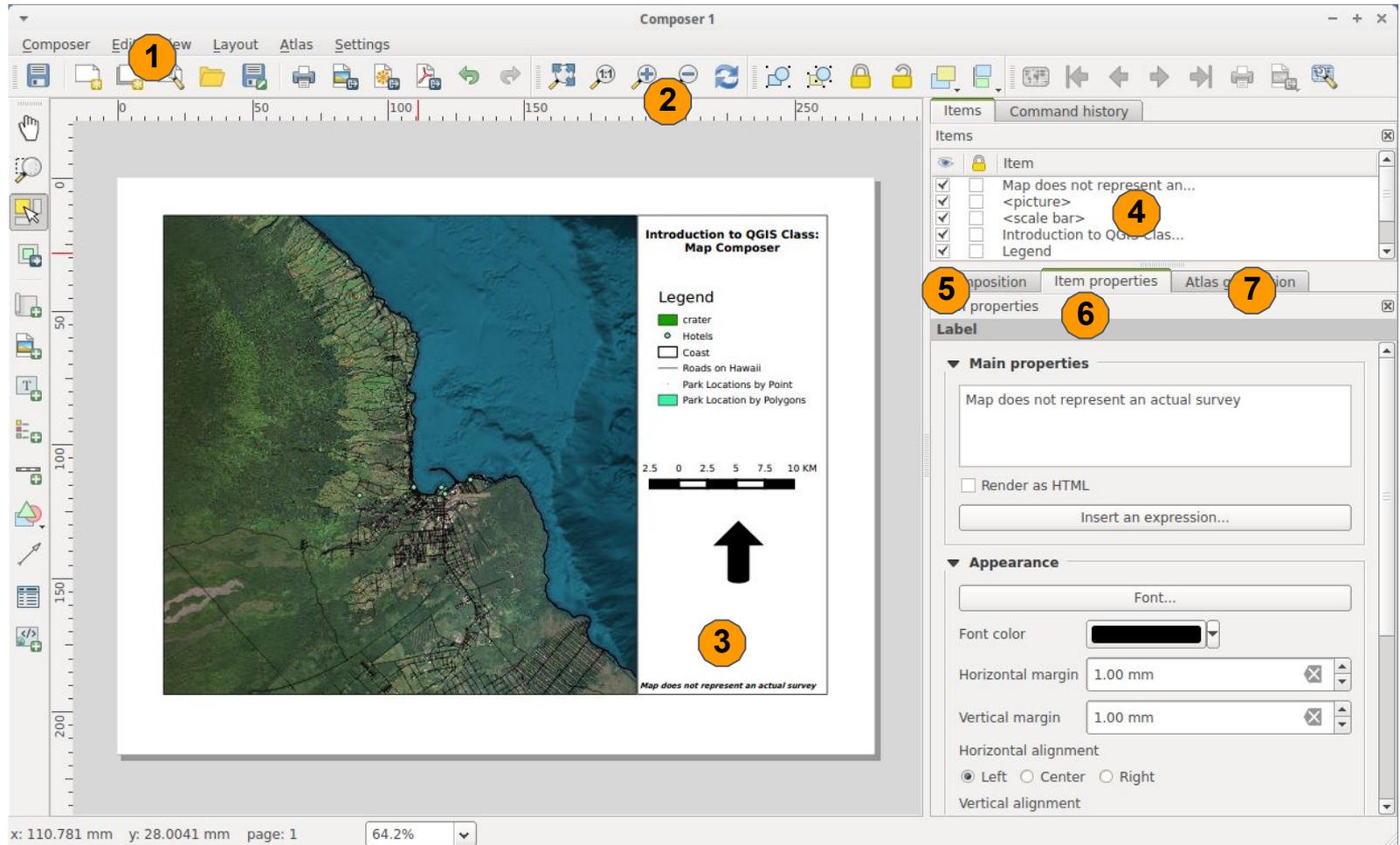
IV. Print Composer

Print Composer

Topics:

- Print Composer
- Adding your Map
- Adding Map Elements
- Saving your Map

Print Composer:



Print Composer interface: 1. Menu Bar; 2. Tool Bar; 3. Map Layout;
4. Command History; 5. Composition; 6. Item Properties; 7. Atlas Generation

Print Composer



- Saving Map Composition
- New Composer
- Duplicate Composer
- Composer Manager
- Load From Template
- Save as Template
- Print
- Export as image
- Export as SVG
- Export as PDF
- Revert Last Change
- Restore Last Change



