Coordinate Reference Systems in Quantum GIS

Coordinate reference systems (CRS) provide a framework for defining real-world locations. Data is represented using either a geographic coordinate system or a projected coordinate system.

Geographic coordinate system locations are defined in terms of the position on a globe using latitude and longitude values. The angles of latitude and longitude are based on a point at the centre of the earth. As the earth is not a perfect sphere a number of globes (spheres, spheroids) exist in mapping each with slightly different centre points and characteristics.

As locations are defined by degrees, distances cannot be accurately measured.

The most common geographic coordinate system is the World Geodetic System 84 (WGS84).

Projected coordinate system locations are defined using Cartesian x, y coordinates on a flat, two-dimensional surface. This enables accurate measurements of distance, angles and areas. Projected coordinate systems are based on a sphere (for example WGS84) that is projected onto a flat plane. Projected coordinate systems are often referred to as projections.

Common projected coordinate systems include

- Universal Transverse Mercator (UTM)
- Lambert Conformal Conic
- Albers Equal Area

For a more extensive introduction to coordinate reference systems please see Chapter 7 of the document ‘A Gentle Introduction to GIS (QGIS_Introduction_to_GIS) in the folder \\CIGIS\documents.

The coordinate reference systems used in the Christmas Island GIS and Cocos (Keeling) Islands GIS are projected coordinate systems based on the WGS84 sphere:

Christmas Island = UTM Zone 48 South WGS84

Cocos Island = UTM Zone 47 South WGS84

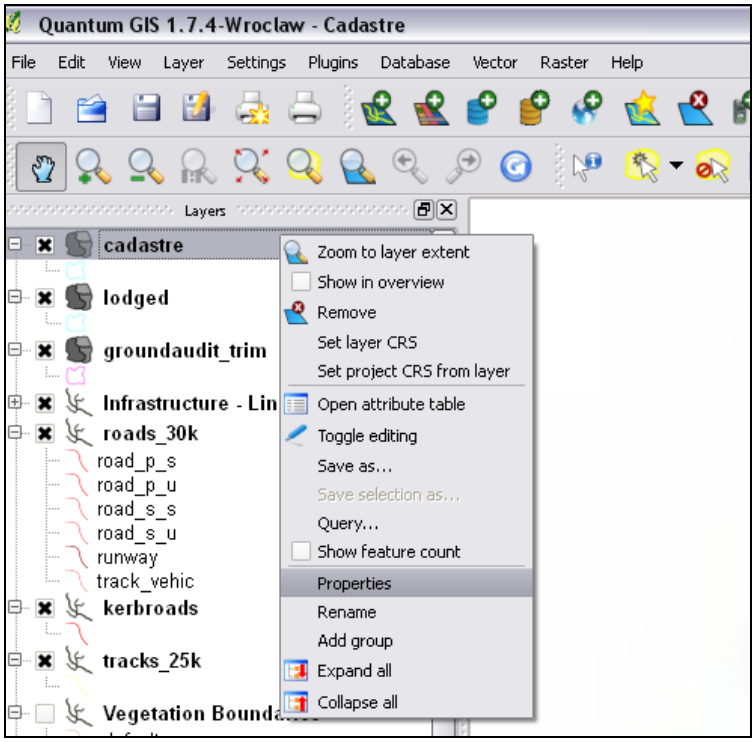
This guide covers the following:

- Checking the Coordinate Reference System of your Data Layer
- Project Coordinate Reference Systems
- On the Fly Coordinate Reference System Transformation
- Transforming Data Layers between Coordinate Reference Systems
- Defining the Coordinate Reference System of A Data Layer

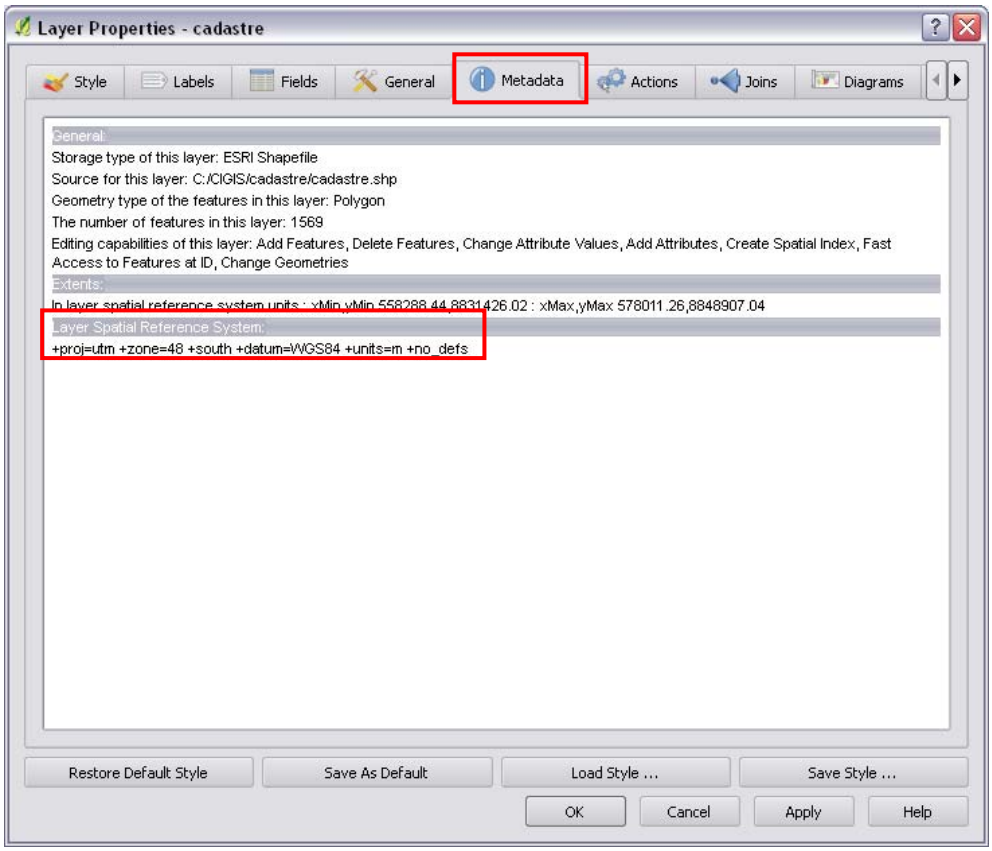
Checking the Coordinate Reference System of your Data Layer

To find out which coordinate reference system (CRS) your layer is in:

1. Right click on the layer name, then click *Properties.*



2. Click on the *Metadata* tab. The CRS is displayed under the *Layer Spatial Reference System* header. The example below shows that the layer projection is UTM, the zone is 48 South and the datum is WGS84.

