

How to Geo Reference a map using a GPS

By Brian Ashton (Lincoln Orienteers) with minor edits by Ken Thompson. April 2014

This is what I have worked out (I am still learning). I have OCAD 11. Some of the menus are different in earlier versions of OCAD.

Get some GPS reference points for your map

- Go to the area and create Waypoints with your GPS for a few definite points at each extremity of the map. Eg fence corners, road junctions, etc
- Also create a waypoint for about the centre of the map. Write these coordinates down as UTM units. (You can also get these coordinates from Google Earth)

Note. You can also get coordinates direct from your background map if it is Geo Referenced

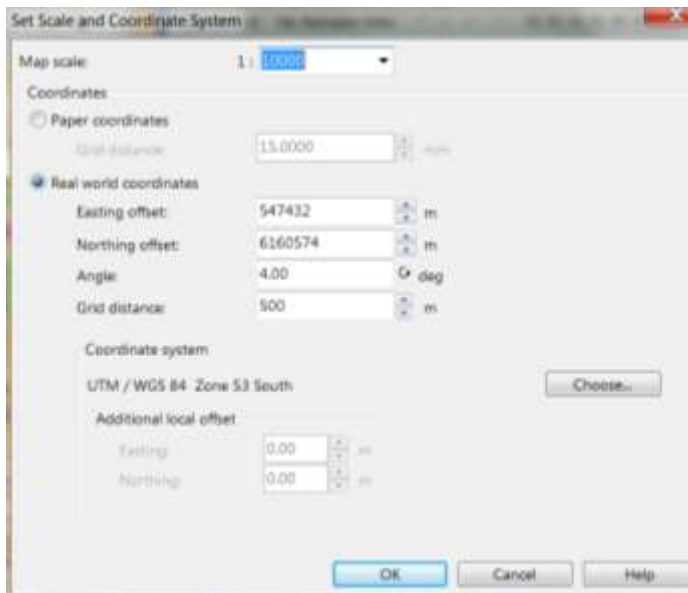
If you got the coordinates by your GPS, save your waypoints to file

- Hook your GPS to your computer (you need the software the GPS came with)
- Select **File New**
- Select **Download from a device**
- Select **File Save as** and save the waypoints as a **GPX** file

To set approximately where your map is in the world

Open your map in OCAD

- Click **Map** then **Set scale and Coordinates**
- Check that the Map scale is right
- Select the button for **Real World coordinates**
- Enter the Easting and Northing offsets for somewhere near to the centre of the map (don't use decimal places)
- Set the angle (see Appendix below)
- Set the grid distance
- For the **Coordinate system** Click **Choose**
- Find and click **UTM / WGS 84 Zone 53 South** (this is our zone: Port Lincoln South Australia)
- Click **OK**