- Zoom to full Extent of Map Composition
- Zoom in
- Zoom out
- Refresh Display

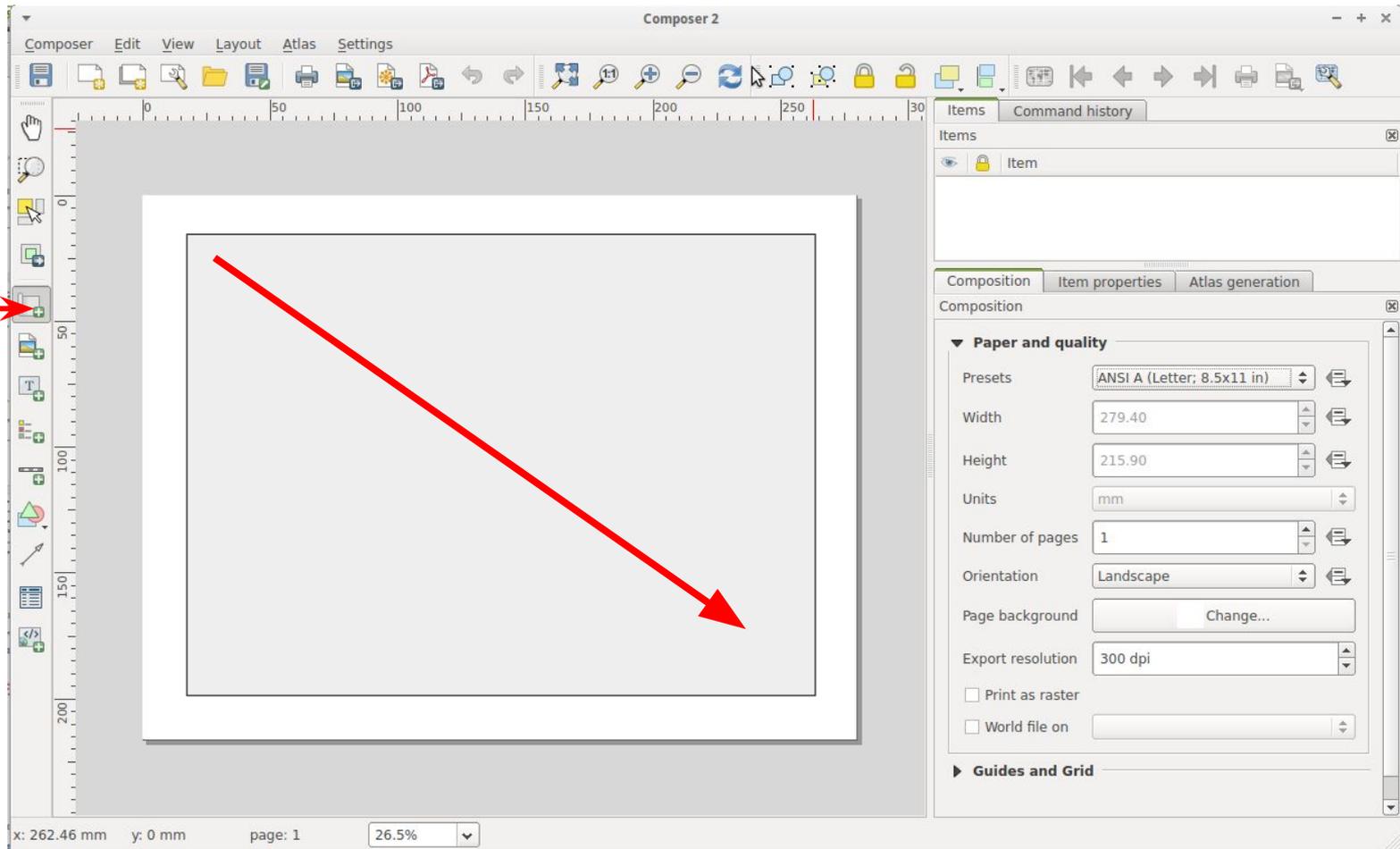
Print Composer

The print composer provides growing layout and printing capabilities.

- “Window” to map canvas (ESRI = data frame)
- Text labels (ESRI = annotation/text elements)
- Images (graphics/pictures)
- Basic shape elements
- Attribute tables
- HTML frames
- Map elements (legends, scalebars, north arrows, and title)
- To open a new print composer window click **Project > New Print Composer**.
- You can have as many as the QGIS project can handle!