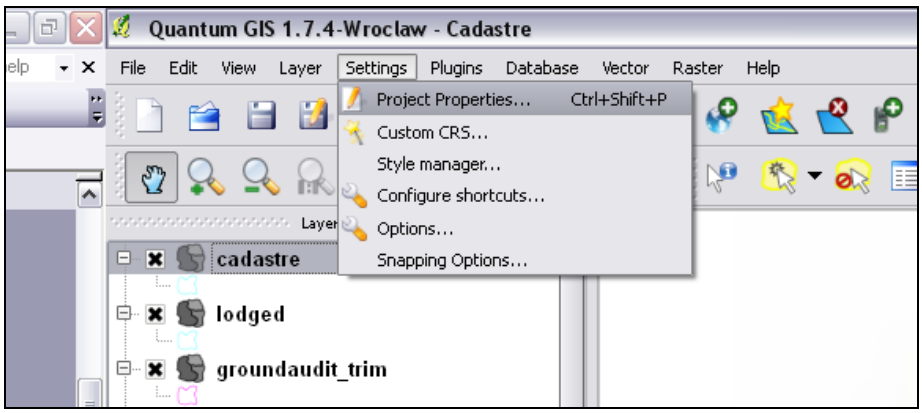


Project Coordinate Reference Systems

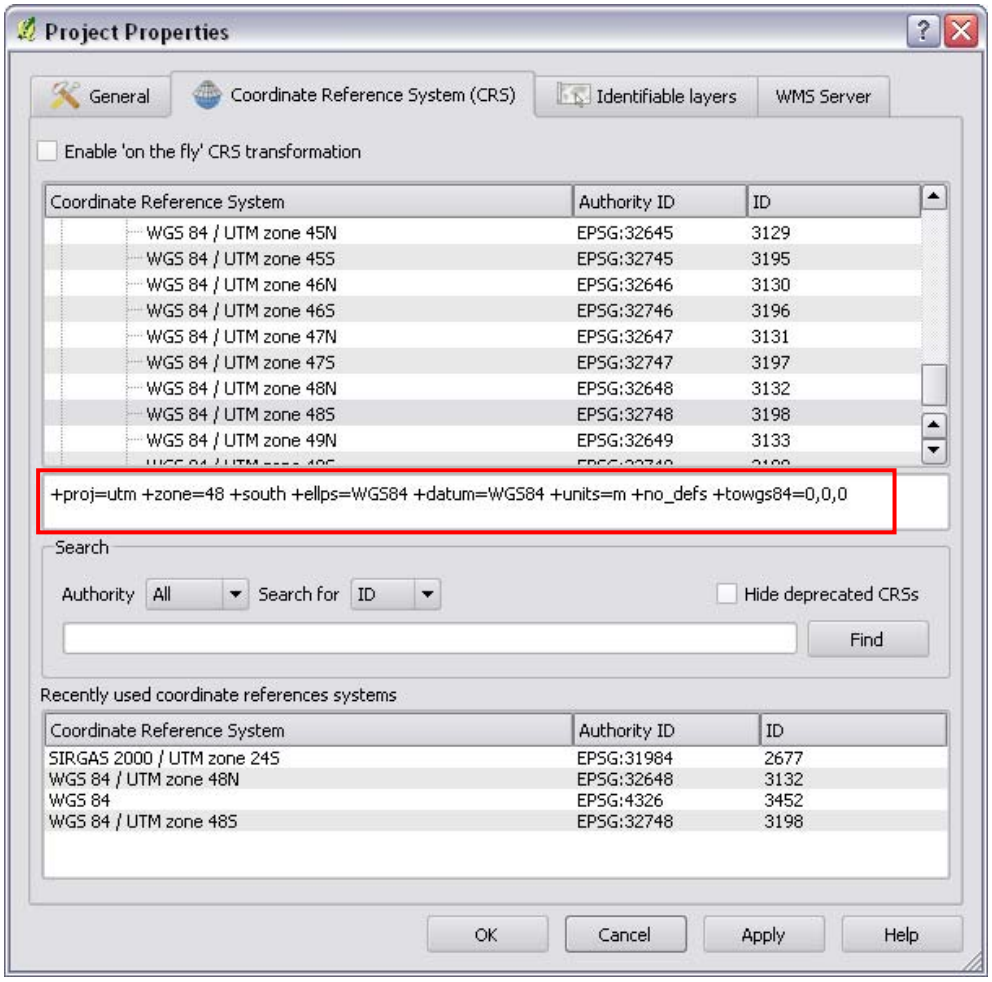
The CRS of the project you are working in affects how the data will be displayed. Layers with no specified CRS (eg no '.prj' file for shapefiles) will be displayed using the project CRS. New data layers created within the project will use the project CRS.

