Annex 03

THE WORLD BANK

REDD+ FIJI

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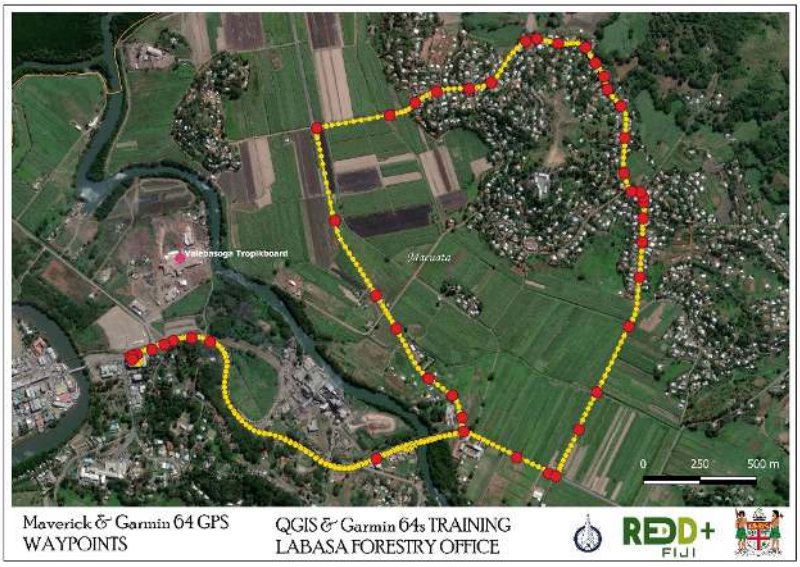


1.0 GEOGRAPHIC INFORMATION SYSTEM (GIS)

GIS is a technological field that incorporates geographical features with tabular data in order to map, analyse, and assess real-world problems. It is an organized collection of computer hardware, software, geographic data, and personnel to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information.

The main functions of a GIS are:

- *Data Capture*
  The input of data into a GIS can be achieved through many different methods of gathering. For example, aerial photography, scanning, digitizing, GPS or global positioning system is just a few of the ways a GIS user could obtain data.
- *Data Storage*
  Some data is stored such as a map in a drawer, while others, such as digital data, can be as a hardcopy, stored on DVD, on your hard drive or in the cloud (internet).
- *Data Manipulation*
  The digital geographical data can be edited, this allows for many attribute to be added, edited, or deleted to the specification of the project.
- *Query and Analysis*
  GIS can be used to analyse your datasets against another and often produces helpful trends and data aggregations that serve as the basis for sound decision making.
- *Visualization*
  This represents the ability to display your data, your maps, and information

A GIS is made up of:

- *Hardware*
  Computer System, Scanner, Printer, Plotter, Flat Board
- *Software*
  GIS software in use are QGIS, MapInfo, ArcGIS, AutoCAD Map, etc. The software available can be said to be application specific.
- *Data*
  A GIS will integrate spatial data with other data resources and can even use a DBMS, used by most organization to maintain their data, to manage spatial data.
  Geographic data and related tabular data can be collected in-house or purchased from a commercial data provider.
- *People*
  GIS users range from technical specialists to designers and maintenance teams. QGIS has a range of developers who contribute plugins that can automate GIS processes.
- *Method*
  The map creation can either be automated raster to vector creator or it can be manually digitized using the satellite/drone imagery or scanned images.

2.0 COORDINATE REFERENCE SYSTEMS

A coordinate is a set of two or more numbers that specifies the position of a point, line, or other geometric figure in relation to some reference system.

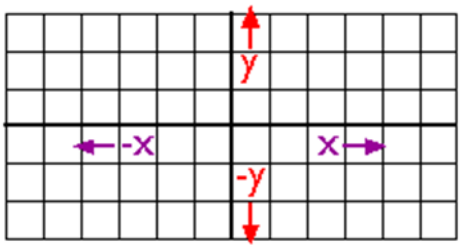


Diagram of a Cartesian coordinate system

The simplest system of this kind is a Cartesian coordinate system. A Cartesian coordinate system is simply a grid formed by two adjacent measurement scales, one horizontal (x) and one vertical (y). The point at which both x and y equal zero is called the **origin** of the coordinate system.

2.1 GEOGRAPHIC COORDINATE REFERENCE SYSTEMS

A **geographic coordinate system** is designed specifically to define positions on the Earth's roughly-spherical surface. Instead of the two linear measurement scales, x and y, the geographic coordinate systems are represented by two curved measurement scales. The east-west scale, called **longitude**, ranges from +180° to -180°. Because the Earth is round, +180° (or 180° E) and -180° (or 180° W) are the same grid line. That grid line is roughly the International Date Line, which has diversions and passes Taveuni Island. Opposite the International Date Line is the **prime meridian**, the line of longitude defined by international treaty as 0°. The north-south scale, called **latitude,** ranges from +90° (or 90° N) at the North pole to -90° (or 90° S) at the South pole.