Print Composer: Map

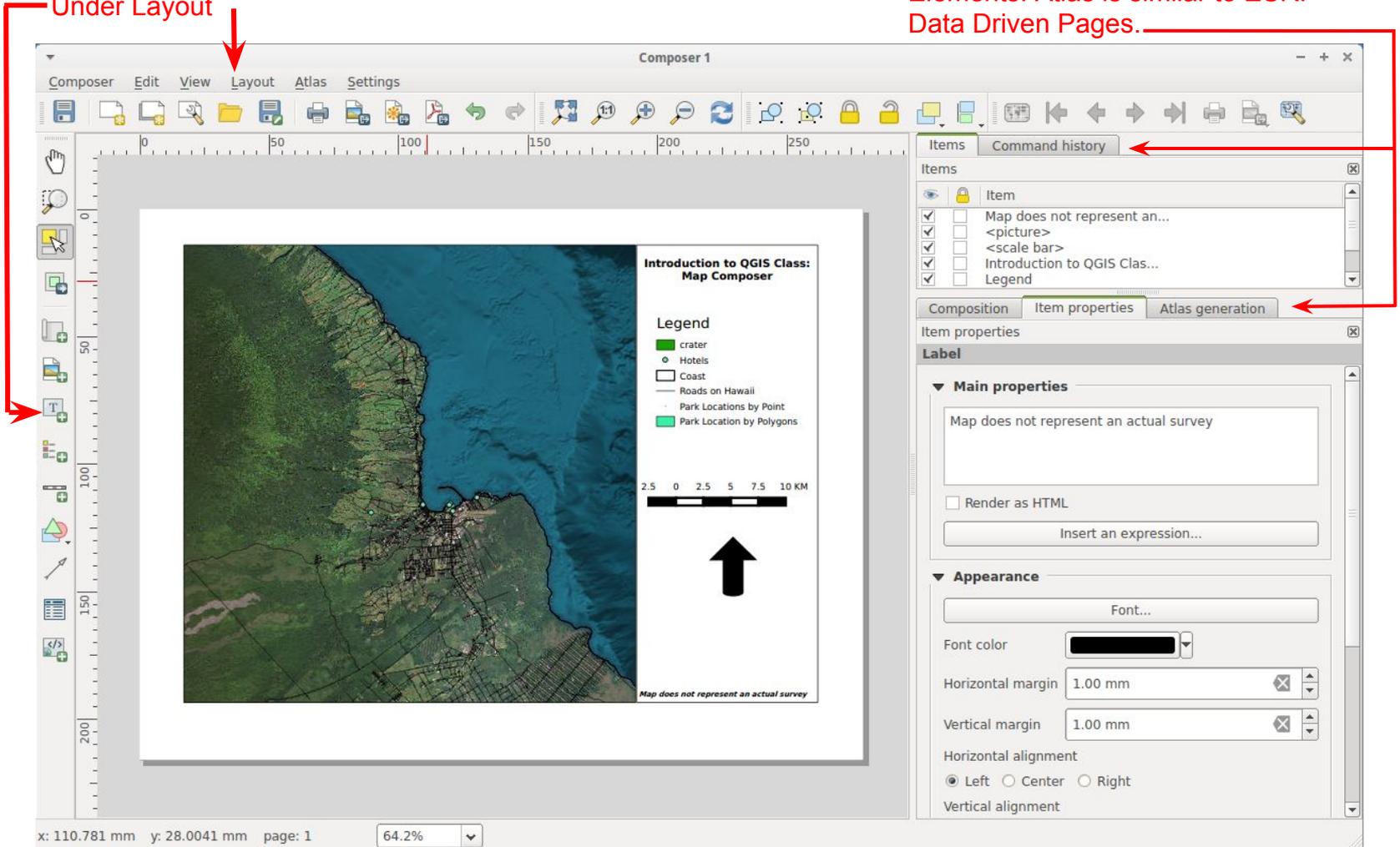
Click on Add New Map button then draw a rectangle for where the Map Canvas will appear.



Print Composer: Map Elements

Add map elements by clicking On the icons or they are found Under Layout

These areas keep track of changes and allow you to customize map Elements. Atlas is similar to ESRI Data Driven Pages.



The screenshot displays the QGIS Print Composer interface. The main window shows a map layout titled "Introduction to QGIS Class: Map Composer". The map includes a legend with categories: crater (green square), Hotels (green circle), Coast (blue line), Roads on Hawaii (black line), Park Locations by Point (green dot), and Park Location by Polygons (green polygon). A scale bar indicates 2.5, 0, 2.5, 5, 7.5, and 10 KM. A large black arrow points upwards from the scale bar. The map is surrounded by a white border with a scale in millimeters (0 to 200) and a zoom level of 64.2%.