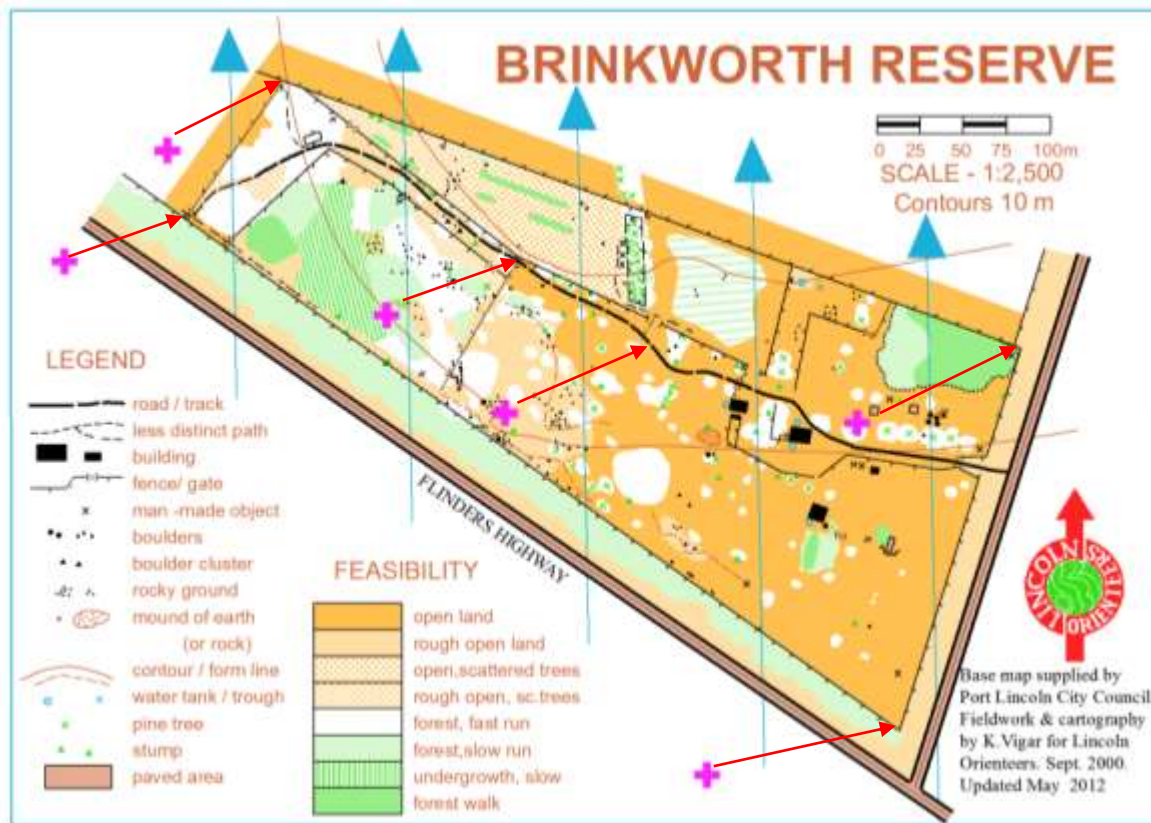
Import the Waypoints into your map

- With your map open in OCAD, Click **GPS**
- Click **Import from file**
- Select the waypoints you want from the **GPX** file you saved earlier
- Tick **Assign symbols** and select an option from the drop down menu
 - For tracks I use **“un-crossable boundary”** but you can use anything
 - For the waypoints I use **“first aid post”** or **“Forbidden route”**
- Click **Import** (and wait a bit)

Adjust your map to align with the waypoints

You should be able to see your waypoints and the existing map (zoom out if you can't). You now have to adjust your map so it aligns with the real world coordinates

An example (Brinkworth Reserve) showing the waypoints and the corresponding point on the map

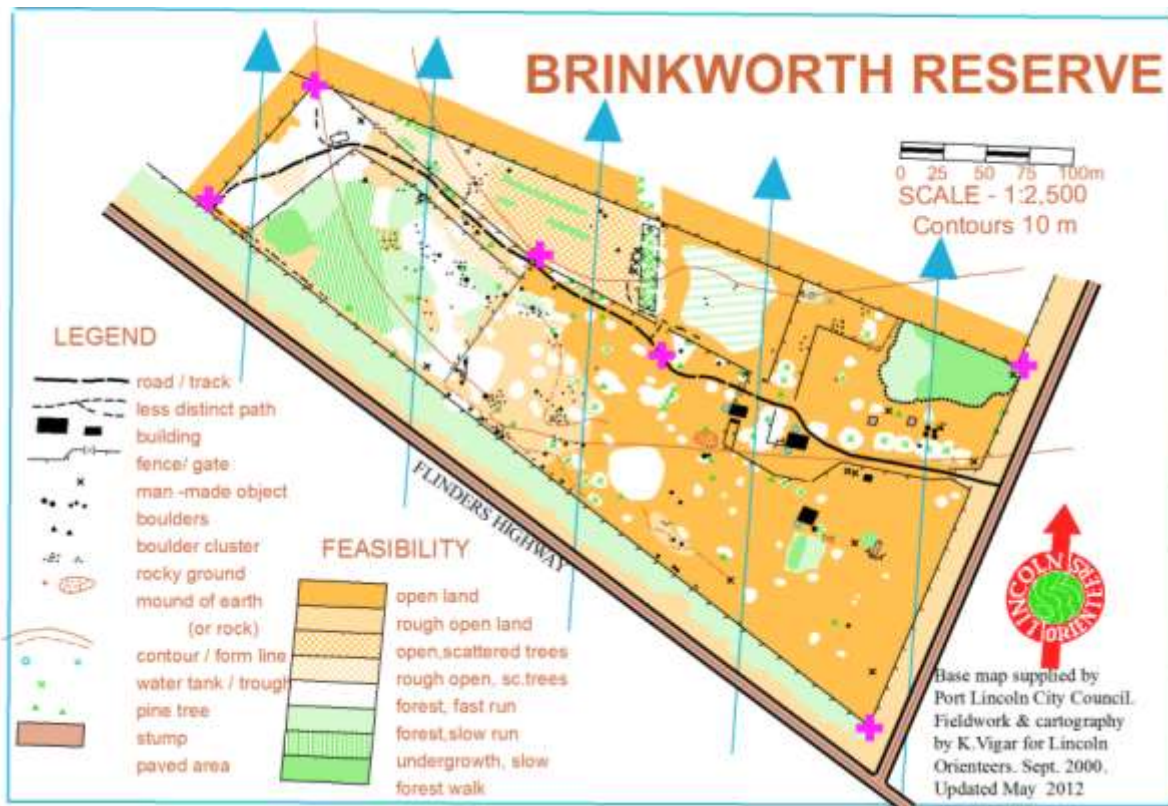


- Click **Map**
- Click **Transform**
- Click **Affine**
- Click the point on your map **and then** the corresponding waypoint
- (You can zoom in and out to make this easier)
- Do this for all the waypoints in turn
- Then click **Enter**

Your map will align and is now Geo Referenced. Delete each of the waypoints you imported and save the map with a GR after the file name.

The map will move so some of your formatting will have to be changed - see example below

Just to check, you can import your waypoints again and they should be where you made them. Eg.