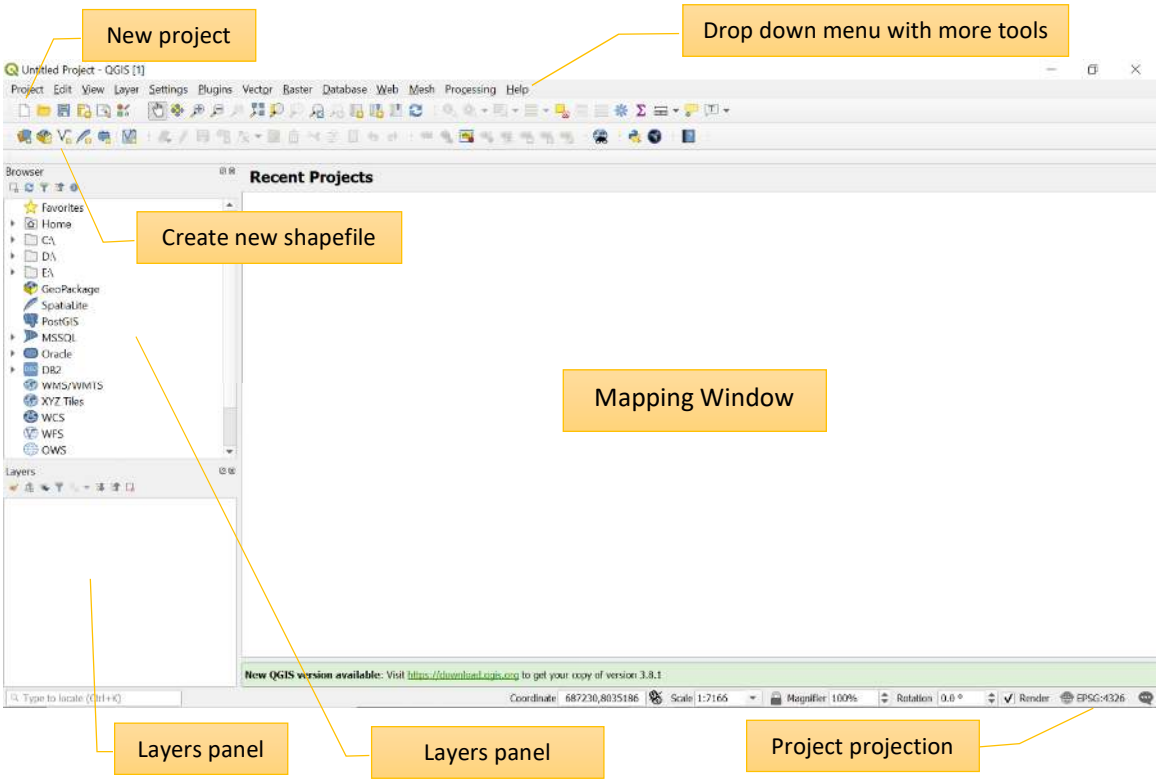
The different applications of GIS uses different Coordinate Systems. GIS in aviation and marine applications uses Global Projections. The main global projection used is Geographic Coordinates using Latitudes and Longitudes, **World Grid System (WGS) 1984, EPSG: 4326**.

A second global projection used mainly by surveyors is the **Universal Transverse Mercator WGS 1984, EPSG: 32760.**

Fiji GIS applications like mapping and boundary definitions need a reprojected system that 'fits' the Fiji Islands much better than global projections. For that purpose, most GIS applications and mapping in Fiji uses the **Fiji Map Grid, WGS 1986, EPSG: 3460.**

You'll most likely use one of these three for Forestry applications and mapping in Fiji.

3.0 THE QGIS INTERFACE



4.0 DATA FORMATS AND STRUCTURE

QGIS can open a lot of data formats.

Formats that QGIS can open include:

Vector	**Raster**
Shapefiles → .SHP	Joint Photograpic Experts Group → .JPEG, .JPG
MapInfo files → .TAB	Bitmap Picture → .BMP
GPS Exchange Format → .GPX	Enhanced Compression Wavelet → .ECW
Autocad Files → .DWG	Tagged Image File Format → Geotiff, .TIF
Key Markup Language → .KML, KMZ	Key Markup Language → .KML, KMZ

