

General notes about using the computer

Computers are fragile. Make sure to use it on your lap or on a table, and make sure it does not fall on the floor. Keep it inside so that it doesn't get a lot of dust in it. Also it will be easier to see the screen inside where the light isn't so bright.

Sometimes the computer asks you if you are sure about something. Usually we mean to do what we are doing, so you can click “OK” or “Continue,” but remember that the computer is checking with you for a reason. Make sure you did mean to do what you are about to do before you click “OK.” For example, after DNR GPS has downloaded the points, it is just telling you that it has done it. So you can click “Okay.” But sometimes you want to save a file and you use the same name as another file. The computer will say, “Do you want to over-write this file?” which means, do you want to erase the old one and put the new one there instead? And you probably don’t want to do that, so instead you will say “No” and then give the new file a slightly different name. So that is a time when it is good that the computer checks with us before we do something we didn’t mean to do.

Also note that usually there is more than one way to do something for all of the computer tasks you are learning. For example, in LibreOffice Writer, you can open a file 1) using the menu (File>Open) or 2) the “Open” icon (a little picture you can click on) or 3) using a keyboard shortcut (Ctrl-O).



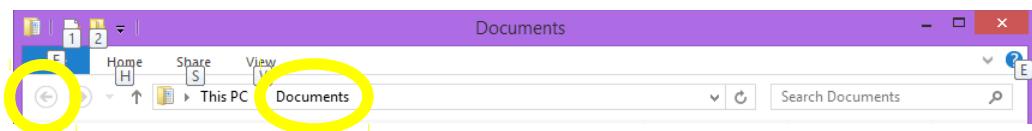
You can find a way that works for you and you can remember. You don't have to do it all three ways.

How to use the File Explorer to find files on the computer:

Click on the folder icon on the bottom of the screen.



Then the “File Explorer” opens. You can see what is in a folder by double-clicking on the folder. We are keeping our data and information in a folder called “Documents”. If you want to go back from the folder you are looking at, you can click on the “back” arrow or on the name of the folder in the “Address Bar”:



For example, you might want to go back to the Documents folder, so you could click on the name Documents. If you get very lost, you can close the window by clicking the red x in the upper right and start over by clicking on the File Explorer icon on the lower edge of the screen again.

In most programs, you can go to the “File” menu and then “Open” in order to open a file you have already been working on. This happens in LibreOffice Calc, LibreOffice Writer, and QGIS, just to name a few. When you choose File>Open, you will have to find the file you want to open. You use the same method to find the file here as you use in the File Explorer. Also note that we use the word “window” to describe the rectangular box that each program is displayed in.

Using the touchpad

The touchpad does three things: 1) as you move your finger around the upper area of the pad, it moves the pointer around on the screen; 2) if you push down in the lower left corner of the pad, it 'left-clicks', and 3) if you push down in the lower right corner of the pad, it 'right-clicks.'



You can quickly click twice on the left side, and that is called a 'double-click.' You can also left-click with one hand, and then use the other hand to move the pointer, which is called "clicking and dragging" and we use that to highlight text or to select part of the area of the Print Composer to make a map in QGIS. Clicking and dragging to highlight text is useful because you can cut and paste a whole block of text, or you can make it all **bold** or *italic*.

You double-click with the left button to open a file from the documents folder or from a shortcut on the desktop. You single click with the left button to open a program from the taskbar or the start screen. You double click on the name of a layer in QGIS to open the window that shows you how to change the symbology, join it to another dataset, or label the points. You right-click on the layer to "zoom to layer" or to look at the attribute table. If you aren't sure whether to click once or twice, try once, and wait a minute, and if nothing happens, try clicking twice.

You can use two fingers together going upward or downwards to scroll up or down through a document or list, for example when you are searching through a list of files to find the one you want to open.

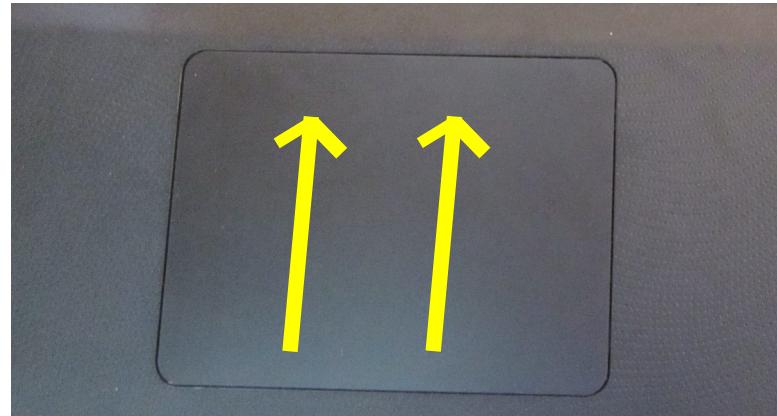
You can make a window take up the whole screen by left clicking on the "Maximize" button in the top right corner of any window: You can undo that by clicking it again. You can close the window by clicking the red x: And you can make the window be a different size by clicking on the corner of the window when the pointer looks like a small diagonal arrow.

You can 'minimize' the window by clicking the minimize button: This makes the window shrink down to the taskbar. To get it back, click on the program's icon on the taskbar. So, for example, if you have shrunk down QGIS, you would click on the Q symbol at the bottom of the screen to un-shrink the window.

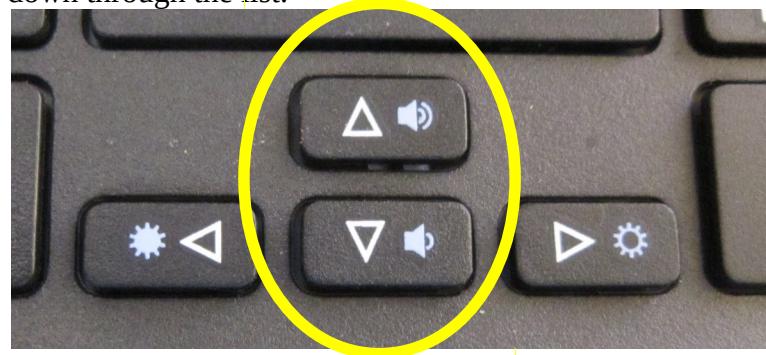
Scrolling/looking through a list

There are several ways to scroll through a list of items. “Scrolling” means looking through the list of item by moving the contents of the screen up and down so you can see all the items.

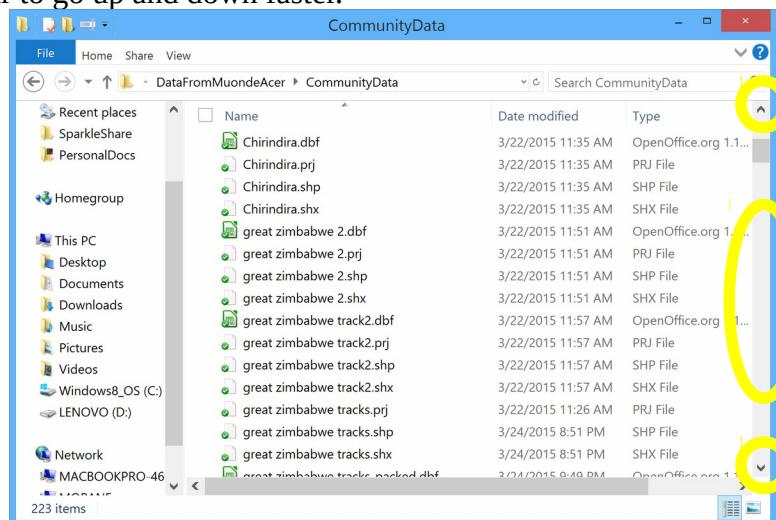
You can use two fingers together going upward or downwards to scroll up or down.



You can use the arrow keys. Single-click on one of the items in the list and then use the up and down arrows to go up and down through the list.



You can click on the arrows at the top and bottom of the scroll bar on the left of the window, or in the middle of the bar to go up and down faster.



These tricks do not always work exactly the same in each program, but you can try them out and see if they help.

Using the keyboard

Keyboard shortcuts are used when you don't want to use the touch pad. Instead, you can use the "control" key, which says "Ctrl" on it, to take a shortcut to get the computer to do something.



The way you do this is to hold down the control key, and then press another key, and immediately let go of them both at the same time. Keyboard shortcuts don't always work the same way in every program, but you can try them to find out. Here is a list of keyboard shortcuts and what they do:

Shortcut	What does it do?
Ctrl-S	Save
Ctrl-C	Copy
Ctrl-V	Paste
Ctrl-A	Select everything ("all")
Ctrl-E	Center the text
Ctrl-B	Make the text bold
Ctrl-I	Make the text <i>italic</i>
Ctrl-O	Open a file

One way to select more than one item in a list is to hold down the control key and click on each item – this will highlight all the items you clicked. If you accidentally clicked one you didn't mean to include, click it again to de-select it. If you want to select several items in a row, click on the first one and then hold down the Shift key, then click the last one. This will highlight everything in between. That trick is very helpful when selecting waypoints and tracks to save from DNR GPS.



Another trick you can use is if you have opened a window you don't want, sometimes you can close it by pressing the "Escape" key, which says "Esc" on it. You can also use this key to stop editing a cell on a spreadsheet.

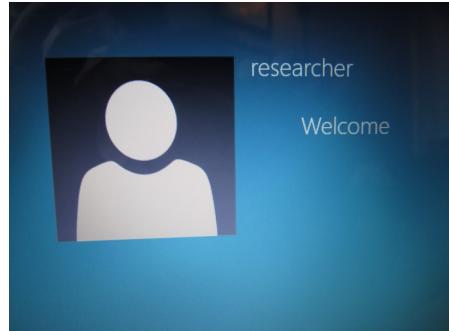


If you want to change the brightness of the computer screen, you can hold down the "Function" key, which says "Fn" on it, and then press the right and left arrow keys. The Function key makes the key do what is written on it in blue. So on the arrow keys, that makes the screen brighter or dimmer. On the up and down arrow keys, it makes the sound on the computer louder or softer.

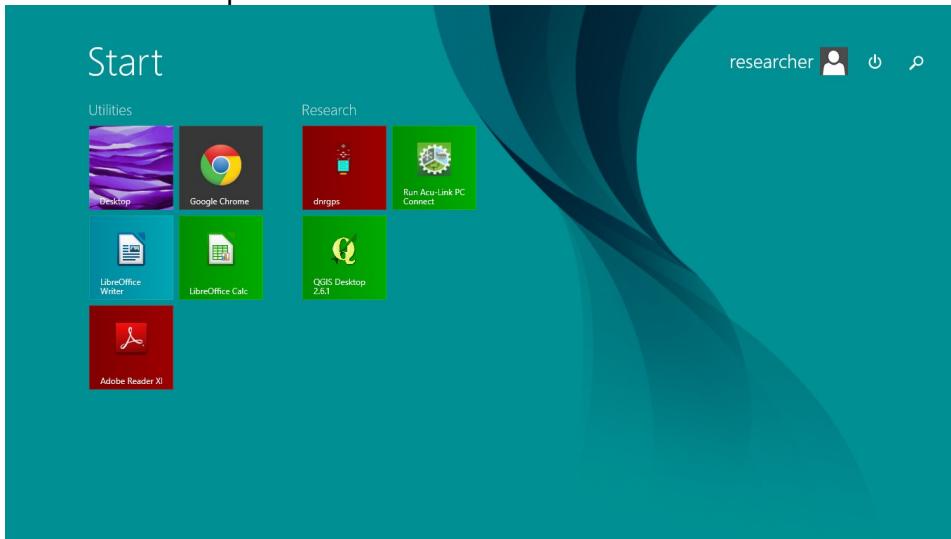


Turning the Acer on and using the Start Screen in Windows 8

The power button is in the upper left corner of the keyboard. When you log onto the computer, the login screen comes up. You don't need to click anything as there is currently no password (the username is "researcher".



Then the Start Screen comes up. It is Windows 8's version of the Start Menu.



You can click on "Desktop" to go look for files or you can click on one of the other programs (the colored boxes) to start them. You can also start programs from the Desktop, too. The programs are:



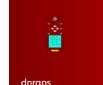
LibreOffice Writer – word processor (like Word), for creating written documents



LibreOffice Calc – spreadsheet (like Excel), for organizing and working with data



QGIS – a program that allows you to view and work with GPS data and maps



DRNGPS – a program that allows you to download data from a GPS unit



Acu-Link – a program that allows you to download data from the weather stations



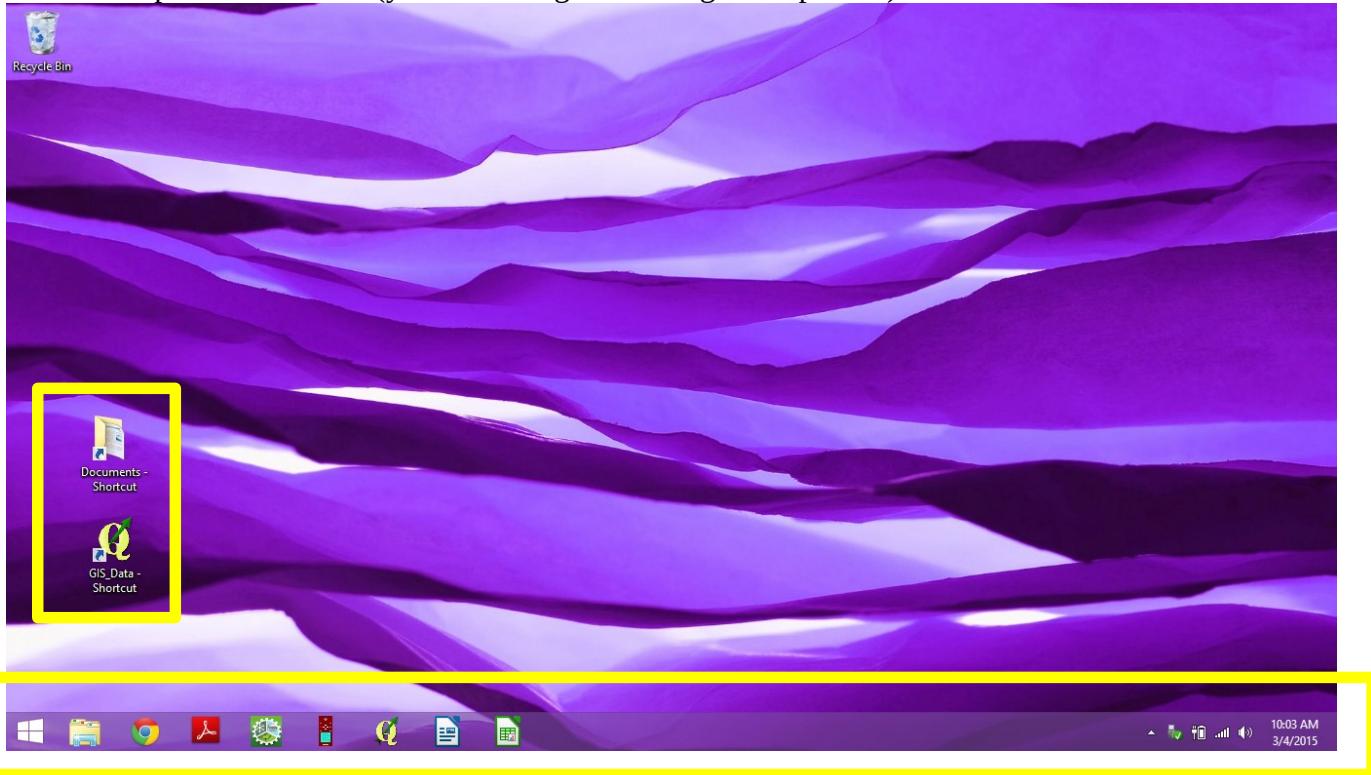
Google Chrome – web browser for viewing web pages (like the www.muonde.org website)