To check the CRS of your project:

1. Click *Settings* from the top menu bar, and then select *Project Properties.*

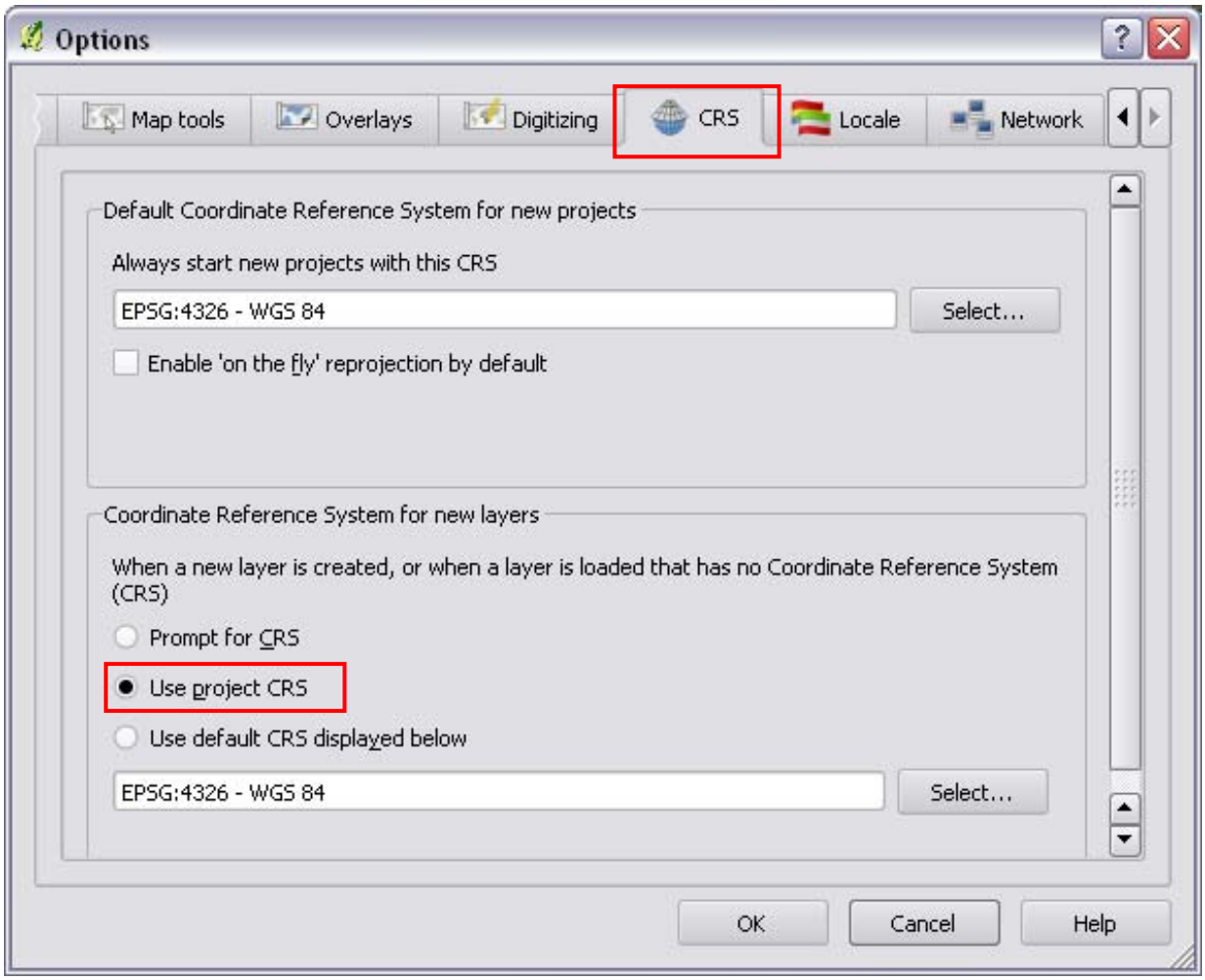


2. Click the centre tab named Coordinate Reference System (CRS). In this tab the text bar in the centre of the window displays the current project CRS.
3. You can change the project CRS by selecting the appropriate CRS from the scroll list or using the search functions.



The project CRS will only be active if it is the Default Coordinate Reference System. Ensure it is the default by:

1. Click Settings from the top menu bar, then click Options.
2. Click the CRS tab. Ensure that the option *Use project CRS i*s selected.



On the Fly CRS Transformation

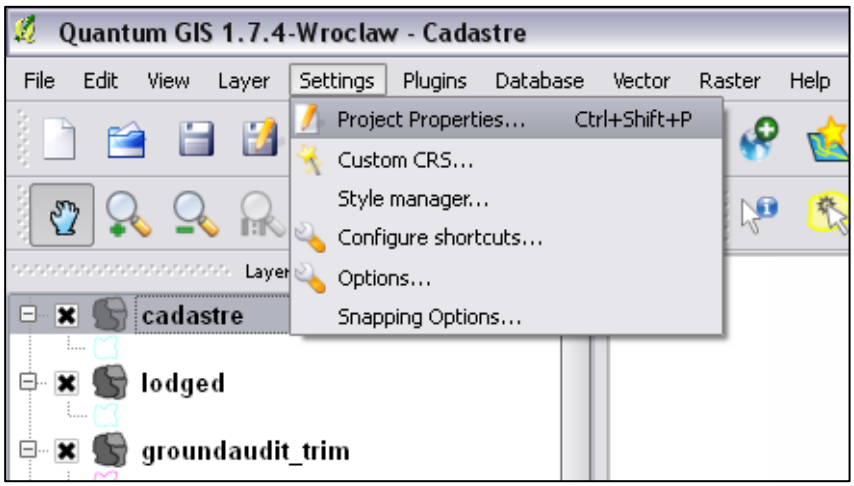
If layers are displaying in disparate locations it is likely they have different coordinate reference systems. This can be resolved by either transforming (see Transforming between Coordinate Systems) the data or viewing it in another CRS, referred to as 'on the fly CRS transformation'. On the fly CRS transformation allows layers to overlay, even if they are in different CRS.

On the fly transformation does not change the CRS of the layer. If the layer is moved to another project it will remain in the original CRS.