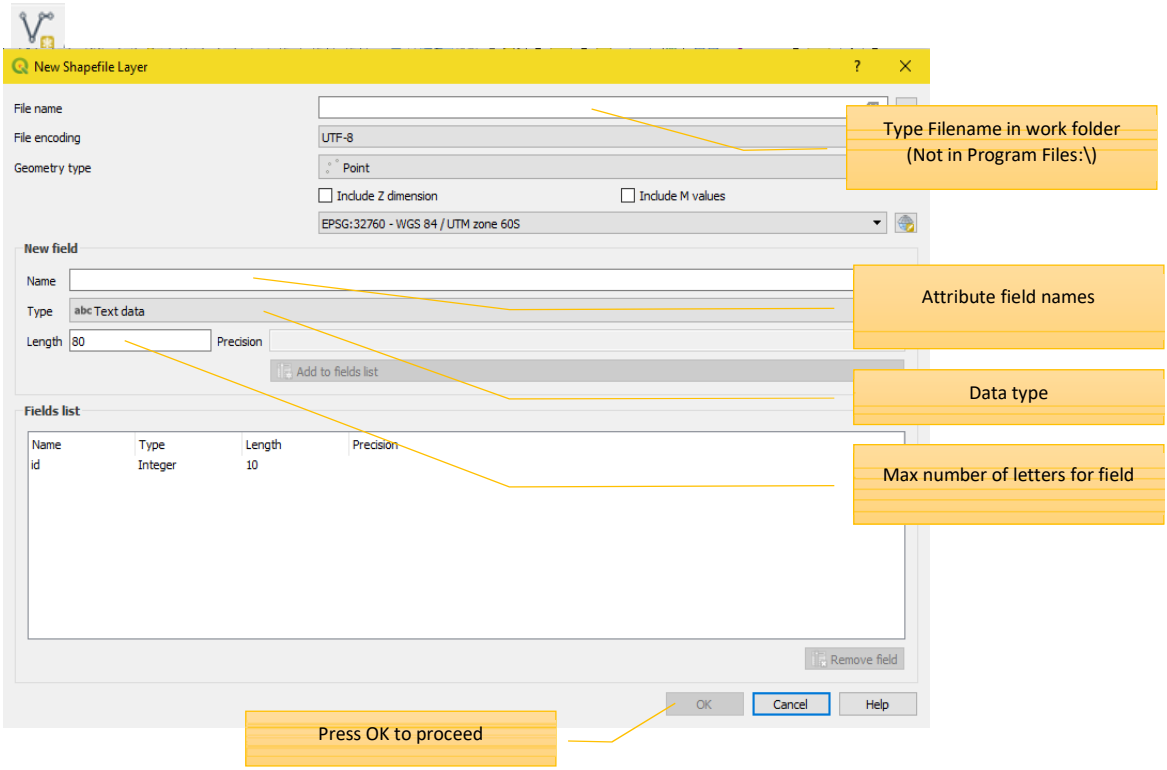
The data structure is dependant on the user and the feature that will be captured.

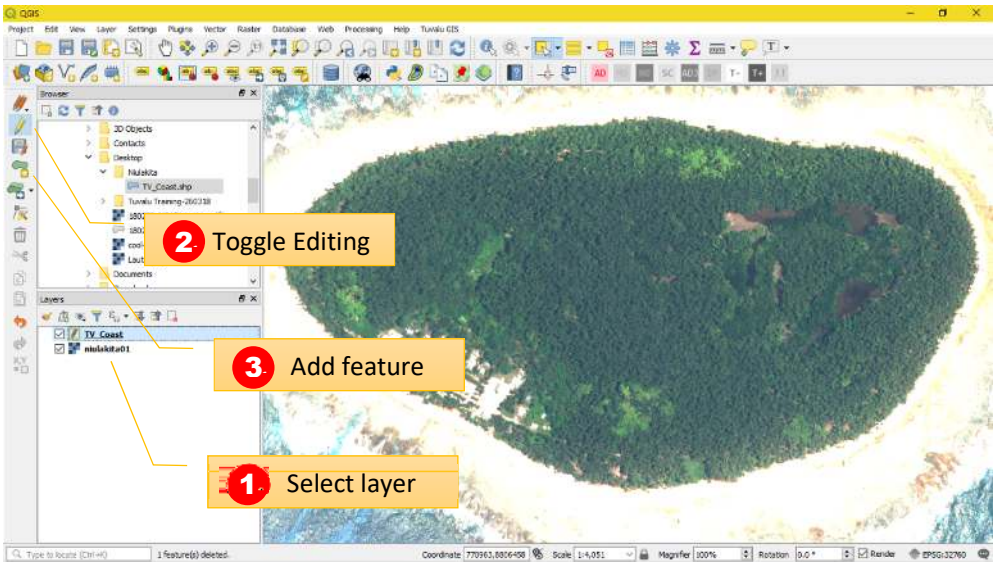
For example:

For features with boundaries like Harvest Area, you'll need an area field with a decimal feature type. Utilising the *Field Calculator*, you'll select the *Update existing field* checkbox and use the **$area** formula to tabulate your area field.