Adobe Reader – for viewing pdf documents

Using the Desktop and getting back to the Start Screen in Windows 8

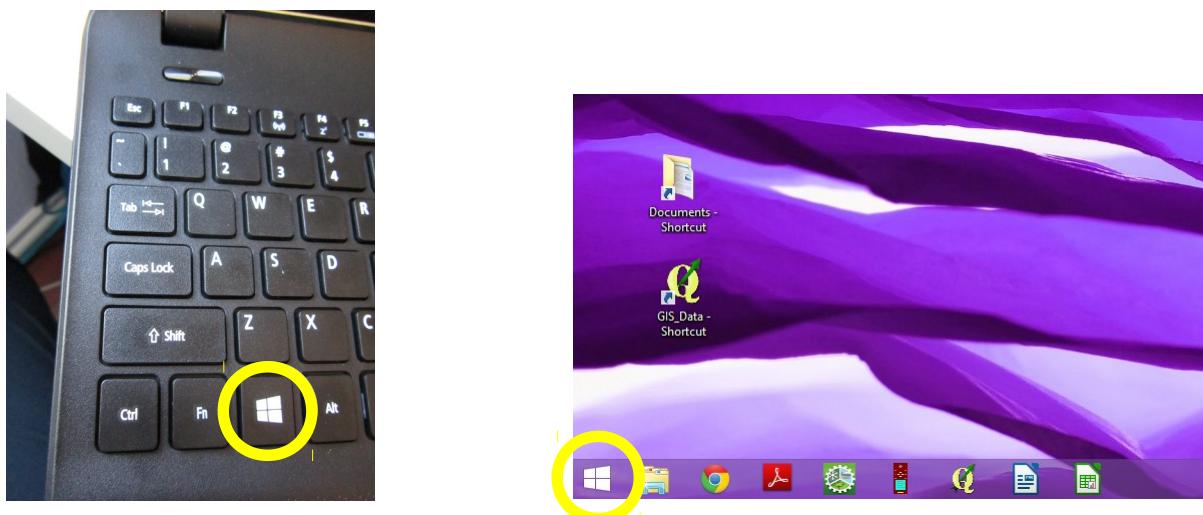
The Desktop looks like this: (you can change the background picture)



The bar at the bottom is called the “Taskbar” and you can start programs from there or go back to the Start Screen.

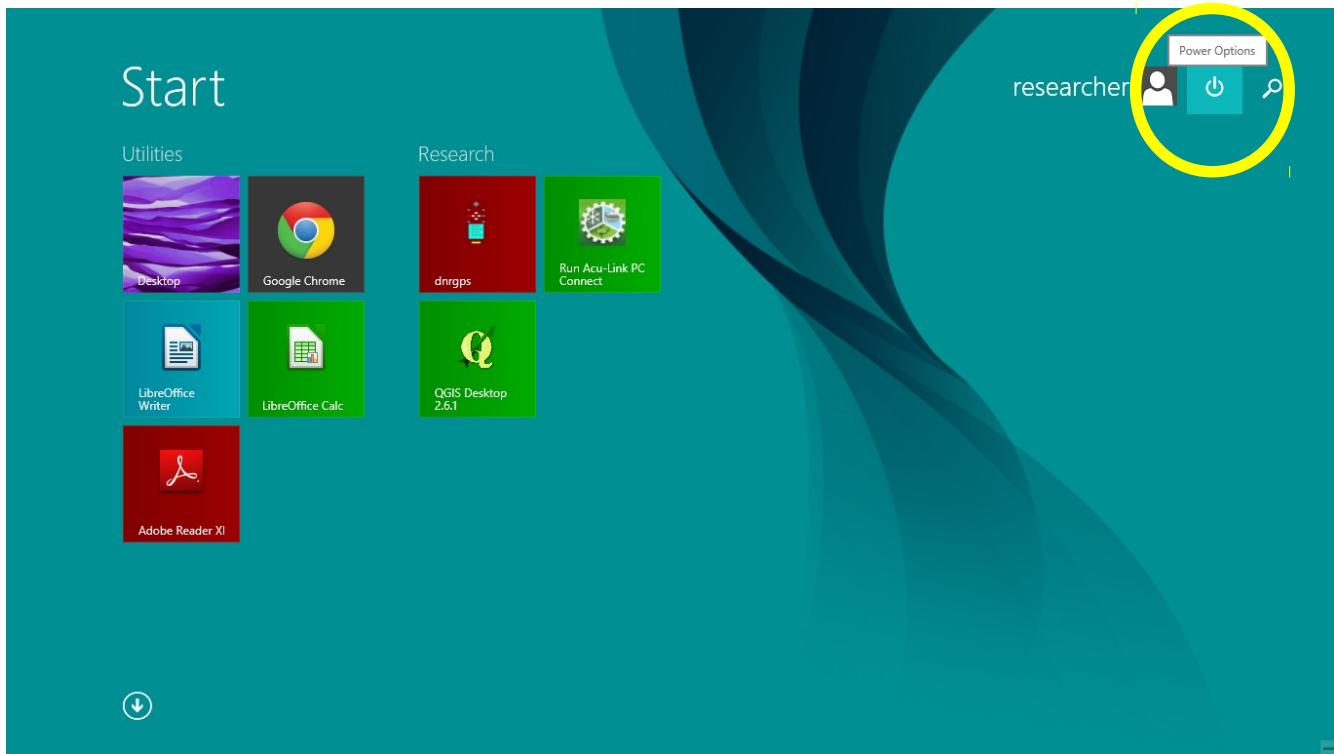
The shortcuts on the Desktop go to “Documents” where we keep the data, or to go to the GIS_Data file which will open QGIS and display the data. You can click on them to go to Documents or to the GIS data in QGIS.

If you want to get back to the Start Screen, you can press the “Windows” key on the keyboard, or click on the “Windows” icon in the Taskbar:

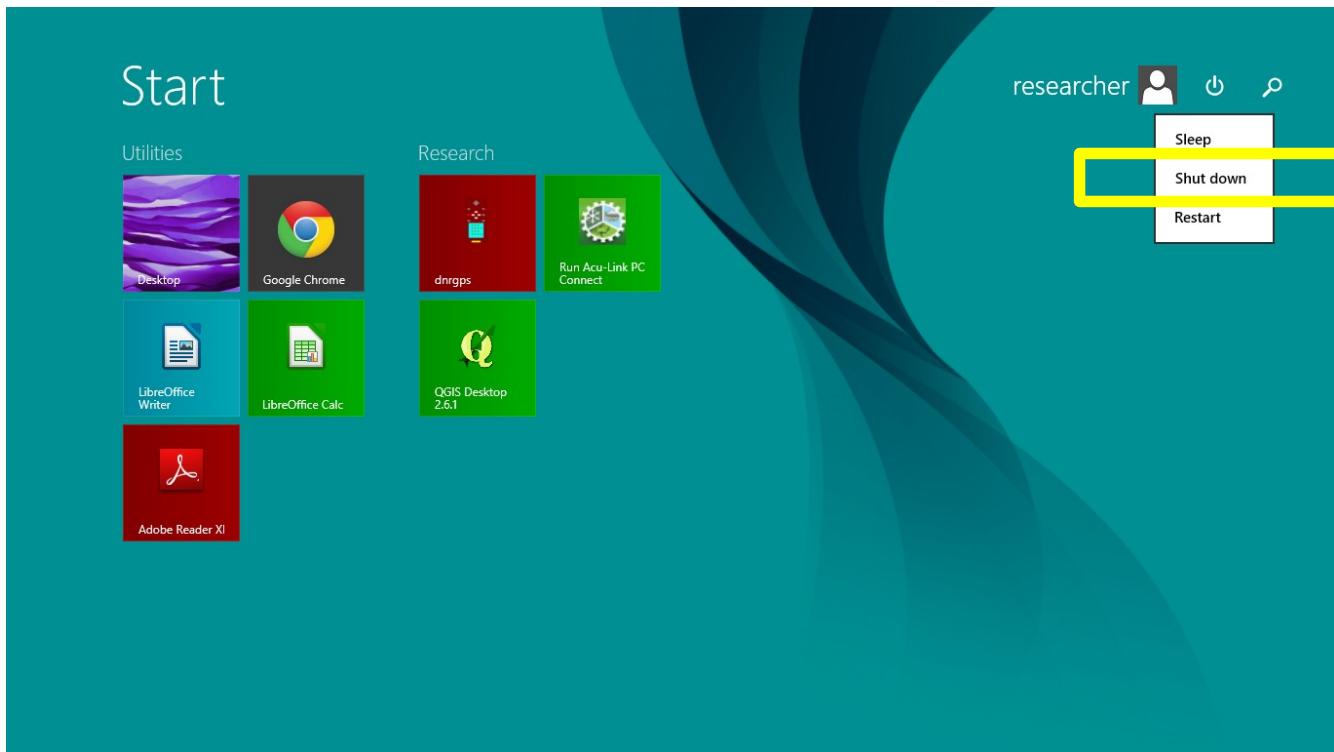


Turning the computer off in Windows 8

Get to the Start Screen, and then click on the power icon:

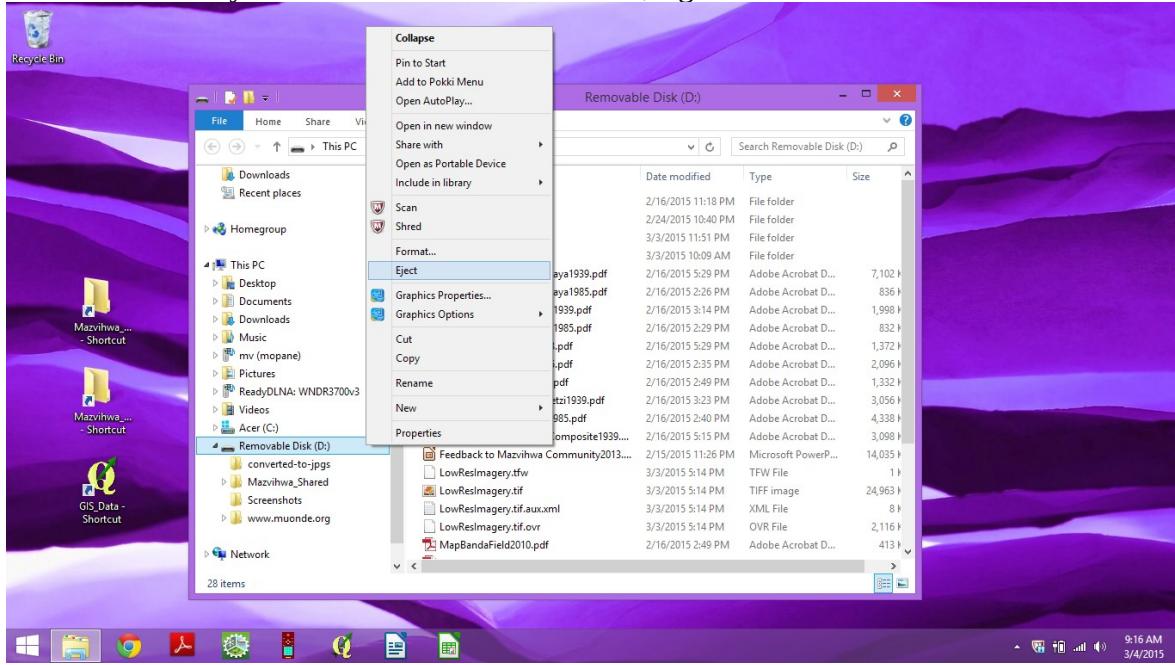


Then you can select “Sleep” which turns off some of the computer processes but not all of them; “Shut down” which turns the computer completely off, or “Restart” which shuts the computer down and then reboots it again immediately. To save battery, use “Shut down” most of the time, as the computer still uses some battery power when it is sleeping.



Safely ejecting (removing) an external hard drive in Windows 8

There are two ways to do this. In the file browser, right-click on the “Removable Disk”



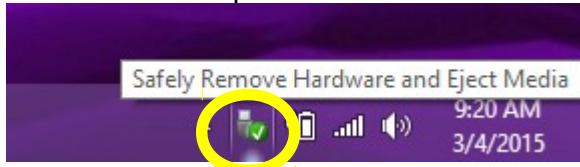
Then click on “Eject”.

Then a message will appear in the bottom right of the computer screen:



Then you can pull the drive out of the computer.