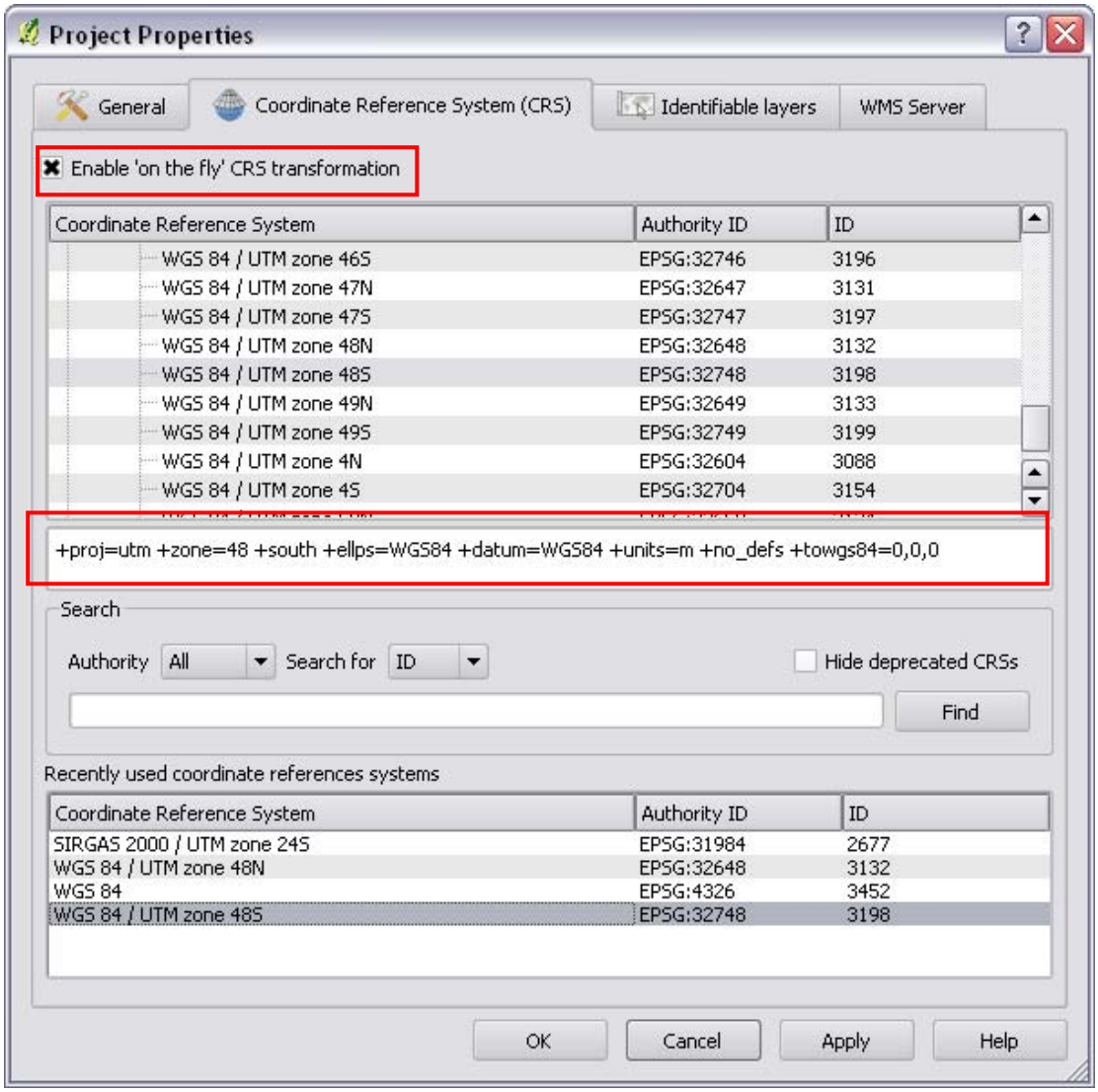
Note: In other GIS applications this may be called Projecting on the Fly.

To enable CRS Transformation on the Fly:

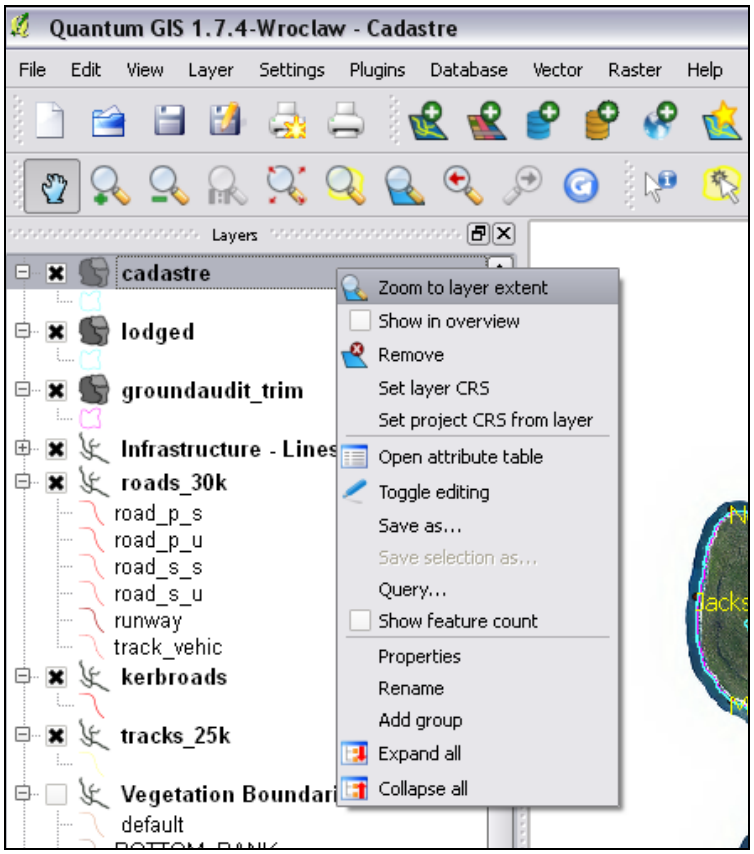
1. Under *Settings* in the top menu bar select *Project Properties*.



2. Click the box next to Enable 'on the fly' CRS transformation. The text box in the centre of the window shows the project CRS. The project CRS determines the CRS that all the layers will be displayed in regardless of the individual layer CRS properties.