5.0 CREATING VECTORS

- Click on  to create a new vector layer



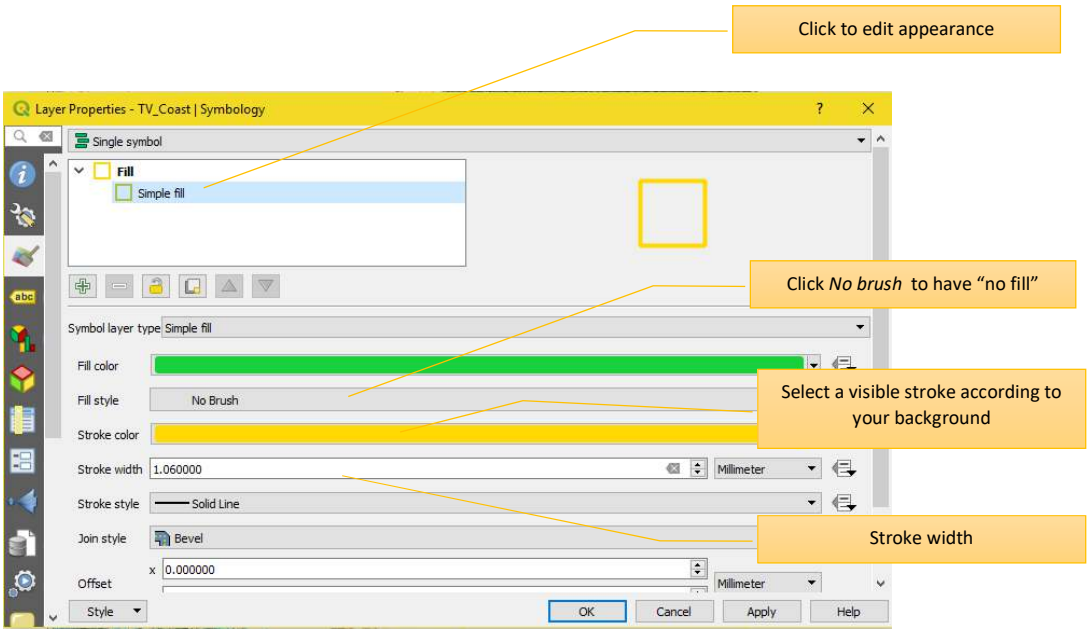


- Click on the image and begin digitising
- Right click to close/end digitising
- Fill attribute table

6.0 DATA THEMES

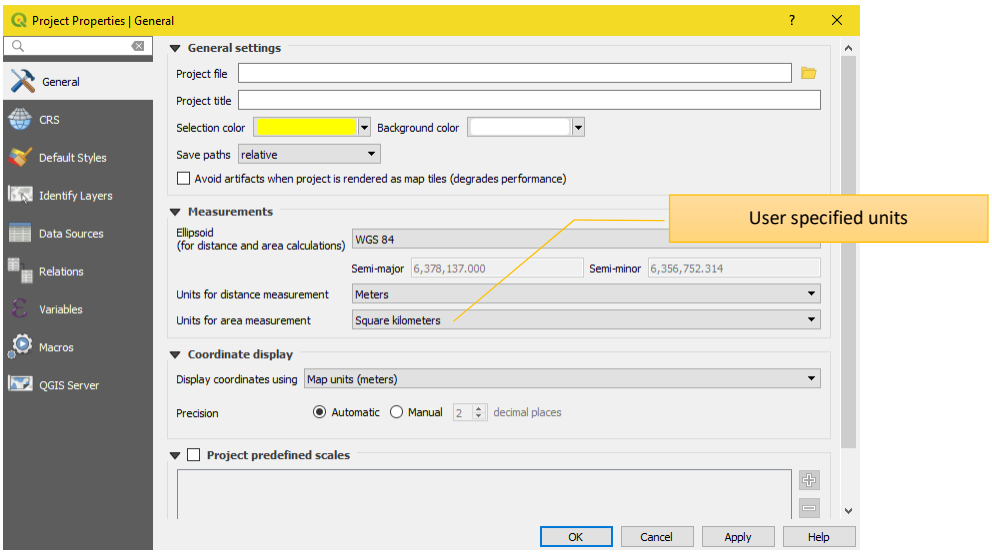
This refers to how we change layer properties (Colours/Labels)