The other way to do this is to click on the little icon with the green checkmark in the lower right corner of the computer screen:



Then click on “Eject Mass Storage”



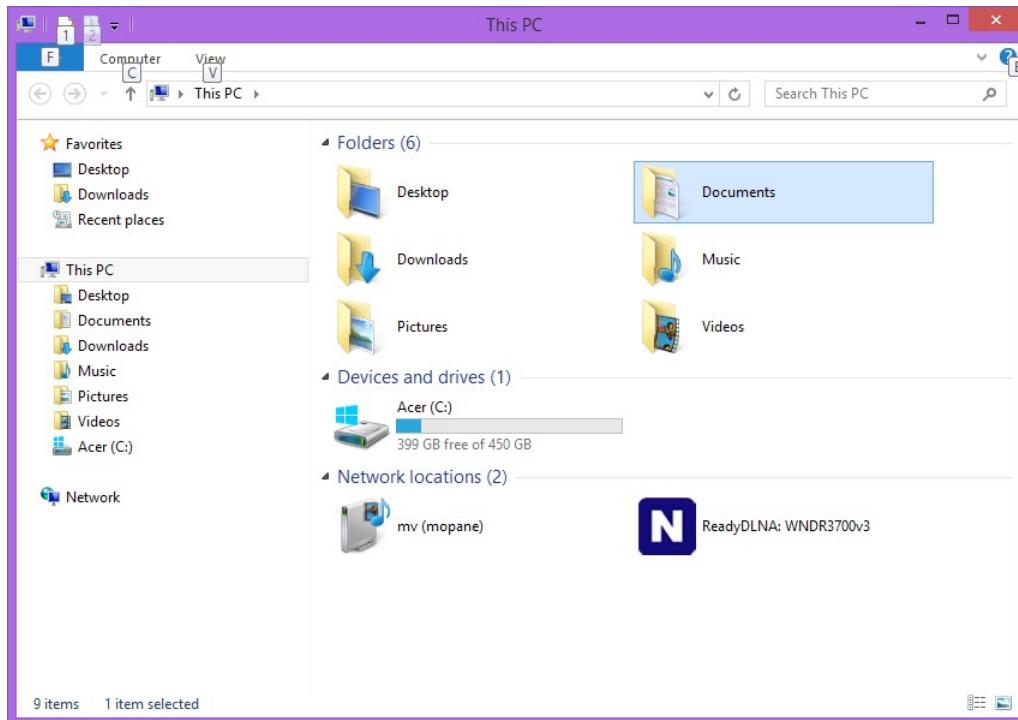
Then the “Safe to Remove Hardware” message will come up and you can remove the drive.

Finding data files on the Acer

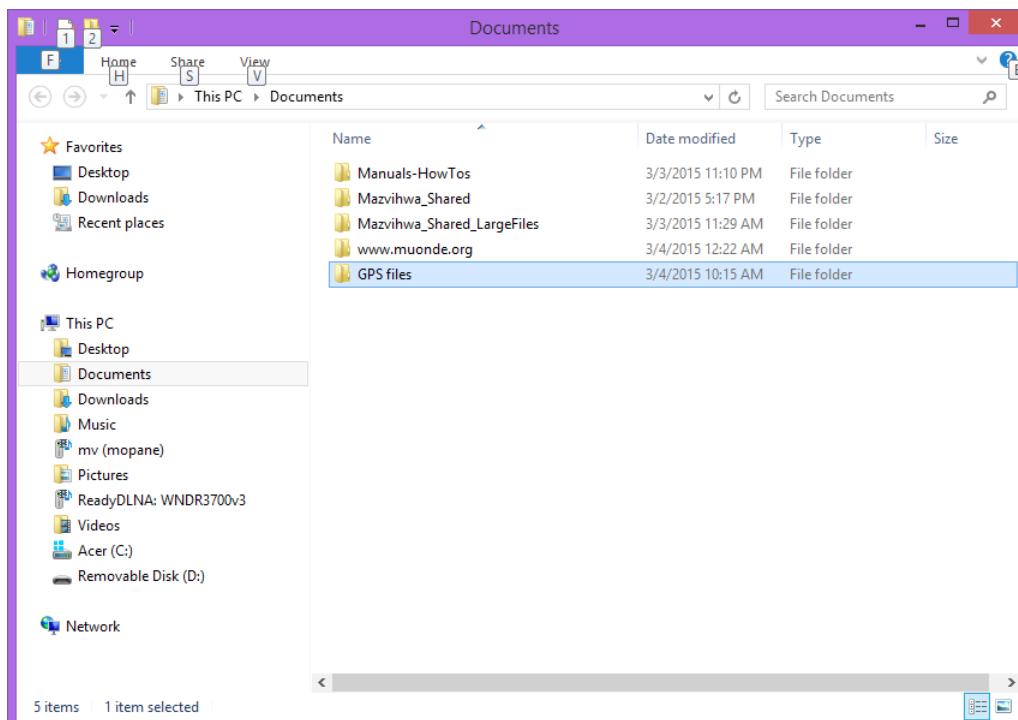
The data files are in the “Documents” folder. You can click on the folder icon on the taskbar:



And the “File Explorer” opens:



Click on Documents and you will see our data and other files on this computer:



There is also a shortcut on the Desktop that will take you to Documents.

Spreadsheet basics in Libre Office Calc

Spreadsheets are the computerized, electronic version of a data table or data sheet. At the top of a column, you should put a name (like “Date” or “TreeDiameter_cm” or “Owner”), and then below that on each row you put the information about each item (like a tree, or a waypoint, or a polygon). Don’t use spaces in the column names, but it’s okay to use spaces in the information about each point.

	A	B	C	D	E
1	Date	Waypoint	Feature	Owner	Kind
2	2015-05-10	PP1	Phiri Pit	Person 1	Phiri pit
3	2015-05-10	DL1	Dead level contour	Person 1	Dead level contour
4	2015-05-10	PP2	Phiri pit	Person 2	Phiri pit

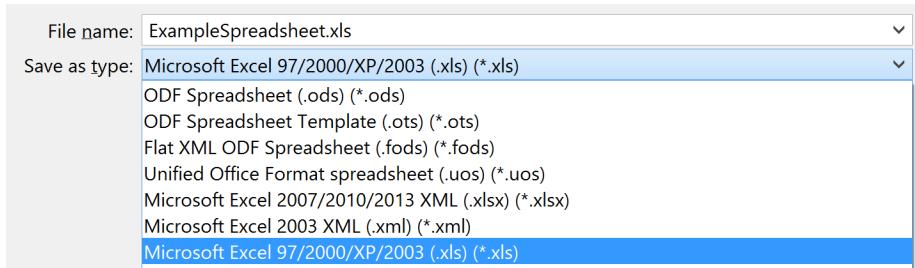
LibreOffice Calc labels the rows with numbers (1, 2, 3, 4...) and the columns with letters (A, B, C, D...). Each square is called a 'cell' and you can refer to a specific cell using the letter and number that goes with the row and column of the cell. For example, in the spreadsheet above, the waypoint code “DL1” is found in column B and row 3 – so you would say that it is in cell B3.

There are slightly different functions when you are actively editing a cell or when you are not. To edit the thing inside the cell, you double-click on the cell and you can change the text like you do in a document. When you press the 'Enter' key, the spreadsheet accepts your changes to the cell. You can get out of editing the cell without making any changes (like when you accidentally type something and you didn't mean to) by using the “Esc” key on the keyboard.

When you are not editing a cell, you can use the arrow keys to go between cells, or you can use the touchpad to move the pointer to a cell and double-click to edit it. If you begin typing without double-clicking in the cell, the computer will write over what was already there. You can do this on purpose if you are writing something new, or if you want to completely change what is in the cell. You should double-click on the cell to make smaller changes (as described above). You can go to the next cell to the right by using the “Tab” key on the keyboard, and the cell below by using the “Enter” key.

You can use keyboard shortcuts, Ctrl-Z to undo the last thing you did, Ctrl-S to save, and so forth. Not all of these work in quite the same way when you are editing a cell as opposed to when you are going between cells. You can center the text using Ctrl-E, make text **bold** using Ctrl-B, and make it *italic* using Ctrl-I, just like in documents.

You can make a new spreadsheet by going to File>New>Spreadsheet. You can also make a new document by opening LibreOffice Calc from the Start Screen or taskbar. You should save the spreadsheet as “.xls”:



Save spreadsheets in the same place in Documents so you can easily find them again. Once you have given the spreadsheet a name, use Ctrl-S to save any changes you make. Save often!

Document basics in LibreOffice Writer

You can write documents using LibreOffice Writer. This is a way to write up reports, papers, and projects, and also a way to write up meeting notes.

You can make the text **bold** or *italic* to make some words stand out (like the title of this document “Document basics in LibreOffice Writer”). You can do this by highlighting the text (also called “selecting” the text). You can do that by holding down the Shift key and using the arrow keys to select



the text:

You can also “click and drag” to highlight text.

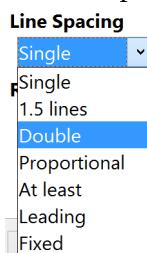
Then you can use a keyboard shortcut, Ctrl-B, to make the text bold, or Ctrl-I to make it italic. You could also click the icons at the top of the screen: for bold, for italics. You can also change the size of the text by clicking on the arrow next to the number next to the bold icon: and picking a new number or clicking on the number and typing a new number in. The title of this document is in font size 15 for emphasis. The rest of the document is font size 12. You can change the type of text (the ‘font’) in the list to the left of the number. “Times New Roman” is a common font to use, and it is what these how-to sheets use. You can also change the horizontal location of the text:

You can left-justify the text (using Ctrl-L) or the icon

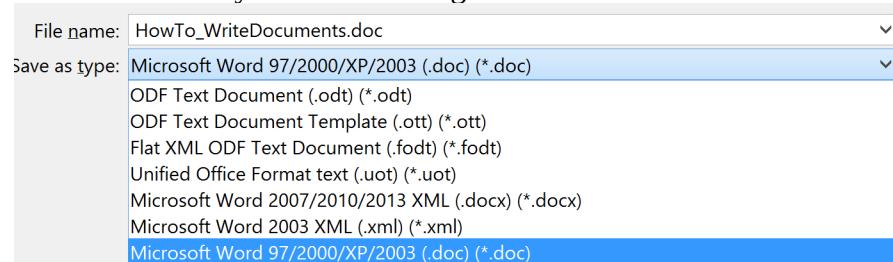
You can center the text (using Ctrl-E) or the icon

You can right-justify the text (using Ctrl-R) or the icon

You can make the text have straight margins on both sides (using Ctrl-J, or the icon . “J” is short for “Justify.”). This formatting makes the text look cleaner because both sides are even on either side. But some people like to only justify the left margin. This paragraph has both sides justified but the other paragraphs in this document do not. You can decide which way you like better. You can change the vertical spacing by highlighting the text and going to Format>Paragraph and clicking on the “Line spacing” and then choose Single, 1.5 lines, or Double spacing.



To save the file, use Ctrl-S or go to File>Save. Then save the file as a “.doc” file. After you've named the file, use Ctrl-S to save it when you make a change. Save often!



You should also go to File>Export as PDF and then click “Export” and then “Save” to make a nice final version of the document to give other people. That is how these How-To documents were made.

Using the Garmin eTrex 10 (GPS unit)

The power button is on the outside lower right. When the unit is already on, that button controls the brightness of the backlight. To turn the unit off, hold down the power button. The “back” button on the outside upper right returns you back one menu. The “menu” button on the outside lower left gives you a different menu of options for each tool. The button on the front is a navigation thumb stick. You push up, down, left, and right to go through menus and move around on the map, and push in to select something. Click on the “Map” tab and use the arrows on the outside upper left of the GPS to zoom in and out, and the navigation stick on the front to move east, west, north, and south.



When you first turn on the GPS, it looks for satellites. The more satellites it sees, the better it can locate itself. The more you can see the sky, the more the GPS can see the satellites. Indoors, in canyons, and under thick trees can make the uncertainty in your position larger. Click on the satellites tab to see the GPS' progress in finding satellites. The GPS uncertainty is in the upper right.

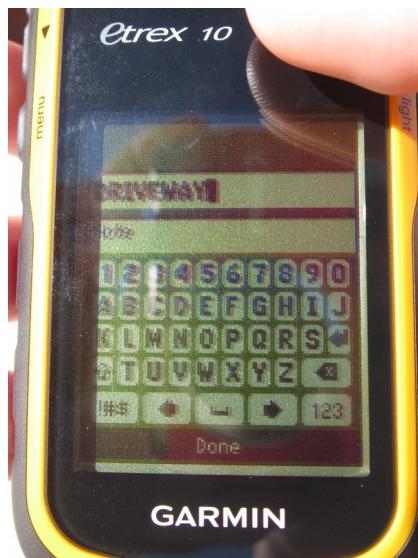


Marking a waypoint with the Garmin eTrex 10 (GPS unit)

Waypoints are single points (locations of trees, wells, buildings, etc). To mark (record) a waypoint, go to “Mark Waypoint.” Each waypoint has a name, notes, location, and elevation.



Change the name and notes by selecting it with the thumb stick and then selecting each letter one at a time using the thumb stick. Give the waypoint a name which clearly identifies where it is on the ground, for example “Northwest corner of Mhototi school” or a number and a name “so-and-so field point 002.” Make sure the name/number are unique. Please note the GPS uncertainty in the “Notes” field (just the number is fine). When you are finished with each of the name and notes, click “Done,” and when you are finished with all of them, click “Done” again.



Waypoint averaging with the Garmin eTrex 10 (GPS unit)

We can average waypoints to get more accurate measurements. Click on “Waypoint Averaging” and pick one of the waypoints you've already marked, then click Start. Garmin recommends 4-8 samples to improve accuracy, and suggests that you wait at least 90 minutes between samples. If you are averaging a waypoint you have just marked, the GPS will warn you that you should wait 90 minutes.