Each of your layers should display in the correct location. To check that this has happened successfully right click the layer name then the option *Zoom to layer extent.*



If your layer does not display correctly it is possible that it has an incorrect CRS defined. For example if the CRS of the data layer is specified as WGS84 but the data was actually collected or digitised in UTM48s, the on the fly transformation option will not work. To fix this the correct CRS must be defined for the layer. To define the CRS follow the steps in the section Defining the Coordinate Reference System.

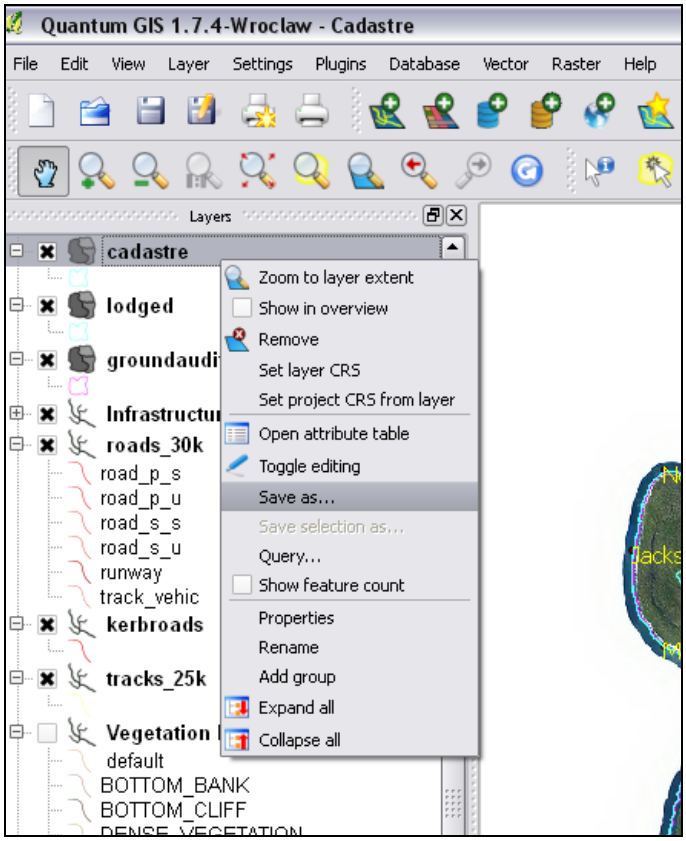
Transforming Data Layers Between Coordinate Reference Systems

You can also transform data layer between different CRS. Don't worry this process will not alter your original data layer as an identical layer is created in the new CRS.

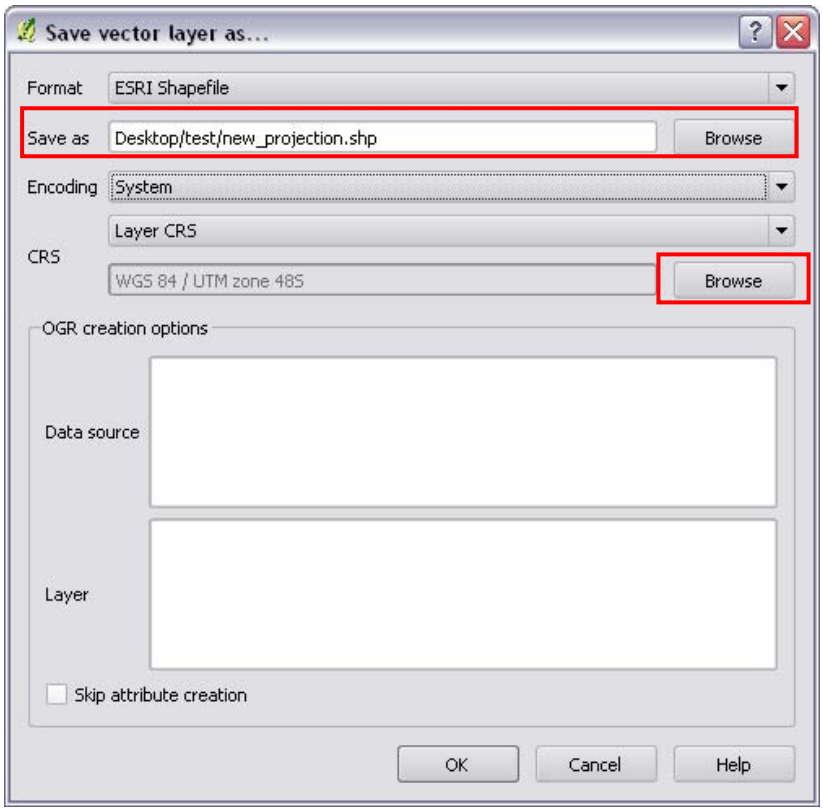
Note:

- The layer must have a CRS already for this to work. For layers with no CRS please see the Defining a Coordinate Reference System section of this guide.
- Do not transform between WGS84 and GDA94 as they are equivalent for practical purposes. Transformation between these datums can degrade the data layer.