- Right click on target layer
- Click *Properties*



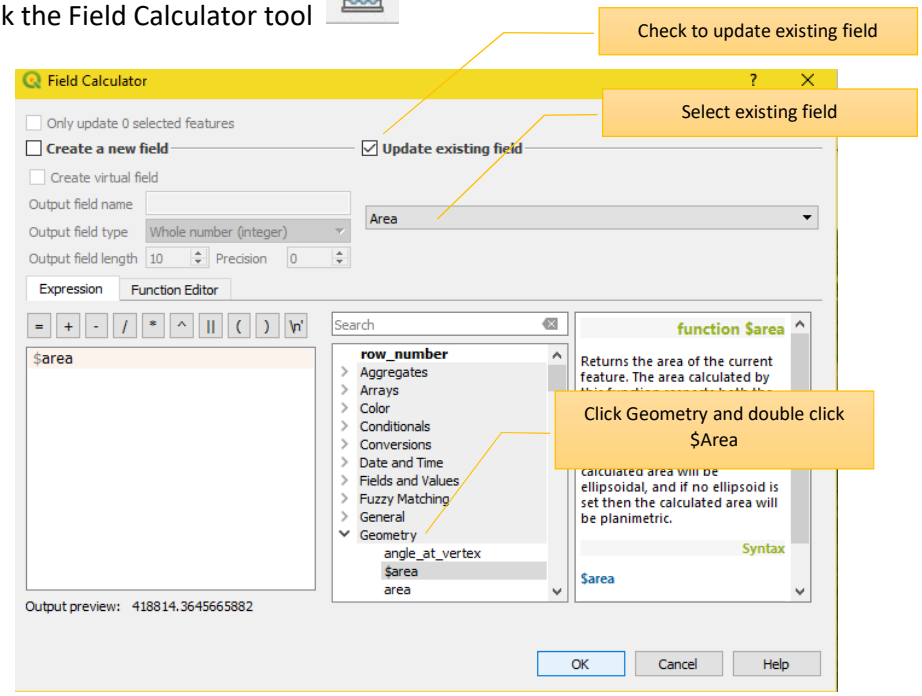
7.0 UPDATE AREA FIELD

- Click Project tab → Project Properties and General section
- Select appropriate units for measurement



Change to Hectares

- Click the Field Calculator tool 



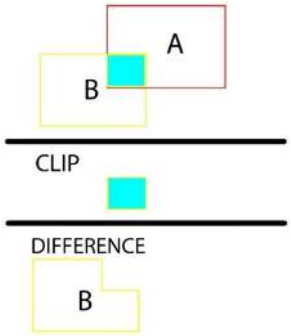
- Click OK to proceed

8.0 VECTOR EDITING

- Use  to select features on the map window. Selected features are shown in yellow.
- To combine 2 features, select both, click on *Edit* and click *Merge Selected Features.*

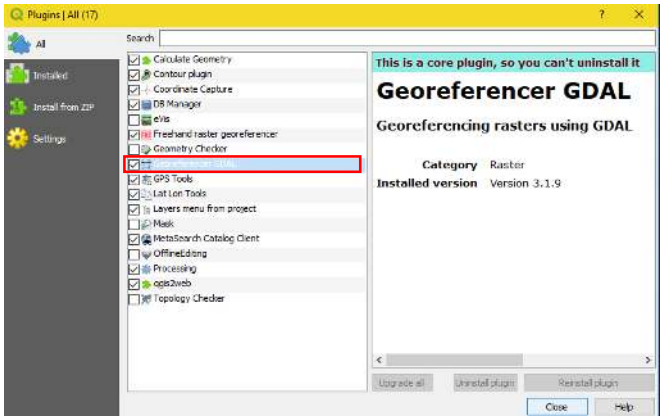
Clip creates a new shape based on the area of the input layer that is overlapped by the clipping layer.

Difference creates a new feature based on the area of the input layer that isn't overlapped by the clipping layer.

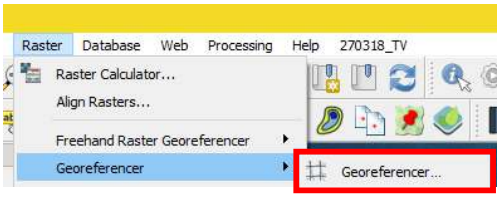


9.0 THE GEOREFERENCER TOOL

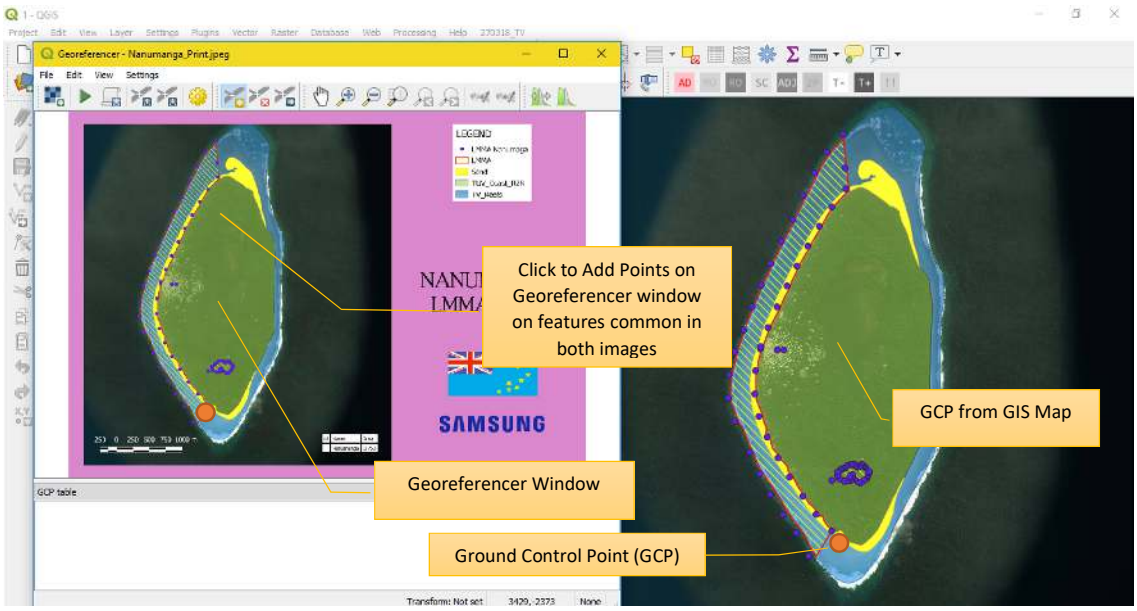
Historic maps can be 'georeferenced' and used as backdrops for GIS. The 'Georeferencer GDAL' plugin can be enabled (Check box) in the Plugins menu.