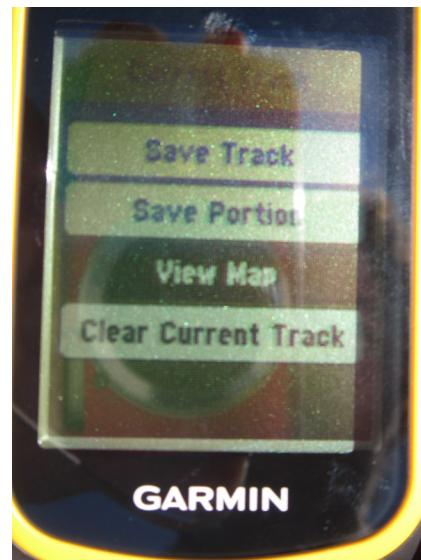
When the “sample Confidence” bar reaches 100%, click “Save”.



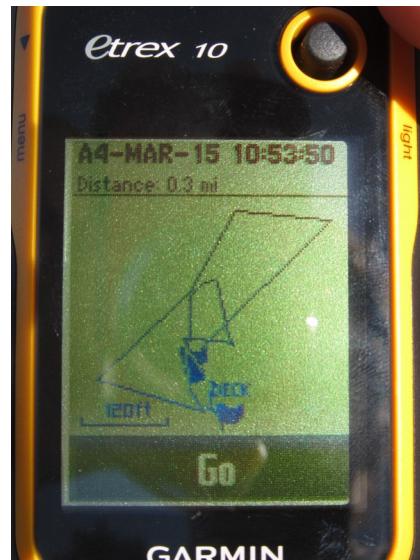
Recording and saving a track with the Garmin eTrex 10 (GPS unit)

Tracks are recorded by default. If you want a track for a specific area in its own file, you have to manually save them separately.

Start by clicking “Current Track”, then “Clear Current Track” (say yes, you do want to clear it). Then walk around a field or water feature or building. Click “View Map” to see where the track is being recorded. Go back and click “Save Track” when you are done walking around the desired feature.

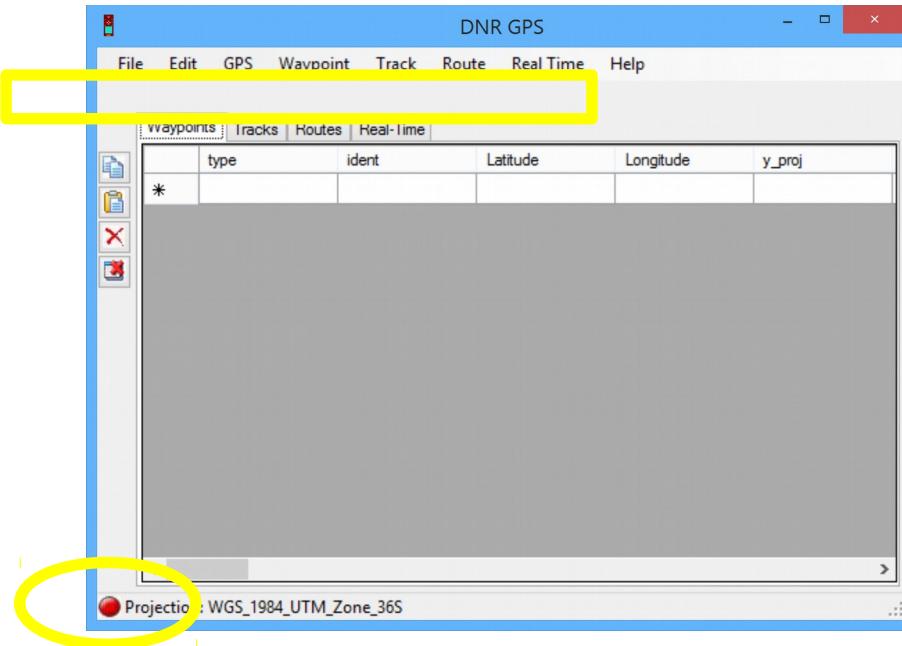


Give the track a descriptive and unique name or number, for example “so-and-so field 011.” You can then clear the current track.



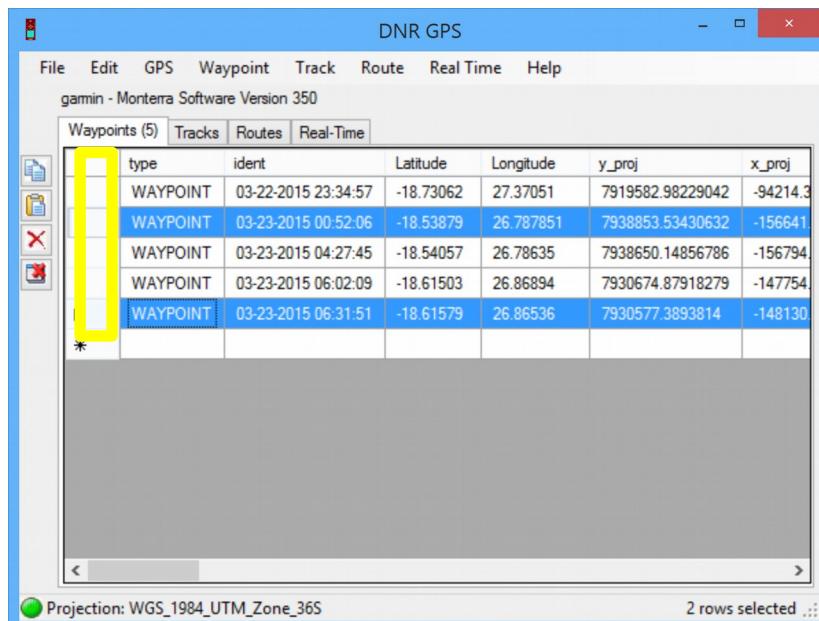
More tips on downloading points and tracks using DNRGPS

If the eTrex 10 is plugged into the computer and DNRGPS has a little red dot in the lower left corner and doesn't say "garmin - eTrex 10" above the "Waypoints" tab, try going to GPS>Find GPS to make sure DNR GPS can find your GPS unit.



When you are downloading waypoints and tracks from more than one GPS unit in DNRGPS, remember to clear the waypoints and tracks from the program in between downloading things from different GPS units. Go to Edit>Empty Table. (You have to do this for waypoints and tracks separately)

Try to make sure there is only one copy of each point or track in the final data file that you save. To select more than one point, hold down the control key (ctrl) and click on each point you want to save. Click on the gray part on the left for each point you want to save (while holding down 'ctrl'):



To select all the points or tracks, click on the gray part and then use the keyboard shortcut ctrl-A.

More tips on using the Garmin eTrex 10

Clearing off the GPS unit to free space for new data

Make sure you have downloaded your waypoints and tracks using DNRGPs, saved them to a shapefile (.shp), and you have checked that the points look correct when you add them to the map in QGIS. Finally make a backup copy of the points or tracks on a USB thumb drive.

Then you can remove the points and tracks from the GPS. In the Waypoint Manager, press the Menu button on the outside lower left side of the GPS unit. Select the option to delete all waypoints, and confirm. The unit will then say “no results found.” To remove the tracks, go to the Track Manager and use the Menu button to select the option to delete all tracks. After confirming, sometimes there are still tracks there and you may need to select each remaining track and click “delete” and confirm. You may also need to clear the current track.

Checking the battery level and changing the batteries

To check the power, when the unit is on, press the button on the lower outside right of the unit (the power button). This also allows you to change the brightness of the unit (you should make the screen less bright to save battery power).

If the battery is flat, find the silver D-shaped ring in the back of the unit, flip it out and turn it until the back case comes off easily. Then change the batteries, put the case back on, and turn and flip the D-ring back into place. You should not have to push hard on the ring or the case in order for it to fit.

You can use rechargeable AA batteries so you don't have to buy new batteries. You will need a charger for the batteries, and more than one set of batteries so you can use the GPS unit while the other batteries are charging. If you change the kind of batteries in the GPS unit, you will need to go to Setup>System>Battery Type and select the right battery type. Look at the file called etrex_10_QSM_EN.pdf (in the Manuals-How-Tos folder on the Acer) to see pictures of how to change the batteries and how to change the battery type.

Data redundancy

Redundancy means having more than one copy of something or more than one way of doing things. While you are still learning how to use the GPS and make maps, it is a good idea to travel in teams to continue to check that you are doing things correctly. This means having at least two GPS units together when you are mapping so that you can download the data from both and make sure that the points and tracks look similar. That way you can also keep helping each other learn how to do it. When you are teaching a new person to use the GPS, you can bring one GPS unit for the teacher and one for the student, so they can imitate what you do, and so you can check their points and tracks with your points and tracks (when you download them later).

Measuring uncertainty/errors in locations

Even after you know how to make points and tracks, having redundant measurements lets us understand what the error or uncertainty is in the measurements. We can never get rid of errors completely and we don't want to pretend we know the exact answer. Instead we want to measure how well we think we know.

For example, remember that when you look at the satellites menu, it says “GPS” and then a number of meters. That is the uncertainty in the position – the GPS does not know exactly where you are. That is one way to measure the uncertainty in location. Another way to measure uncertainty in location is to stand in one place and take many waypoints (and do not average them). Another way to measure uncertainty is for two people to make the same measurements and then compare them.

Taking photos with cameras and locations from Garmin eTrex 10

Why take a photo and record its location (coordinates: latitude and longitude)?

Any time you need to know where you were when you took a picture, you can use a GPS unit to record your location and connect it with the picture.

When would you want to know where you took a photo?

You might be making a map of a place to show someone who has never been there (like Great Zimbabwe). You would be using the GPS to mark waypoints at different features of interest, and you can tell the story better if you have pictures of those features.

You might take a picture of a tree or landscape and then want to go back to that same place five years later and take another picture to see how it has changed.

You can think of other examples, too!

How do you combine the photo and the GPS location?

When you mark a waypoint and record it in your notebook, you can take a photo and record the number of the photo in your notebook along with the waypoint's code (like "BH1"). You can read the photo number on the camera's display. It is also useful to record your compass bearing (the direction you are facing, measured clockwise from North in degrees) so that you know whether you are looking to the north, south, east, west, or somewhere in between. You can write the bearing in the notebook along with the photo number. Then when you record the information about the waypoints in your spreadsheet, you can have a column for "Photo Number" and "Photo Bearing" in addition to all the other columns you already have ("Feature", "waypoint", "owner", "date", and so on).

You can also take a picture of the GPS unit before you take the picture of the feature or landscape. Take a picture of the Satellite screen which gives the latitude and longitude and GPS uncertainty, and then take the picture of the feature or landscape you are recording. Always take the picture of the GPS screen first so you know which picture the location goes with.

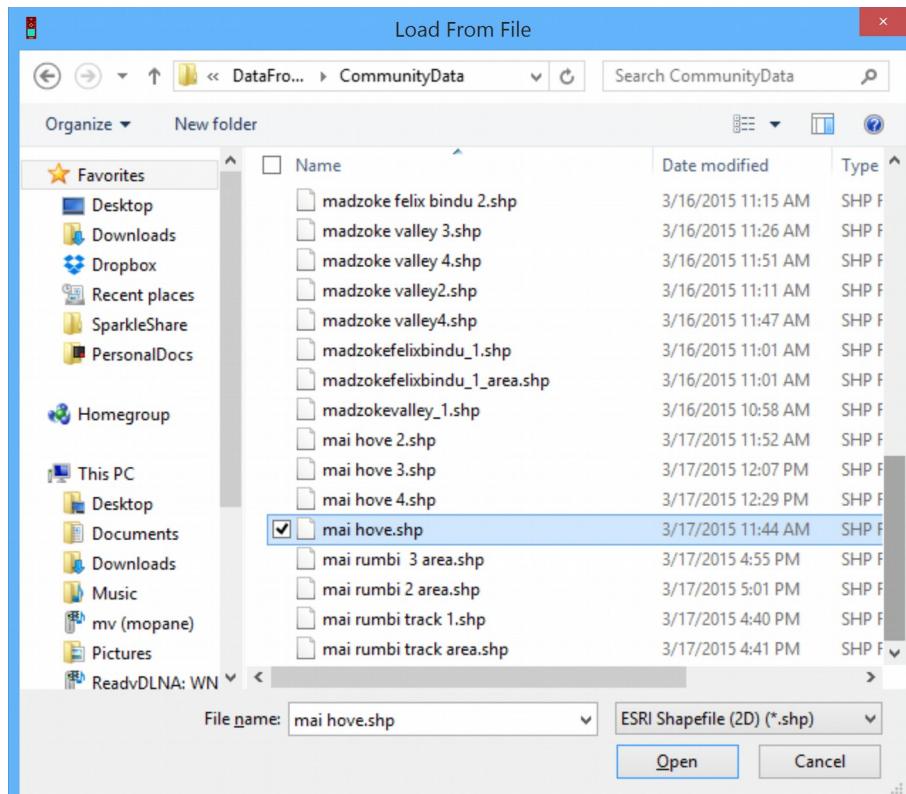
It is a good idea to do both of these things. The first way is better for doing research, but the second way is good for data redundancy in case something goes wrong – for example if you lose your notebook.

Uploading points to GPS unit using DNRGPS

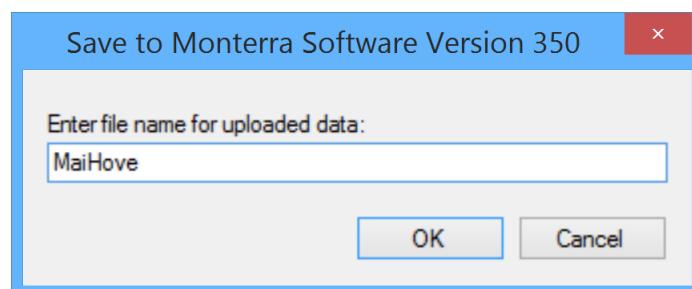
GPS units are very helpful for recording the locations of features of interest. But they are also useful for going back and finding those features again later, or for finding features based on locations that other people give you. For example, we might want to re-measure trees that we had measured in the 1980s to see how fast they have grown since then. To do that, we can get the waypoints from the researcher who measured them in the 1980s and put the points in the GPS to go find the trees again.