The interface includes a menu bar (Composer, Edit, View, Layout, Atlas, Settings) and a toolbar with various icons. On the right side, there are three panels: "Items" (listing map elements like "Map does not represent an...", "<picture>", "<scale bar>", "Introduction to QGIS Clas...", and "Legend"), "Item properties" (with a "Label" section containing a text box "Map does not represent an actual survey", a "Render as HTML" checkbox, and an "Insert an expression..." button), and "Atlas generation" (with a "Main properties" section containing a "Font..." button, "Font color" dropdown, "Horizontal margin" and "Vertical margin" input fields, and "Horizontal alignment" and "Vertical alignment" radio buttons).

Red arrows point to the "Layout" menu, the "Items" panel, the "Atlas generation" panel, and the "Main properties" section of the "Item properties" panel.

Print Composer: Map Elements

Once the map has been added, decorations or elements can be added. Their properties, as well as the page properties, can be viewed and modified. The Print Composer tracks changes in the Command History window.

Composition Tab:

- Set the Page Size
- Snap to Grid
- Snap to Extents
- Map Units: Inches or MM

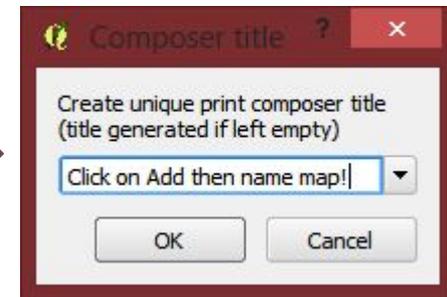
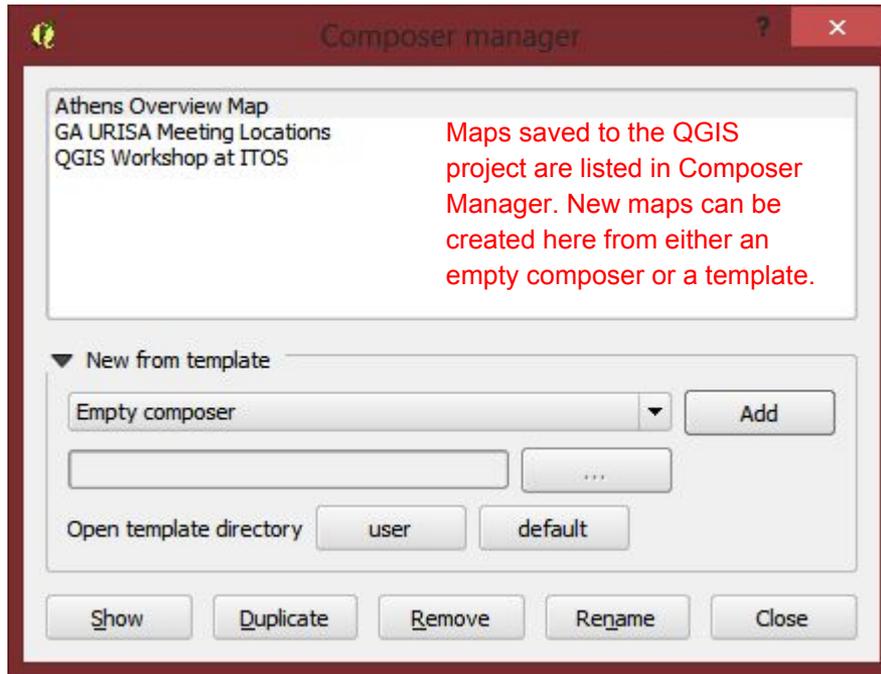
Item Properties Tab:

- Set the Font
- Set Scale Bar Properties
- Set Legend Properties
- Set Map Element Properties

Atlas Generation Tab:

- Create Automated Map Books

Print Composer: Saving



The Composer Manager is accessed from both the project and Print Composer. Project > Composer Manager or Composer > Composer Manager.

Exercise 7

1. Follow Along and Let's make a map!

Have Questions? Need Support?:

The Google is your friend! Most searches will lead you to common support resources, like:

- Mailing Lists
- Forums
- StackExchange
- Chat
- Issue Tracker
- Commercial Support (NRGS is on this list!)

Find links to all the above at:

<http://www.qgis.org/en/site/forusers/support.html>

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