The tool *Georeferencer* can be accessed under the *Raster* menu

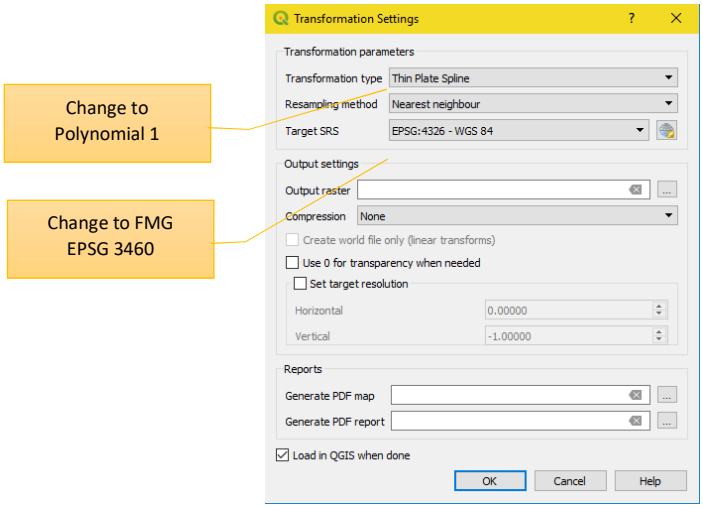


Click on  and browse to the raster image that you need to georeferenced



Click on *Transformation Settings*  to set your preferred transformation parameters

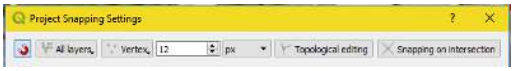
Two important parameters to configure correctly here are Transformation Type and Target SRS (Projection)

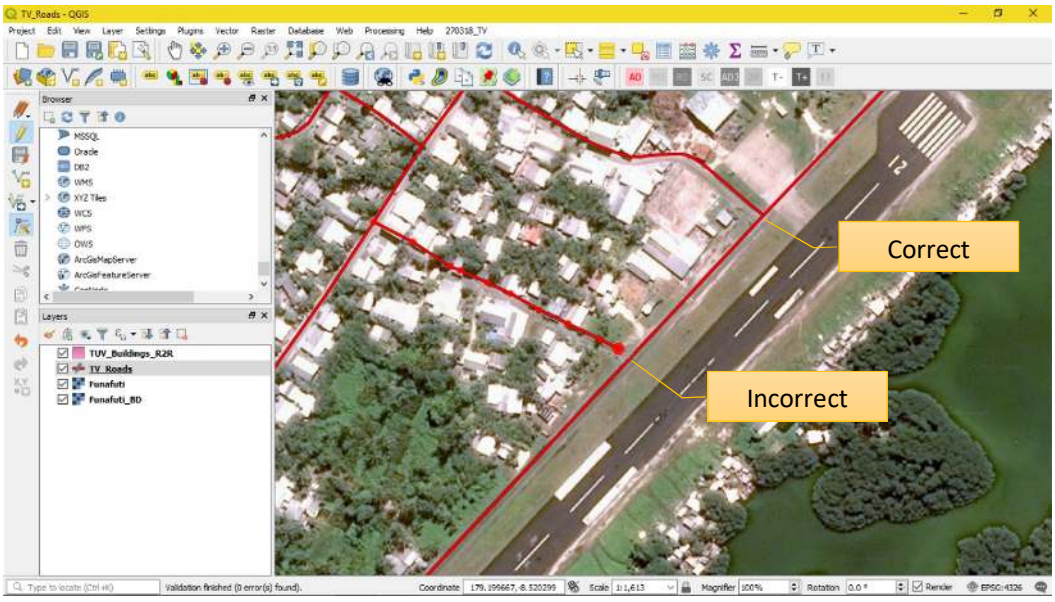


A good georeferenced image will sit perfectly on the raster backdrop. Good features to use for this purpose include road junctions, prominent building features, ridges and valleys and certain hydrological features

10.0 DIGITISING NETWORKS (ROADS, HYDROLOGY ETC)

Important to enable *Snap* from Project Menu *(Snapping Properties)* when digitising connected networks.





11.0 ADVANCED LABELLING

- ✓ Access the labels in properties and click *'Single Labels'*
- ✓ Click the *'Label with'* drop down menu and select the layer you want to label your features with.