To do this, you need to upload points to the GPS. After plugging the GPS unit into the computer and starting up DNRGPS, go to File>Load From> File...

Choose a shapefile (shp) that you want to put onto the GPS and click “Open”.



DNRGPS tells you “Load From File(s) Complete”. Click Ok. The points should appear under the “Waypoints” tab. Select all the points using ctrl-A. Then go to Waypoint>Upload. Give the waypoints a name and click “ok”:



(note that your version will say “Save to eTrex 10 Software Version 340”, not “Monterra”) DNR GPS will say “Upload Complete”. Click OK.

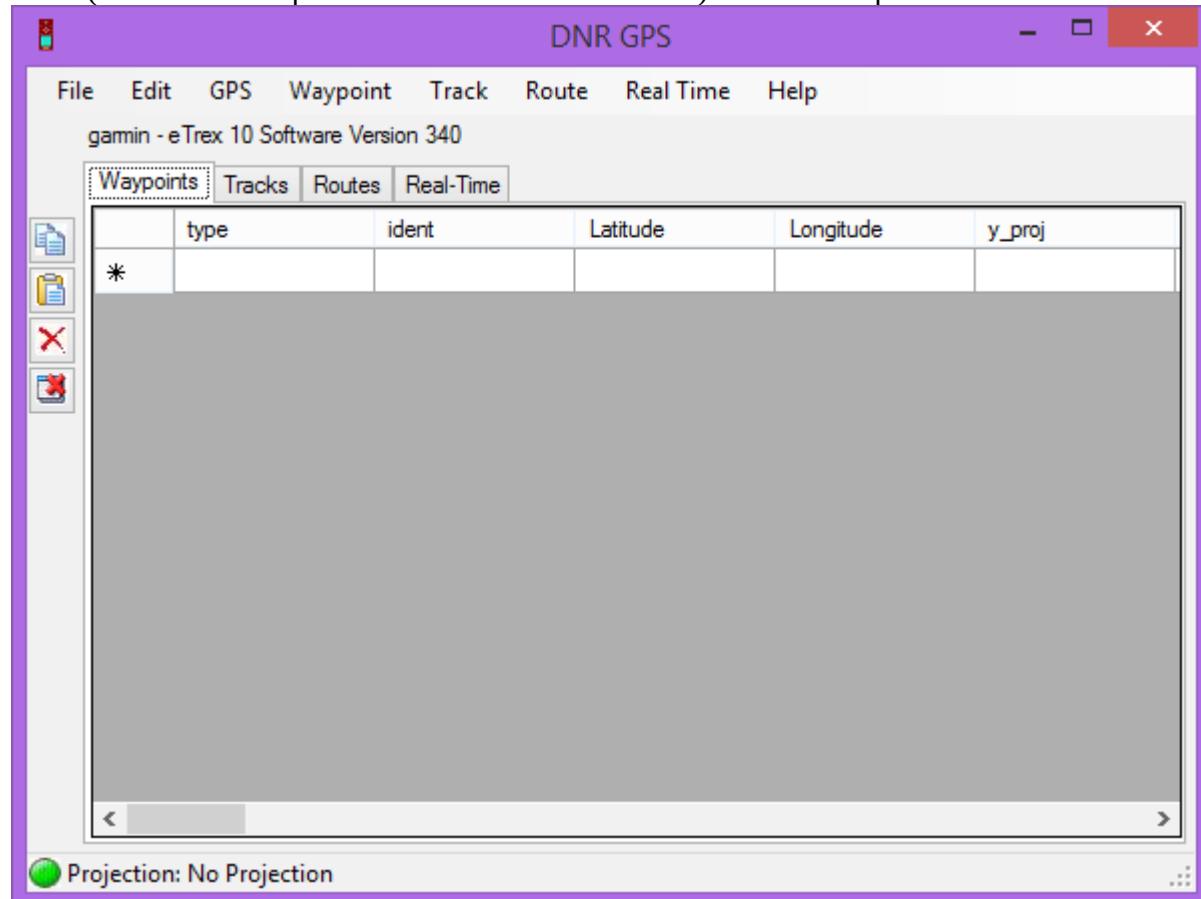
Now go to the waypoint manager on the eTrex 10 and check to make sure the points are uploaded to the GPS. You should be able to walk to the old waypoint and re-locate it (within the GPS uncertainty).

Plugging in GPS and starting up DNRGPS

Plug the Garmin eTrex into the computer using the USB cable (small end goes in the GPS, large end goes in the computer):

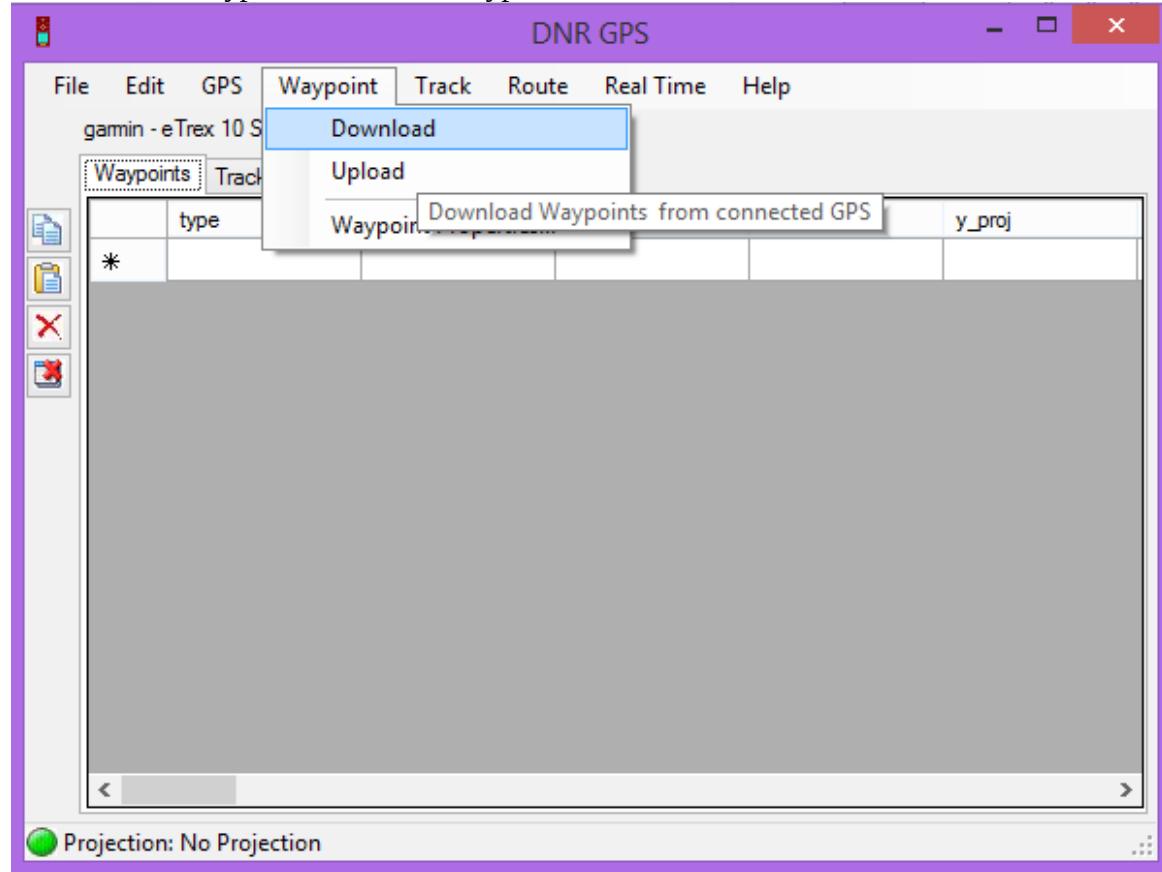


Start up DNRGPS from the Start Screen, or the bar at the bottom of the Desktop. (“Taskbar”) DNR (Minnesota “Department of Natural Resources”) GPS starts up and looks like this:

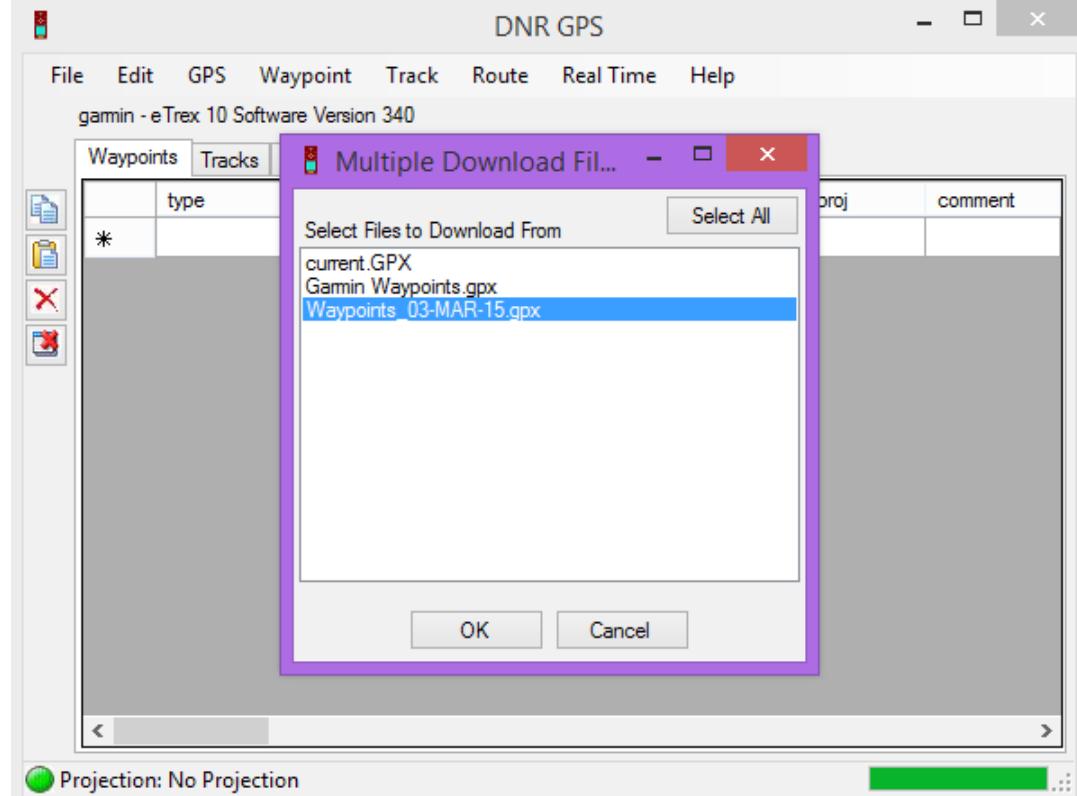


Downloading Waypoints from GPS using DNRGPS

To download waypoints, click on Waypoint>Download



Then select the file to download (probably the one with today's date, but you can try different ones if you need to)

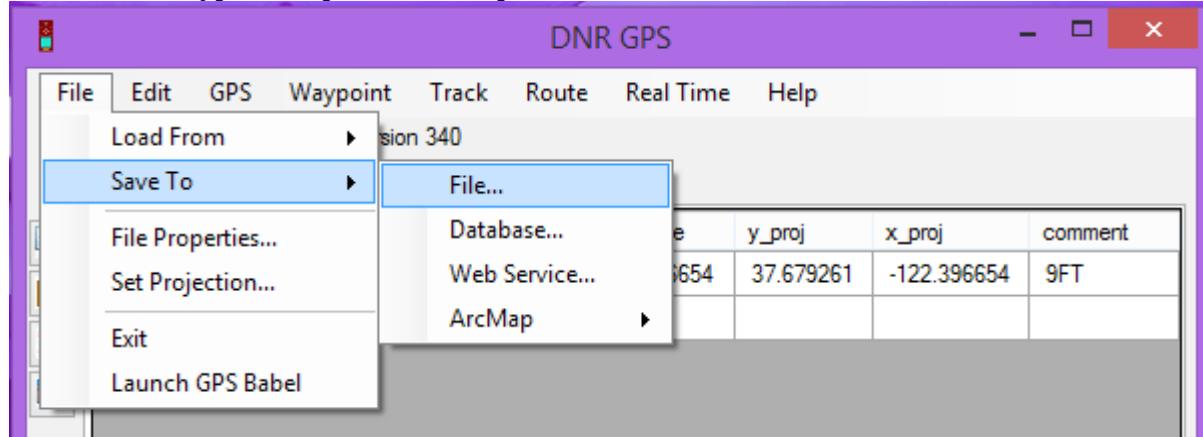


Click "OK"