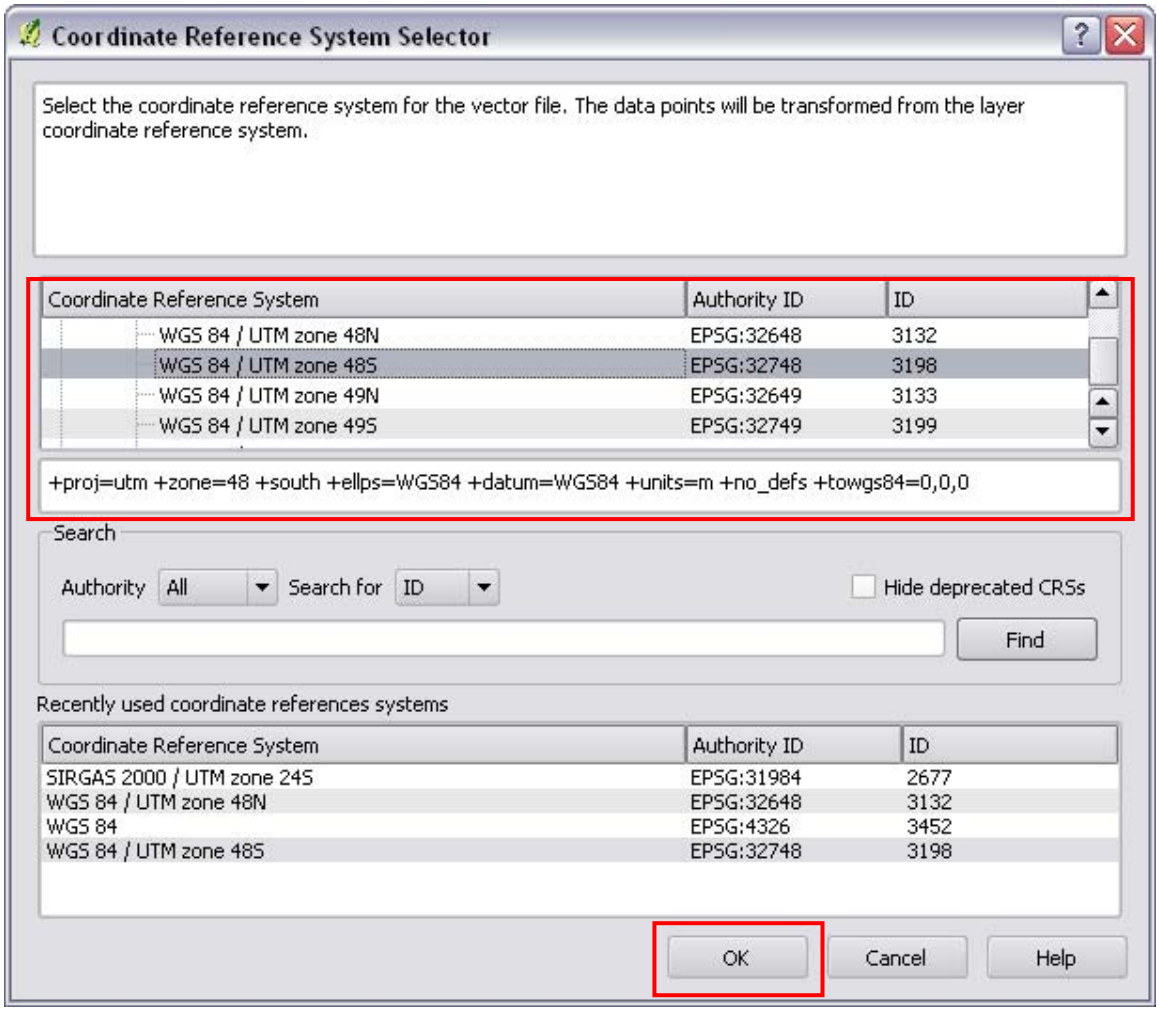
1. Right click on the layer name, then click *Save as.* The *Save vector layer as* window will display.



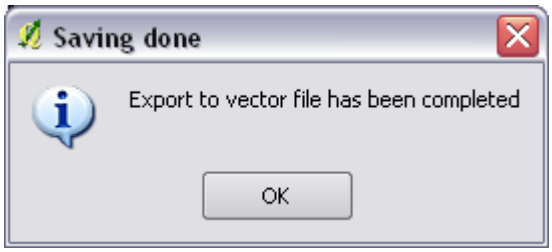
2. Use the *Browse* option next to *Save As* to choose a location for the new layer to be saved, and the layer name.
3. Use the CRS Browse to open the Coordinate Reference System Selector window.



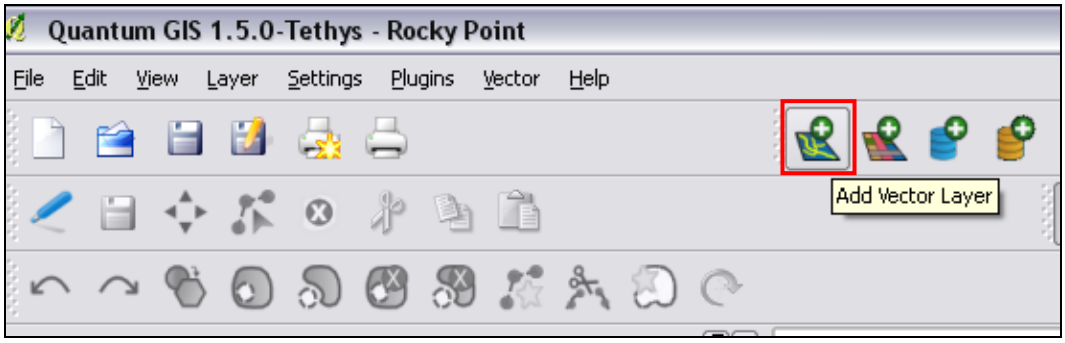
4. Select the desired CRS of the layer from the scroll list in the centre of the window. Click OK.