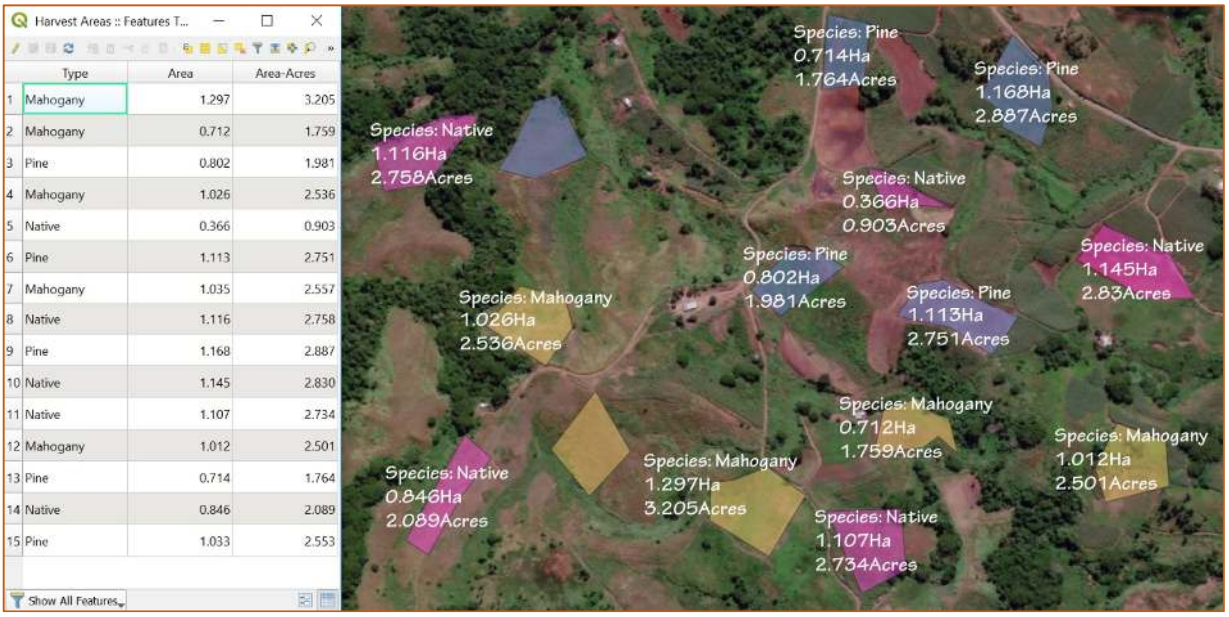
To show two or more field labels you'll have to use a formula.

Access the formula field by clicking on  next on the *label with* drop down box.

Use the formula below to label the corresponding harvest plan map with more than one label (as shown below)

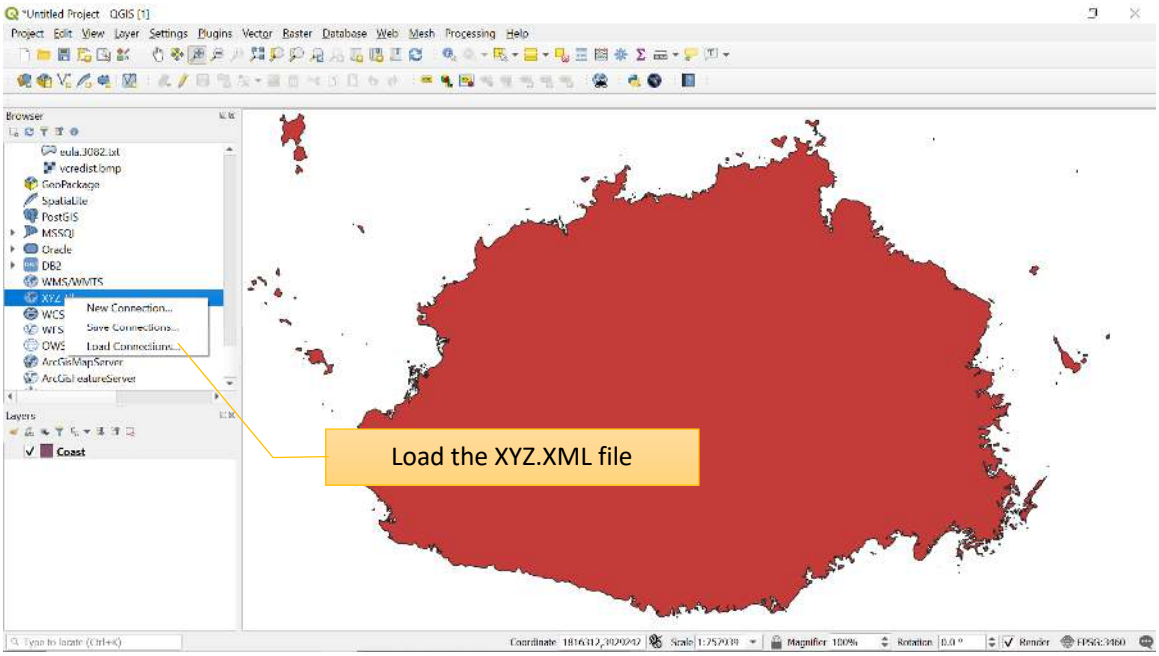
```
'Species' ||':' ||' ' || "Type" || '\n' || "Area" || 'Ha' || '\n' || "Area-Acres" ||'Acres'
```