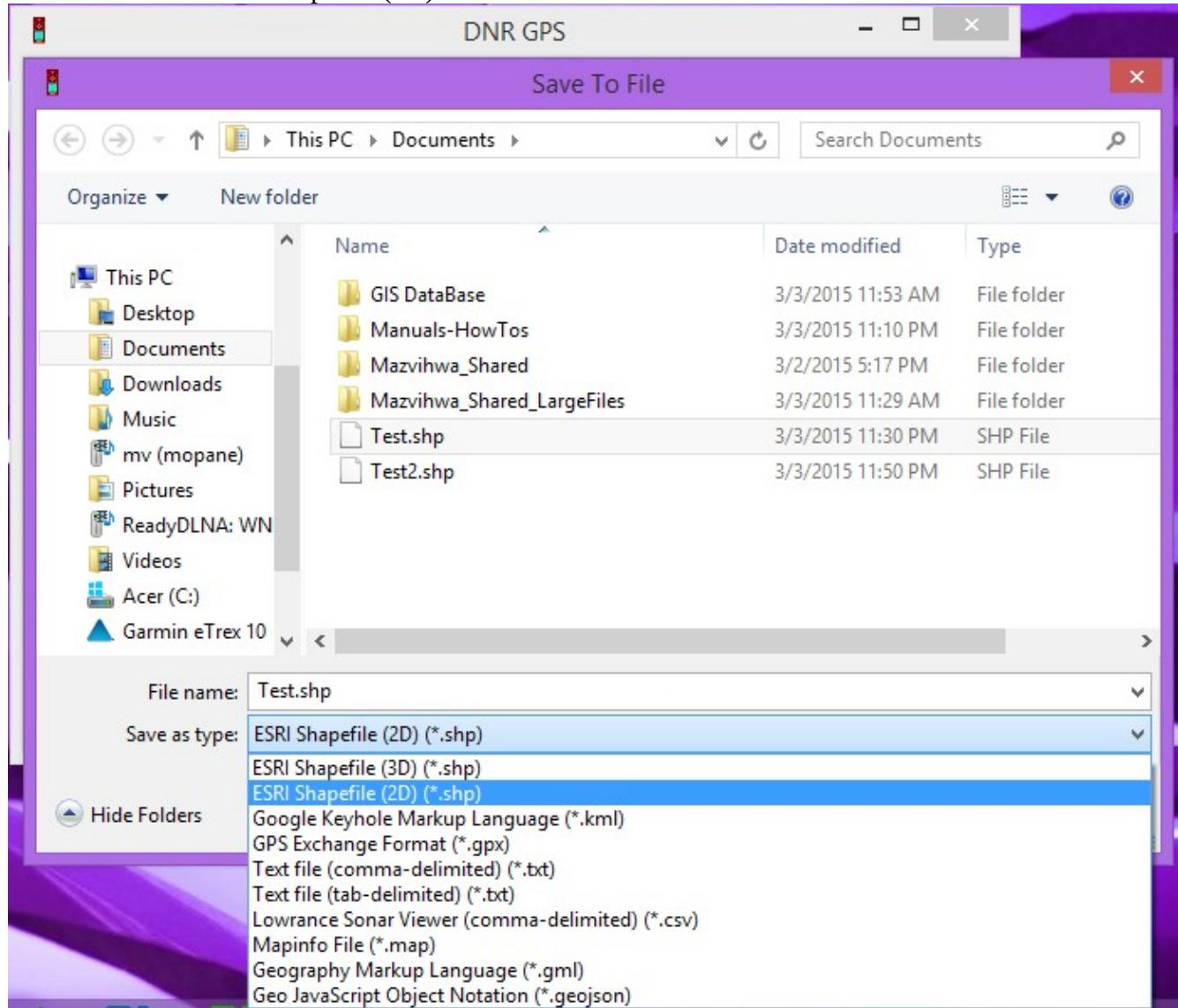
it will say "Download Complete" - click "OK"

Saving Waypoints from DNRGPS

To save the waypoint to put on the map, click File>Save To>File...



Pick a location for the file (“This PC>Documents>GPS files” is a good place), give the file a name and save it as an ESRI Shapefile (2D):

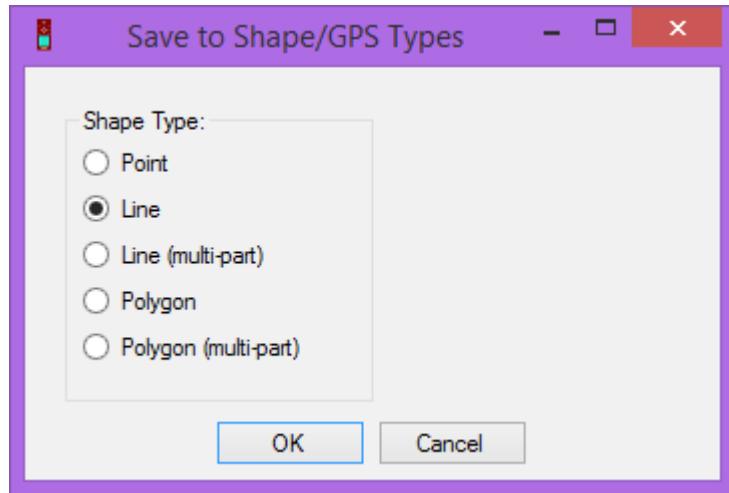


It will say “Saved to File Successfully at” and tell you where it put the file - click “OK”

Saving Tracks from DNRGPS

The same process works for Tracks – click instead “Track>Download” to download the track (and choose which track to download), then “File>Save To>File...” to save the track as an ESRI shapefile (“shp”)

At that point, it will ask what kind of Shape Type you want for the Track. Please choose “Line” for Tracks. Click OK.



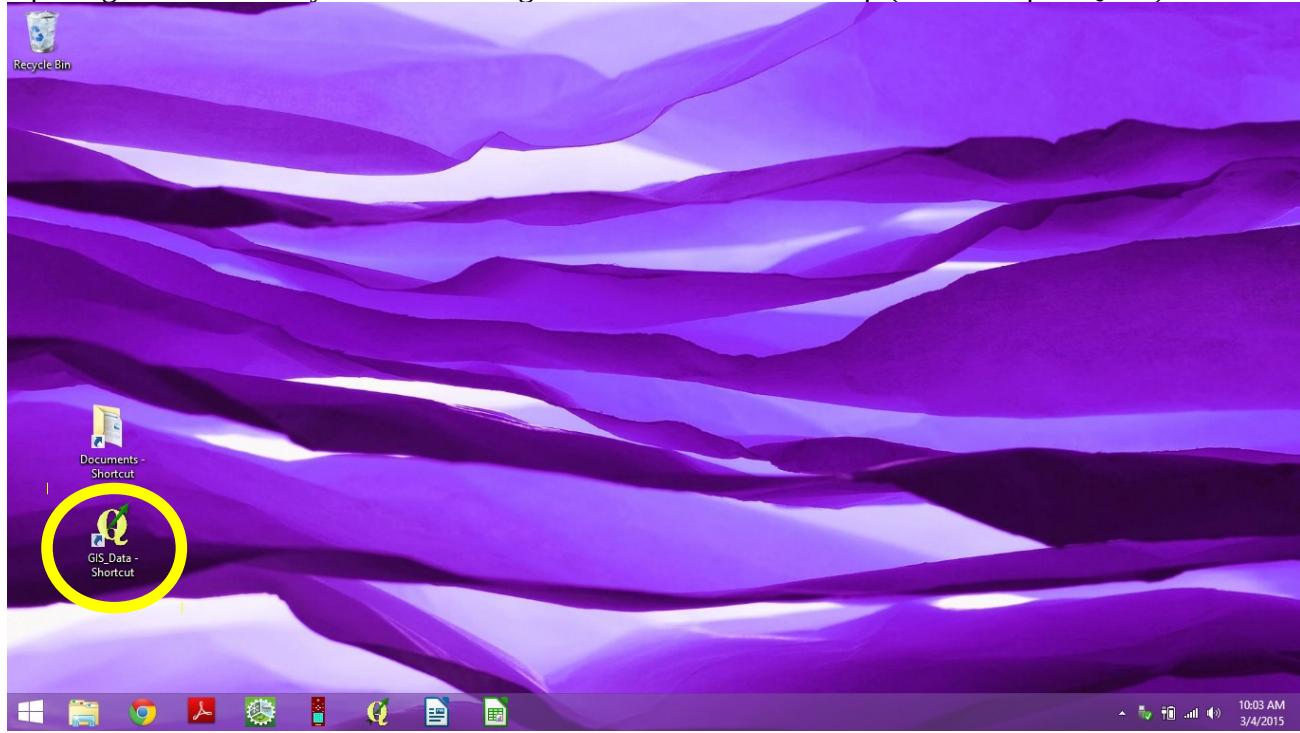
Then it will say “Saved to File Successfully at” and tell you where it put the file - click “OK”.

Note: if you collect and save a track just for mapping a field or a water feature, you can save the track as a “Polygon” and view it in QGIS as a shape instead of a line.

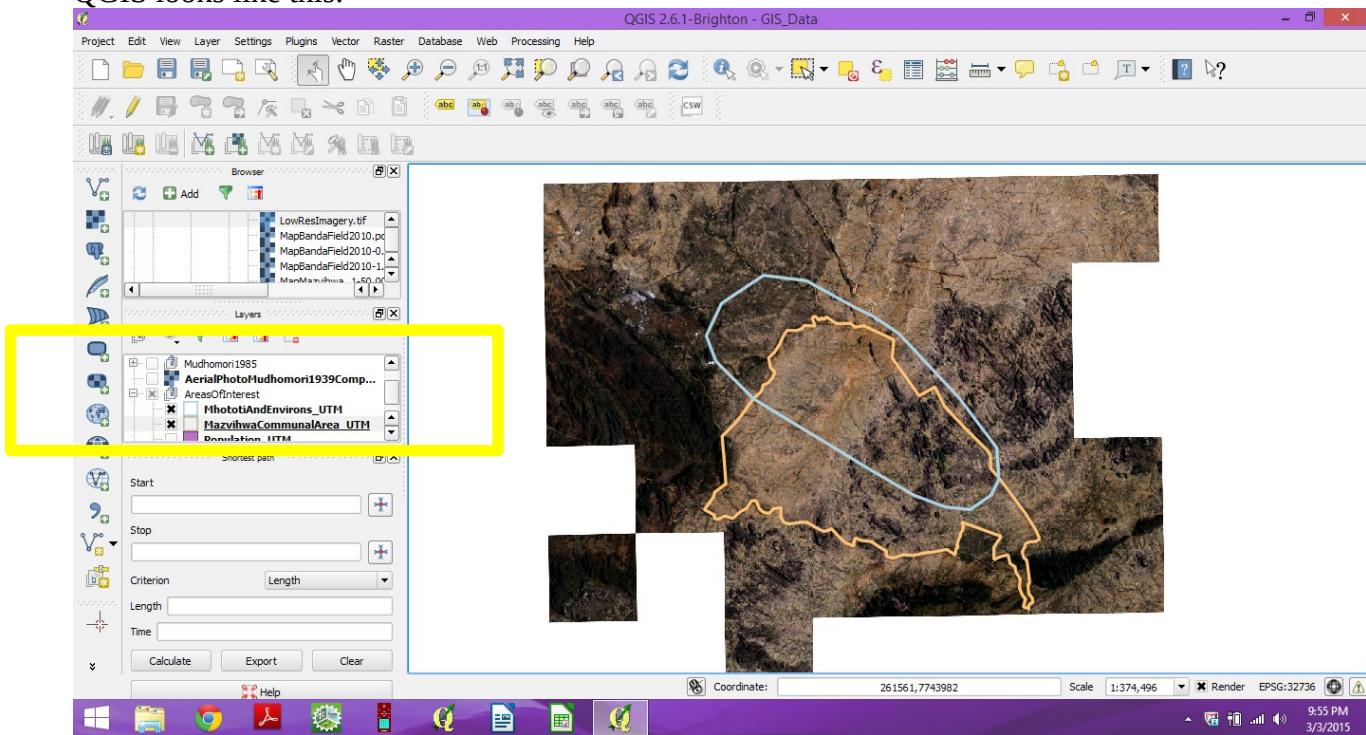
Looking at data in QGIS

A few definitions: lines, points, and shapes (or “polygons”) are called “**Vector**” files and pictures are called “**Raster**” files.

Opening the GIS data by double-clicking on the shortcut on desktop (this will open QGIS)



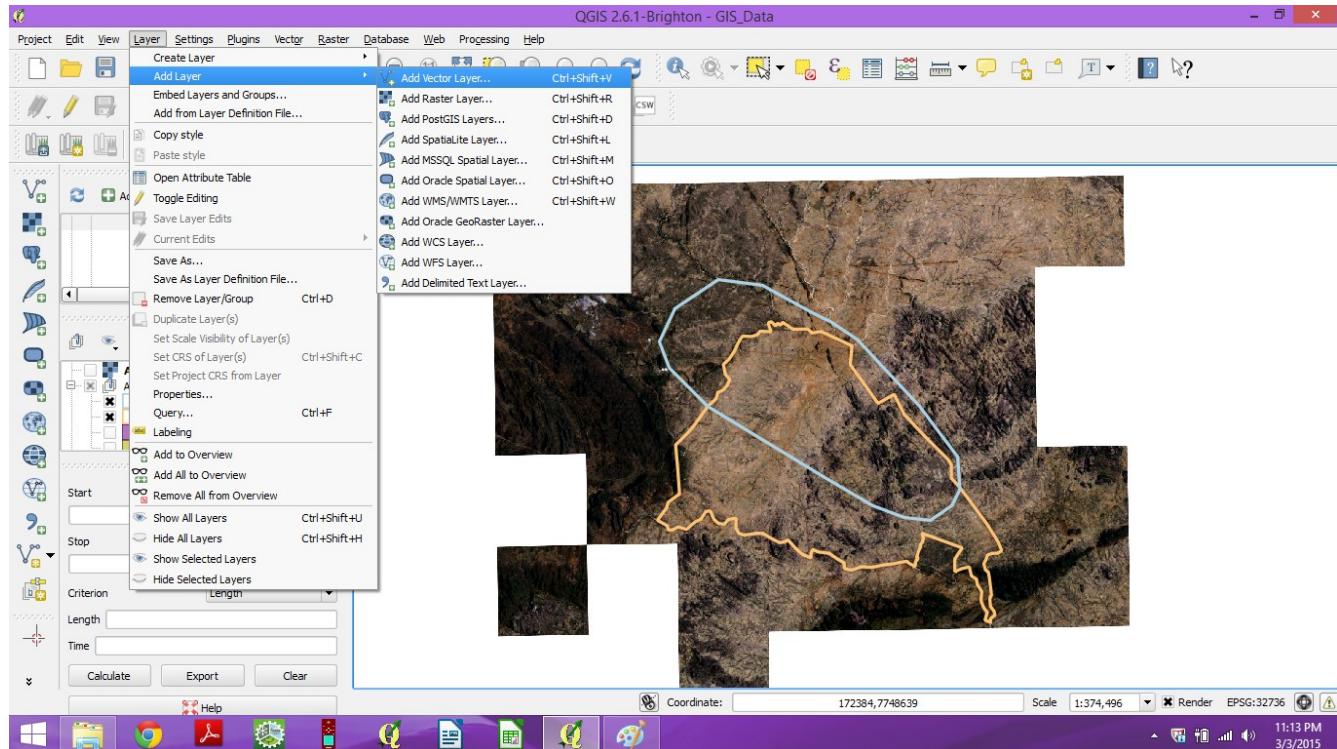
QGIS looks like this:



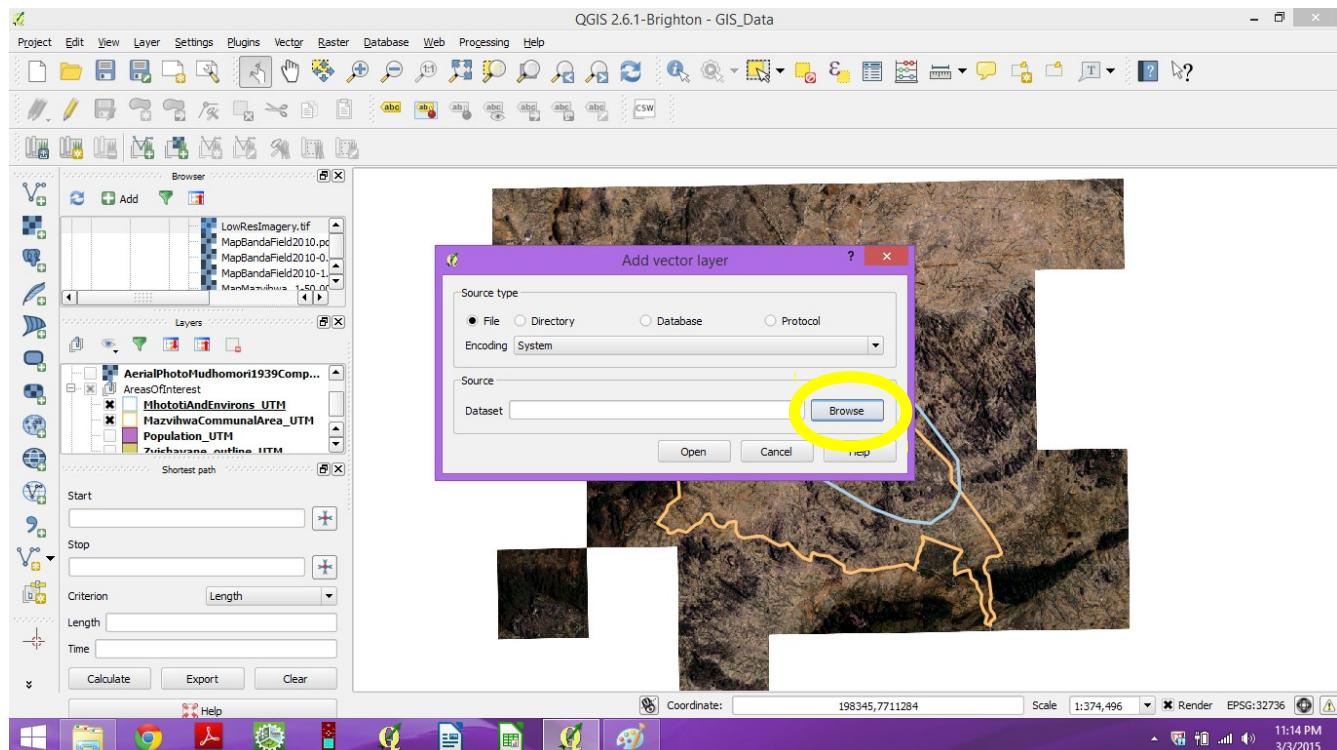
You can turn layers (vector and raster) on and off by checking or unchecking the box next to the name in the “Layers” list.

To add waypoints and tracks to the map in QGIS

Go to Layer>Add Layer>Add Vector Layer



When the “Add Vector Layer” dialog box comes up, click “Browse”

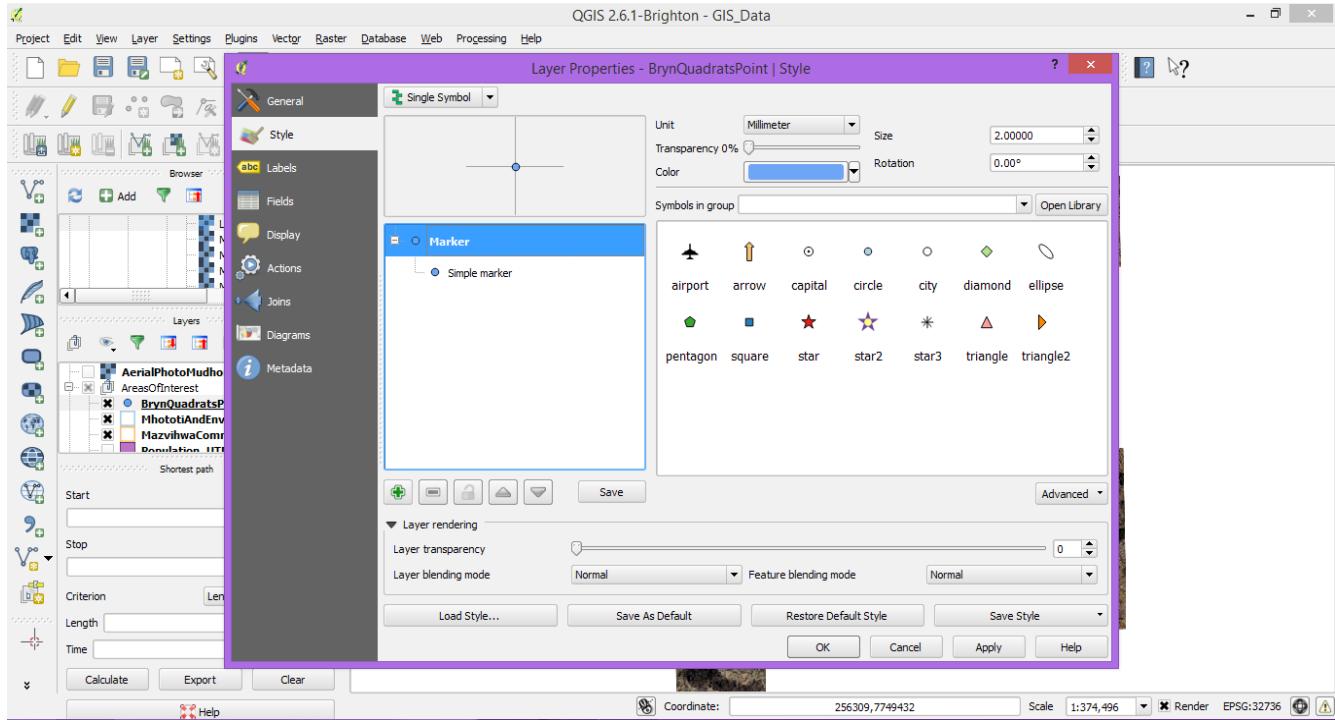


Go to the place you saved the GPS files (for example, Documents>GPS files)

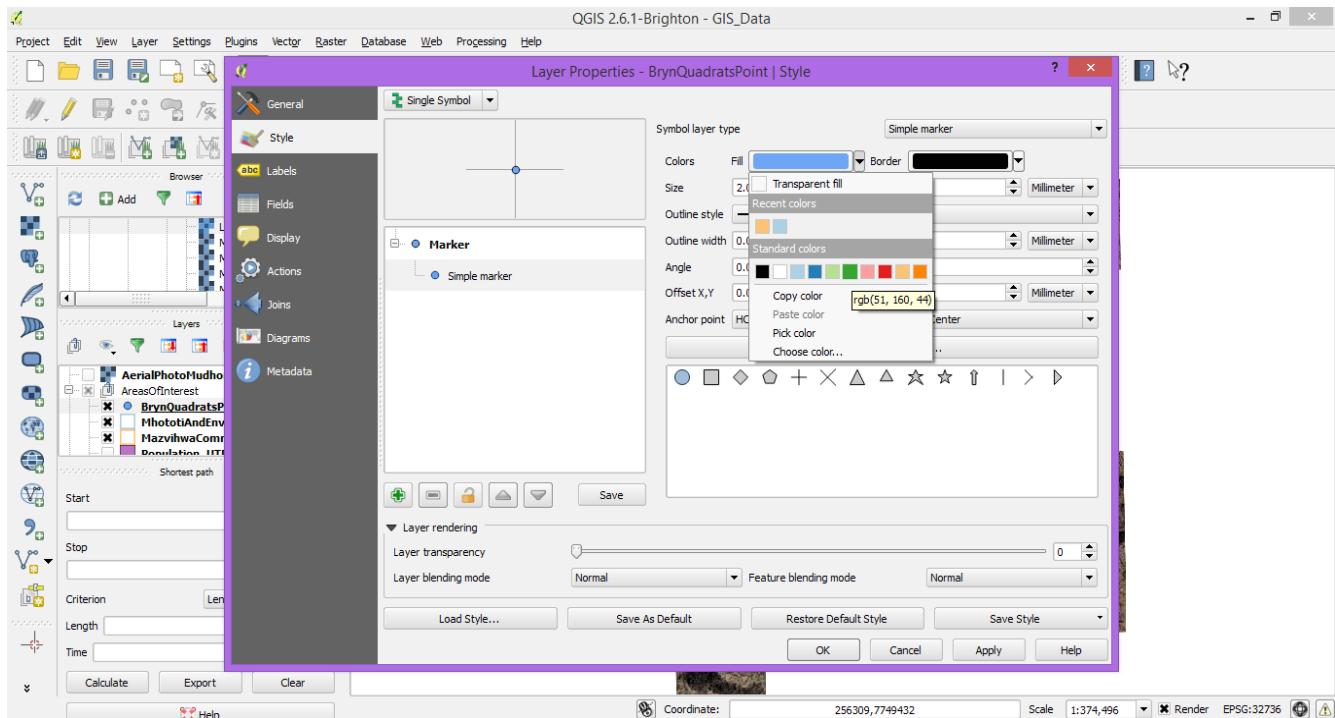
There will be quite a few files with the same first part of their name. Select the file that ends with “.shp” and click “Open”. Then the box called “Dataset” will have that file listed in it. Click “Open.”

Changing symbology/the way the waypoints and tracks look in QGIS

Double click on the name in the “layers” area. The “Layer Properties” window opens. Under “Style” (on the lefthand side of the window), you can change the shape and color of the points, lines, and shapes/polygons (vector data).

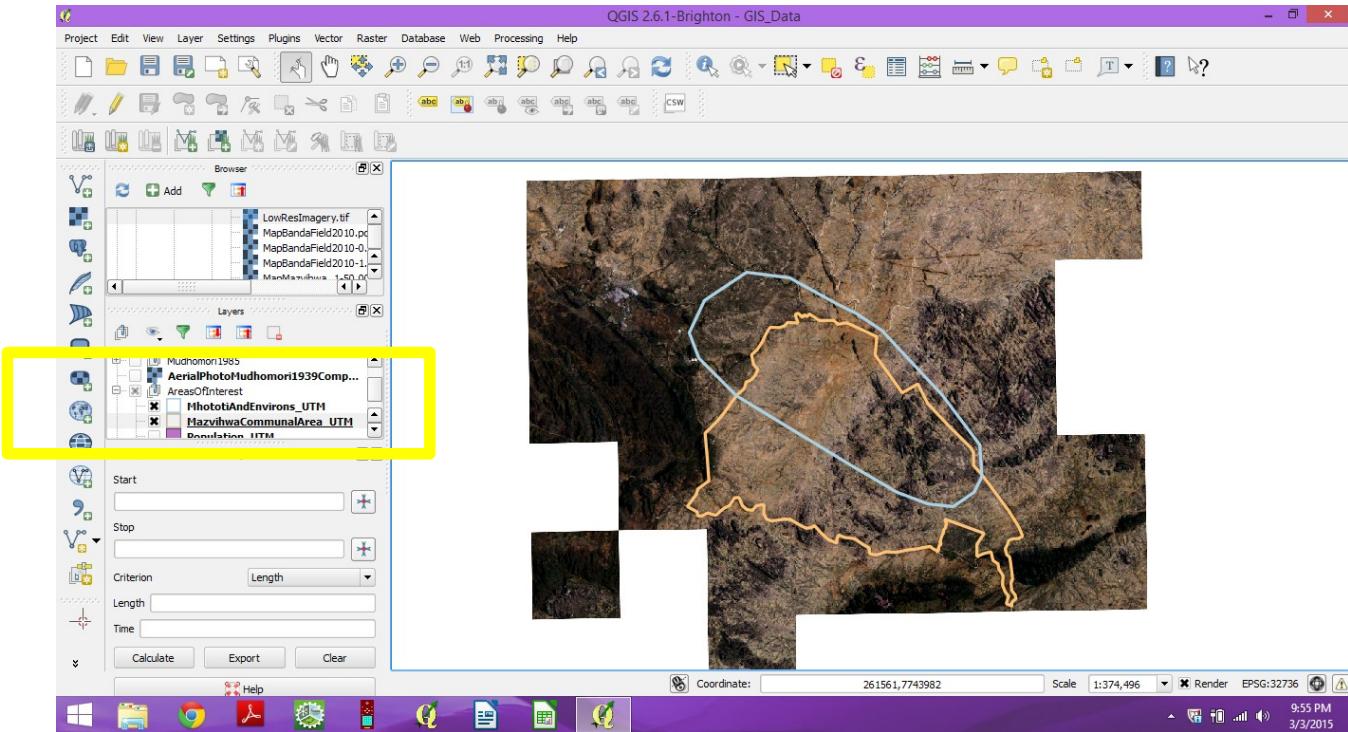


You can do more specific changes if you click on the “Simple marker” item below the word “Marker”. The words are different for lines or shapes (polygons), but the concept is similar.