Appendix

To calculate the Angle

The angle in our area seems to be about 7.5 but can vary significantly in different locations.

To find out the correct rotation of the map go into Google Earth and put your pointer on about the centre of the map. At the bottom of the screen it will give you the latitude and longitude and elevation. If the units are wrong (UTM) go to **Tools Options** and change the units to what you want. Write this down. Eg.



Then go to <http://www.ga.gov.au/oracle/geomag/agrfform.jsp>

Enter the information required Eg.

You are here: Home > Earth Monitoring > Geomagnetism > Geomagnetism Data & Reports > AGRF Calculations

Geomagnetism


- Geomagnetism homepage
- Data
 - Real-time magnetograms from Canberra Observatory
 - AGRF Calculations
 - The AGRF Model
 - Revised Images
 - Magnetic Field Components
 - Compass Bearings Conversions
 - Minute Values - Data & Plots
 - Geomagnetic Indices
 - Australia Wide Total Intensity Variability
- Reports
 - Australian Geomagnetism Report
- Products & Services
- Geomagnetism Factsheets
- Geomagnetism Links

Related links

- Natural Hazards
- Earth Monitoring

Australian Geomagnetic Reference Field Values

updated: 13 June 2013

 If the chosen location is outside the coloured area in the adjacent image then a global magnetic field model will be used for the calculations.
If location coordinates are unknown, try the [place name search](#). The WGS84 datum is used for location coordinates.

• **Geographic Latitude:** degrees minutes seconds
(Enter negative value for south of equator)

• **Geographic Longitude:** degrees minutes seconds
(Enter positive value for east of Greenwich)

• **Altitude (km):**
(Enter 0 if unsure of altitude)

• **Select a year, month and day:** Year: Month: Day:
(Models not available prior to 1985.0 or after 2015.0)

• **Select magnetic field elements:** (0 is the Magnetic Declination/Variation)

Main Field: ☐ D ☐ F ☐ H ☐ X ☐ Y ☐ Z ☐ I

Annual Change: ☐ dD ☐ dF ☐ dH ☐ dX ☐ dY ☐ dZ ☐ dI

Press **Submit Request**. It will give you a figure D. In the example below it is 6.886

Online Tools

- Downloads
- Online Maps
- Databases
- Recent Earthquakes
- Place Name Search
- Sunrise & Sunset Times
- Distance Calculations

Factsheets

- Marine & Coastal
- Oil & Gas
- Meteorite

Australian Geomagnetic Reference Field Computation

Requested: Latitude -34° 42' 21", Longitude 135° 49' 13", Elevation .198 km, Date 2014/02/18
Calculated: Latitude -34.7058°, Longitude +135.8203°, Elevation 0.20 km, Epoch 2014.1205

Magnetic Field Components:

D = 6.886 deg

Then go to http://www.ga.gov.au/nmd/geodesy/datums/redfearn_geo_to_grid.jsp

Fill it out as below.

Updated: 24 November 2011

Geodetic Calculations - Redfearn's Formulae, Geographic to Grid

Given Latitude and Longitude, calculate Easting, Northing, Zone for a Universal Transverse Mercator (UTM) projection, Grid convergence and Point Scale Factor.

- The calculations are performed using the GRS80 ellipsoid which is used for Australia's new coordinate system (the Geocentric Datum of Australia - GDA) and is also compatible with the global coordinate system (WGS84) ($a = 6,378,137.0$ metres; $1/f = 298.25722210$)
- Redfearn's formulae are used (Redfearn, Empire Survey Review, No. 69, 1948) to convert between latitude & longitude and easting, northing & zone for a UTM projection, such as the Map Grid of Australia (MGA) used in conjunction with the GDA. These formulae are accurate to better than 1mm in any zone.
- Latitude must be between 0° and +84°/-80°. South Latitude is negative (eg -35° 58' 56.12").
- Longitude must be between 0° and ± 180°. West Longitude is negative (eg -148° 56' 25.12").
- **NOTE:** Given Easting, Northing and Zone for a UTM projection, calculate Latitude, Longitude, Grid convergence and Point Factor use the [Grid to Geographic](#) version of Redfearn's Formula.

Point Name: eg Flinders Peak (Optional - for display only)

Latitude: ° ' " eg -37° 39' 10.15610"

Longitude: ° ' " eg 143° 58' 25.18190"

Press **Submit data**

GDA Redfearn Calculation Results (Geographic to Grid)

| | | | |
|--------------------------|-----------------------|---------------------|----------------------------|
| Site Name: | Brinkwothy Reserve | GDA-MGA: | (UTM with GRS80 ellipsoid) |
| Zone: | 53 | | |
| Easting: | 575136.385 | Northing: | 6159251.774 |
| Latitude: | -34 ° 42 ' 21.65000 " | Longitude: | 135 ° 49 ' 13.67000 " |
| Grid Convergence: | 0 ° 28 ' 1.80 " | Point Scale: | 0.99966958 |

Record the Grid Convergence. Convert this to a decimal eg. the example $28/60 = 0.47$

Add these two figures together to give you the **angle**.

Brian Ashton

10th March 2014