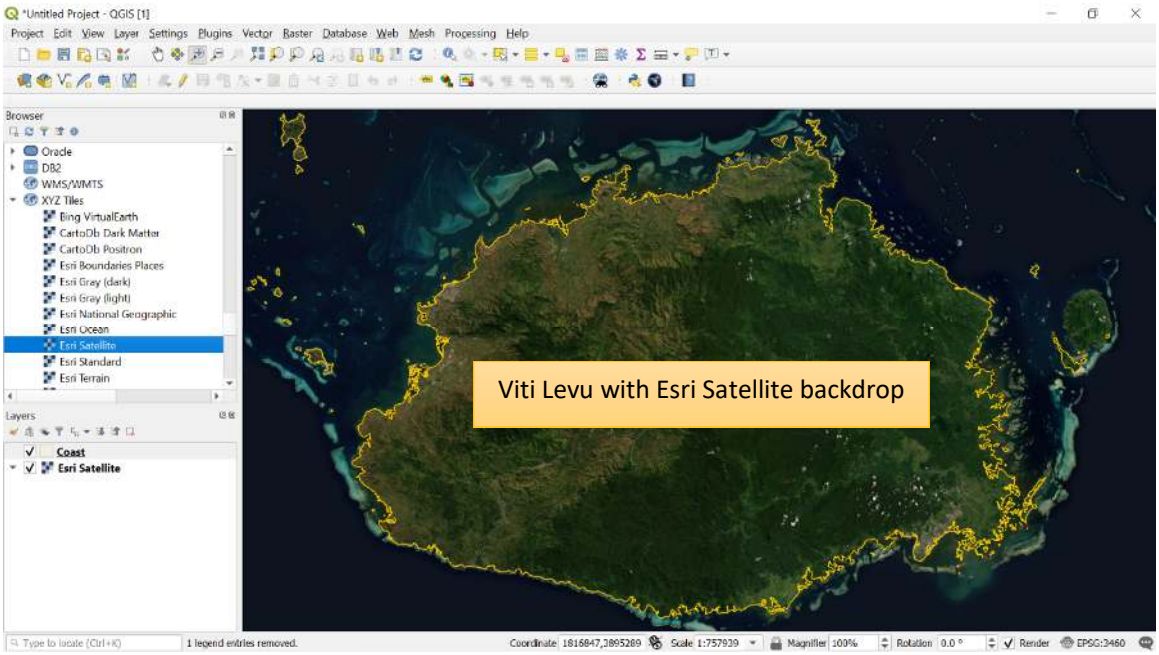
- || Text Separator
- '\n' Creates a new line
- "Area" Put inside " " the field names in your attribute table
- '*Sample*' Put inside ' ' any additional text you want shown eg. units



12.0 ONLINE IMAGE SOURCES – XYZ Tiles

Various online imagery providers host data on their servers which could be accessed through the XYZ Tiles connection. You will need internet connectivity to access these files.



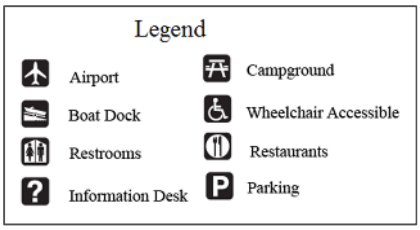


13.0 MAP PRODUCTION – Layouts

Map Layout is the assembling of the various elements of a map into a single whole, including the map itself, its legend, title, scale bars, and other elements.

LEGEND

A map legend, or map key, is an explanation of the symbols or pictorial language and convention of the map. Legend content, design and placement are important because a map can fail to communicate its message if readers cannot determine what the symbols in the map are intended to represent." Not all symbols used on the map necessarily need to be included in the legend; Symbols that are intuitive, conventional, well-labeled, or unimportant may be left out with careful consideration. Maps with highly standardized symbology, such as street maps or topographic maps, may remove the legend altogether.



Elements of legend design

- A legend includes four parts: content, wording, placement, and style.
- Symbols must look exactly like the symbol used on the map in order to ensure viewer comprehension. This is particularly important in regards to size.
- The legend title should be explanatory and make a clear connection to the map's legend.

MAP TITLE

The **title** of the map gives the audience the contextual information that they need to use the map properly.

REPRESENTING SCALE

Including a scale on a map is essential because it explains the size relationship between one and two dimensional features on the map and the part of the earth's surface it represents. Zero dimensional, or point features, have no size relationship with the map scale. There are three common ways to represent scale on a map:

- A **scale bar**, a ruler-like visual depiction of map distances to scale.
- A **representative fraction**, giving the mathematical ratio between distances on the map and distances on the ground (e.g., 1:25,000).
- A **verbal scale**, which describes a scale by comparing common map and ground measurements, such as '1 inch equals 2 miles

INSET MAPS

Inset maps are small maps projected onto the main map, which are used to depict an area of the map at a larger or smaller scale for a particular purpose

GRIDS

Grid references define locations in maps using Cartesian coordinates. Grid lines on maps define the coordinate system, and are numbered to provide a unique reference to each location on the map.

14.0 SAMPLE LAYOUTS