5. Click OK in the *Save vector layer as* window.



6. Once saved, use the *Add Vector Layer* icon in the menu bar to add your new layer to the project.

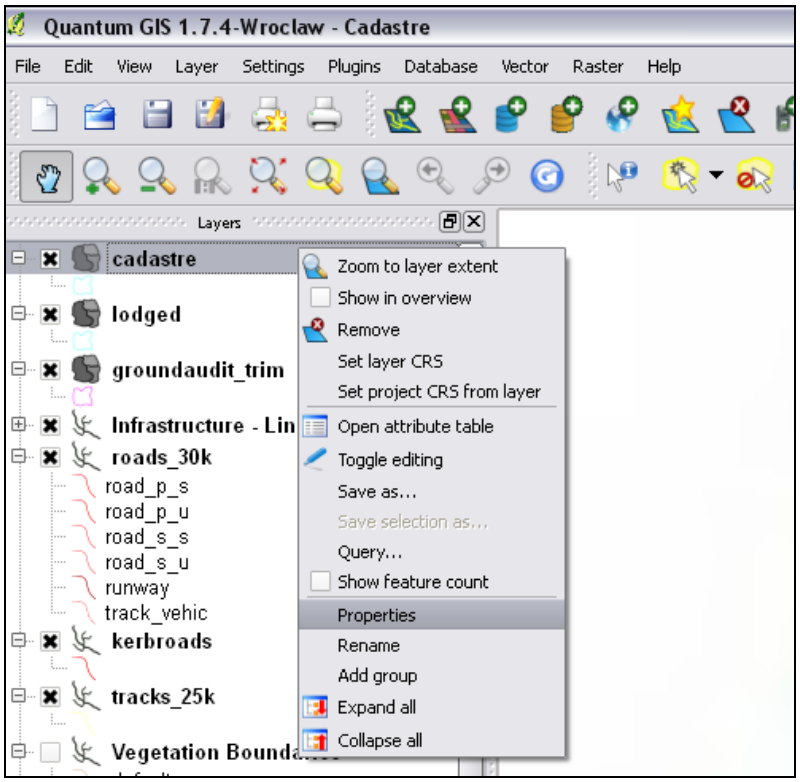


Defining the Coordinate Reference System

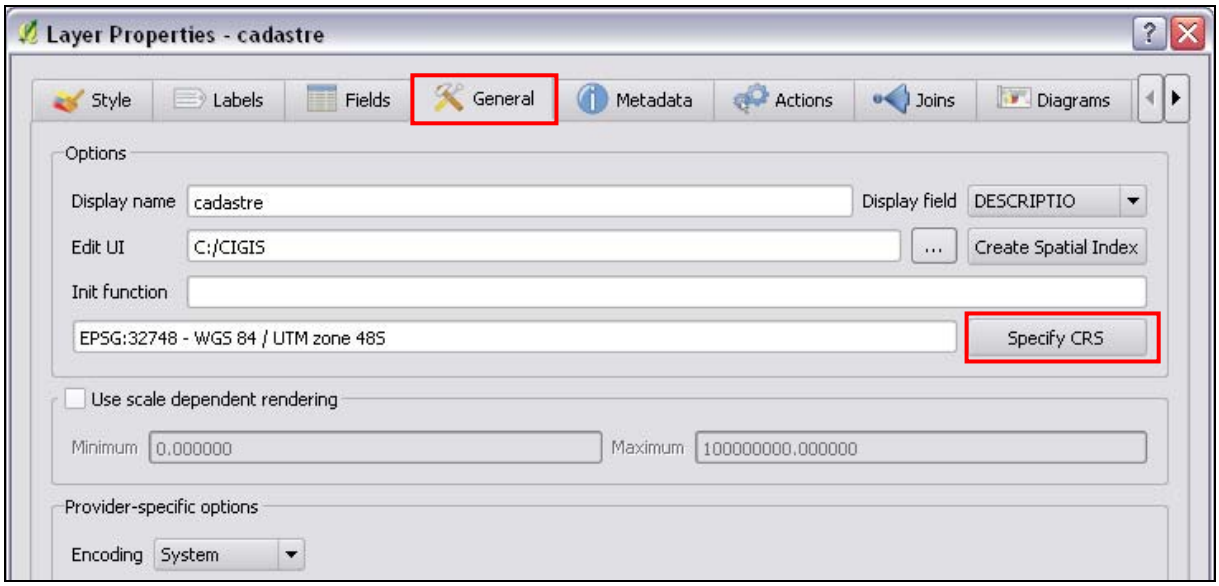
Layers with no CRS will automatically display in the CRS of the project (see project CRS), making it difficult to determine if the layer has a defined CRS. If your layer has a .prj file attached to it, the CRS is already defined.

A CRS can be added to a layer with no CRS using the following process. This process can also be used to change the CRS of a layer if it is in the wrong CRS. Defining the CRS will not 'move' the data layer; it will specify how its position is determined.

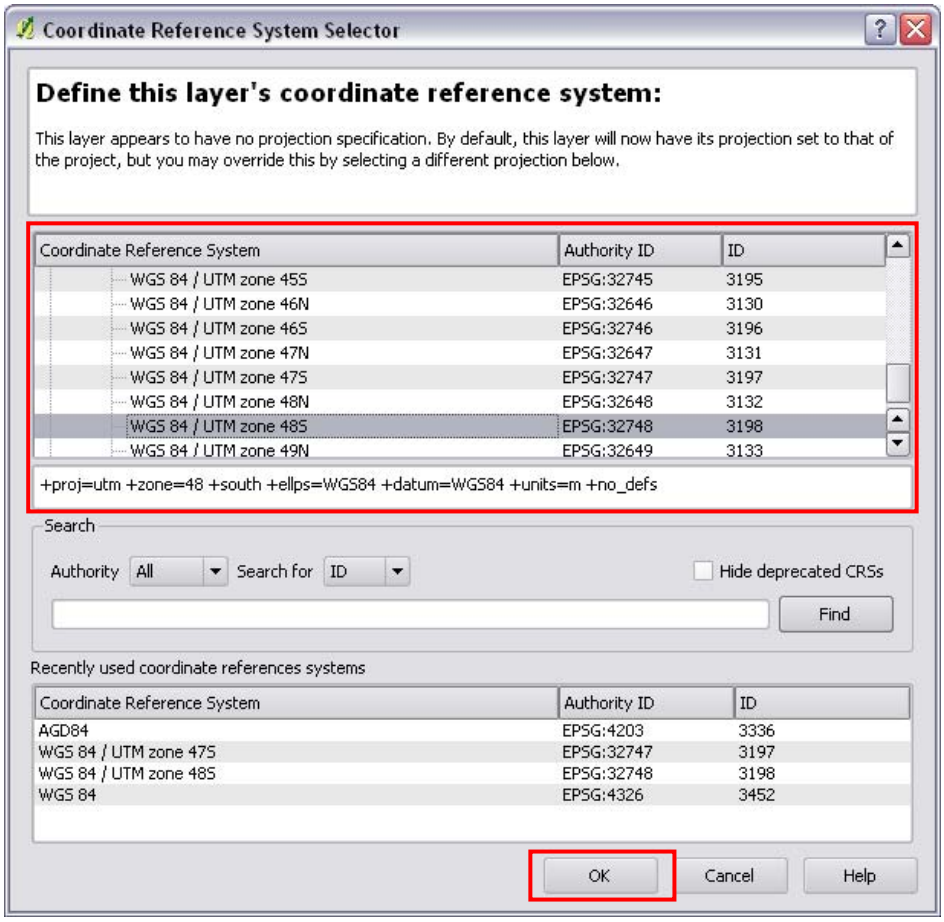
1. Right click on the layer name in the left hand menu, then click *Properties.* The *Layer Properties* window will display.



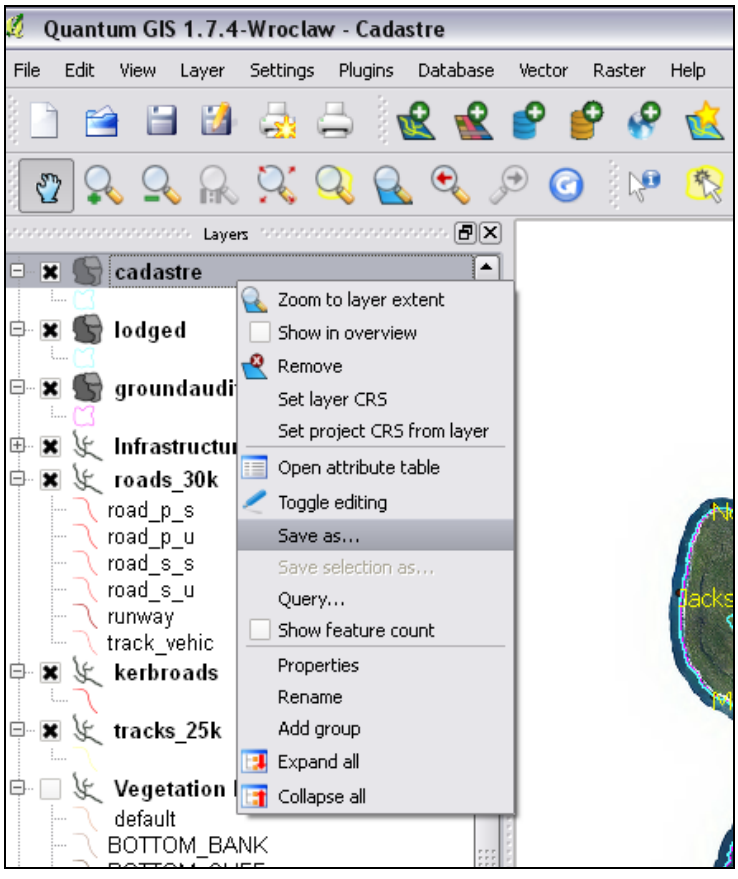
2. In the *General* tab click the *Specify CRS* button (see over page). The *Coordinate Reference System Selector* window will display.



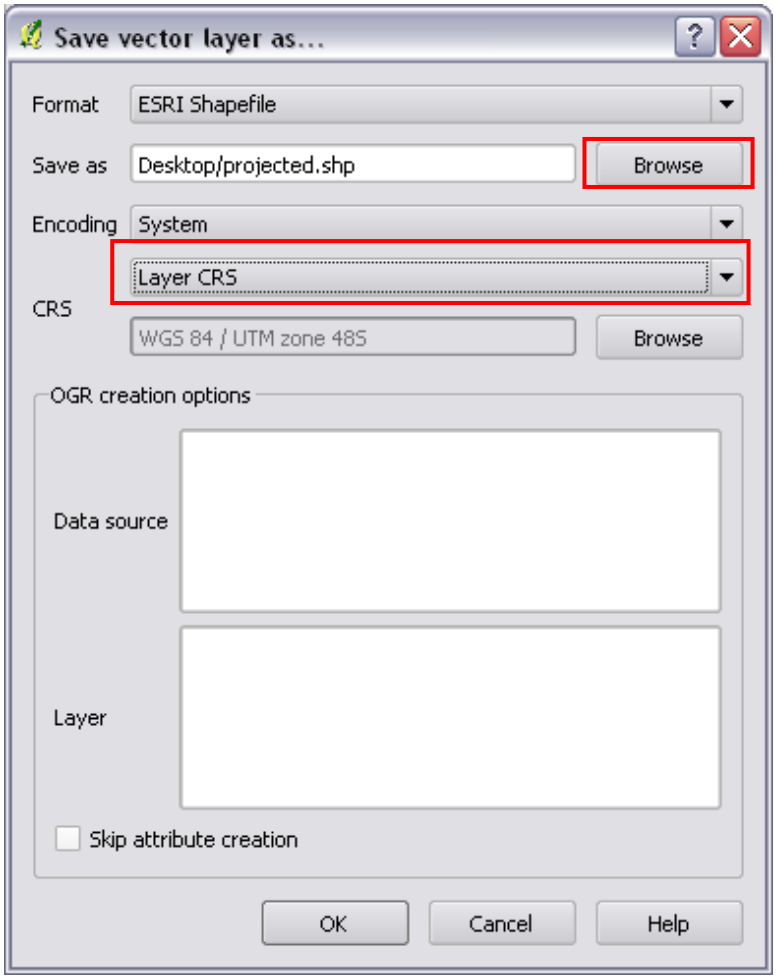
3. Choose the correct CRS for your layer from the list then click OK.



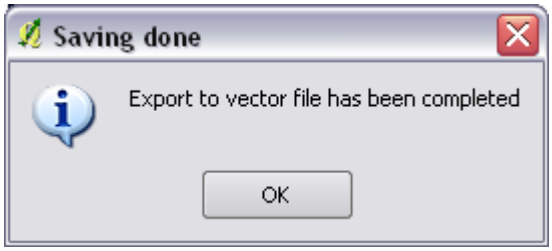
4. The layer must be saved with the new CRS. The original layer will remain without a CRS. Right click the layer name, the click *Save As.*



5. Use the Save as *Browse'* option to choose a location for the new layer to be saved and the layer name.
6. As you have already defined the CRS, leave the CRS as *Layer CRS.*



7. Click *OK.* The following window should display.



8. Use the *Add Vector Layer* icon in the menu bar to add your newly created layer to your project.