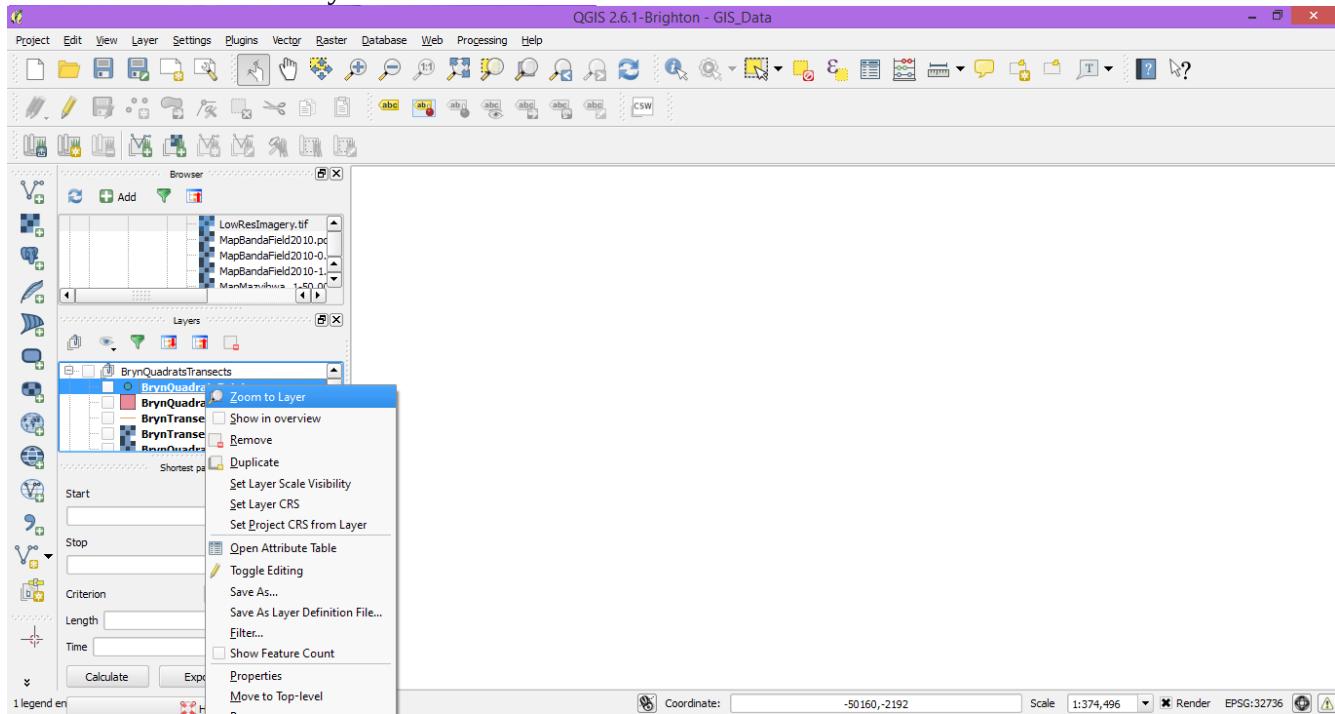


Zooming to look at specific data in QGIS

Right click on the name in the bar on the left



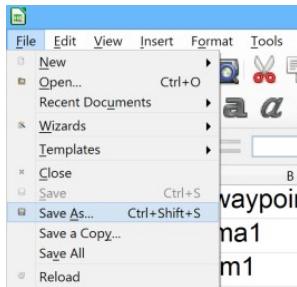
Then select “Zoom to Layer”



QGIS will zoom to just that data, helping you find it.

Saving a spreadsheet as Comma Separated Values in LibreOffice Calc

Go to File> Save As...



Save the spreadsheet as a CSV (comma separated values). For “Save as type:” select “Text CSV (*.csv)”

A screenshot of the LibreOffice Calc application window. The main area shows a spreadsheet with columns labeled 'date', 'waypoint', 'feature', 'owner', and 'type'. The 'Save As' dialog box is overlaid on the bottom right. In the 'Save as type:' dropdown, the option 'Text CSV (*.csv)' is selected and highlighted with a yellow circle. The rest of the dialog shows the file name 'muonde points.xls' and a list of other save formats.

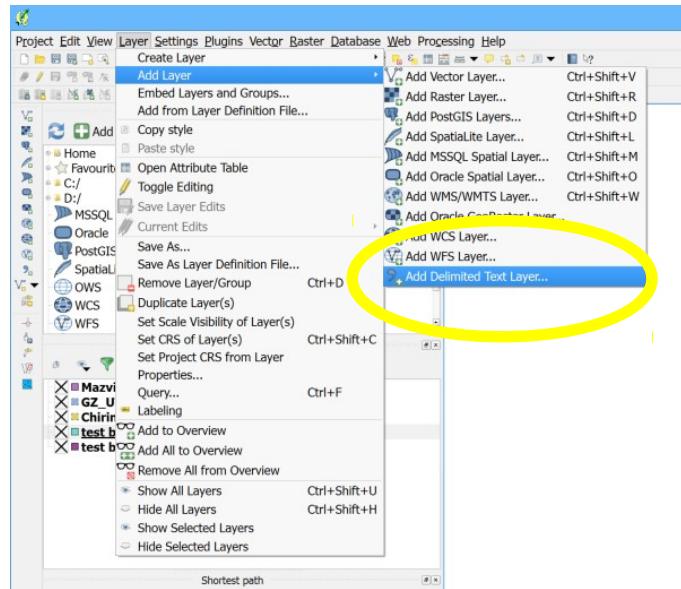
A window will pop up which says “Export Text File”. The default values are okay, so click “OK.”

Make sure the waypoint code in the spreadsheet is exactly the same as the waypoint code from the GPS. “md1” is not the same as “MD1” - the codes are “case-sensitive” which means that when QGIS joins/links the GPS codes with the codes you have in the spreadsheet, it is sensitive to whether the letters are UPPER CASE or lower case. You may have to fix this before you can add the csv to QGIS.

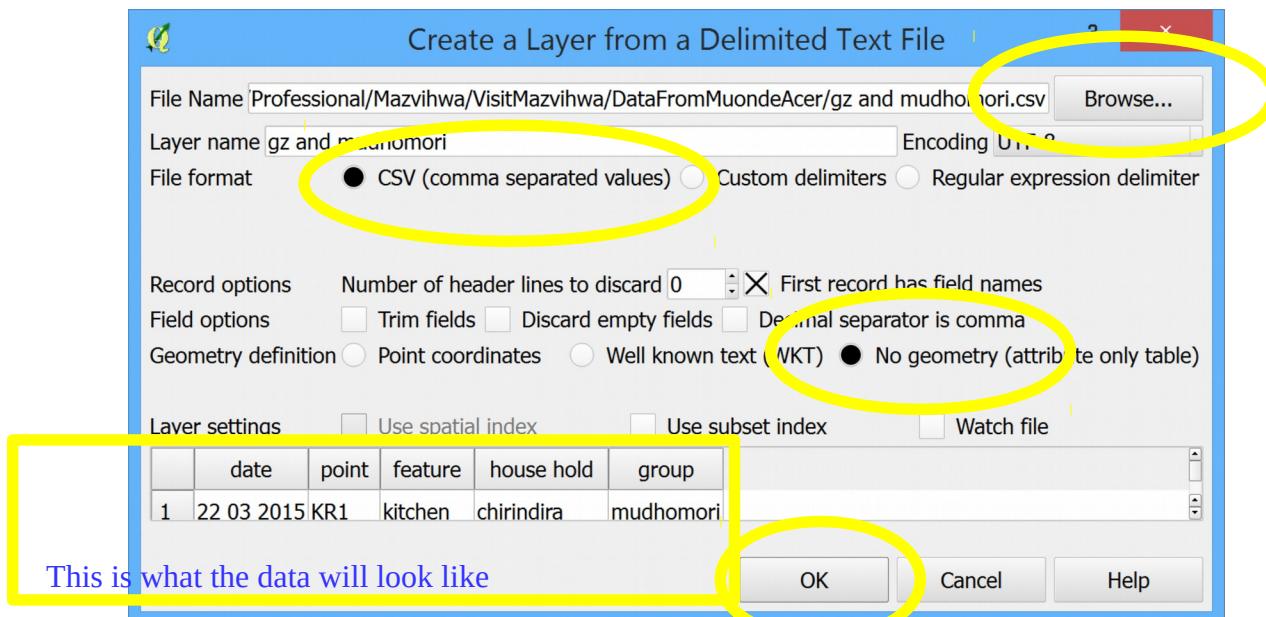
Notice the names of the columns in your spreadsheet. Here the waypoint code is in a column called “waypoint” and the label you will add to the map is in a column called “feature.” You can choose different names if you want. But remember what they are when you are doing the join later.

Add Comma Separated Values table to the map in QGIS

Go to layer>add layer>add delimited text layer

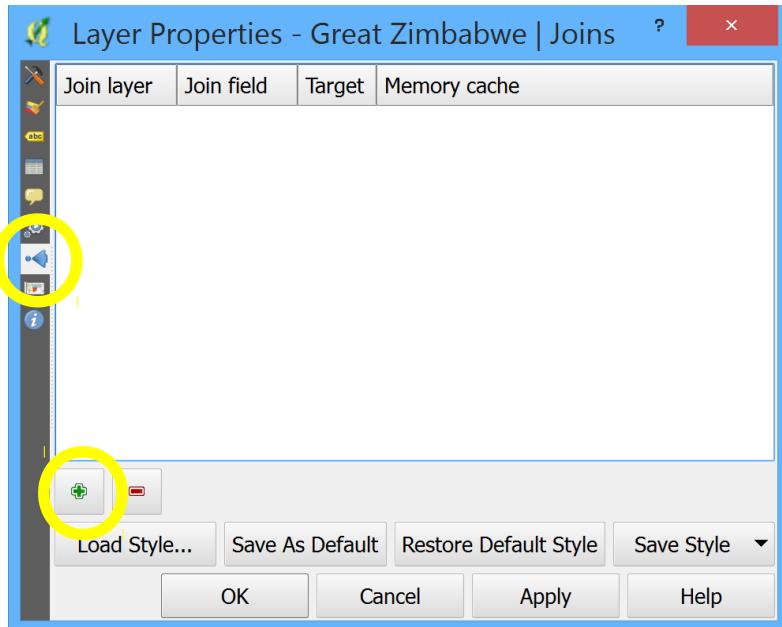


Browse to find the CSV file you just saved. Make sure "CSV" is selected. Click 'no geometry (attribute only table),' make sure the data looks all right at the bottom of the window, and click OK.



Joining the Comma Separated Values table to the waypoints in QGIS

Left double click on the points you want to label (in the table of contents on the lefthand side of the screen) and go to 'joins' (the picture of the little blue arrow:). Click the green plus .



A new window appears:

The first screenshot shows the initial state of the 'Add vector join' dialog. The 'Join layer' dropdown is set to 'gz and mudhomori'. The 'Join field' dropdown is set to 'point'. The 'Target field' dropdown is set to 'date'. The 'Cache join layer' checkbox is checked. The 'Create attribute index on join field' and 'Choose which fields are joined' checkboxes are unchecked. Below these are two checkboxes for 'date' and 'point', both of which are checked.

The second screenshot shows the 'Target field' dropdown expanded, revealing options like 'ident', 'type', 'Latitude', 'Longitude', 'y_proj', 'x_proj', 'comment', 'display', and 'symbol'. The 'ident' option is selected.

The third screenshot shows the 'Cache join layer' checkbox unchecked. The 'Create attribute index on join field' and 'Choose which fields are joined' checkboxes are still unchecked. The 'date' and 'point' checkboxes remain checked.

"join layer" should be the CSV file name.

"join field" is whatever it's called in the spreadsheet like 'point' or 'waypoint'

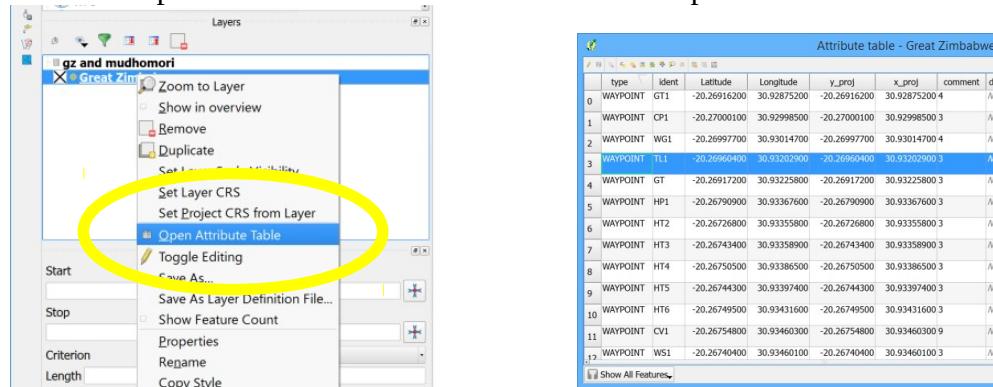
"target field" is 'ident' (this is what the GPS calls the waypoint name/code)

Then click OK and then OK again

Checking values in the attribute field of points/lines/polygons in QGIS

Displaying points, lines, and polygons (shapes) on a map is very useful. But it is even more useful to have information about each of those points, lines or polygons – like who owns/manages the field, how large the field is (area), how long the dead-level contour is, and so on. You can see this information by looking at the 'attribute table' of the vector layer. “Attribute” just means the information about the point, shown in the columns of the spreadsheet.

Right-click on the name of the vector layer on the table of contents on the lefthand side of the screen. Then left-click on “Open Attribute Table.” The attribute table opens in a new window.



This is a good way to make sure your join with the Comma Separated Values worked. Scroll all the way to the right. Information from a joined csv file starts with the name of the file, for example “gz and mudohmori” with an underscore “_” and then the name of the column from the spreadsheet, like “date” or “feature.” “NULL” means there isn’t information for that column for that point.

The image shows a detailed view of the attribute table for the 'Great Zimbabwe' layer. The table has 13 rows and 7 columns. The columns are labeled: p, dgpsid, dir, gz and mudhomori_date, gz and mudhomori_feature, gz and mudhomori_house hold, and gz and mudhomori_group. The 'gz and mudhomori_date' column contains dates like '22 03 2015'. The 'gz and mudhomori_feature' column contains feature names like 'toilets', 'third corner', etc. The 'gz and mudhomori_group' column contains 'Great Zimbabwe' for most entries. The 'gz and mudhomori_house hold' column contains 'zimbabwe' for most entries. The 'dgpsid' and 'dir' columns contain NULL values. The 'p' column contains row numbers from 1 to 12.

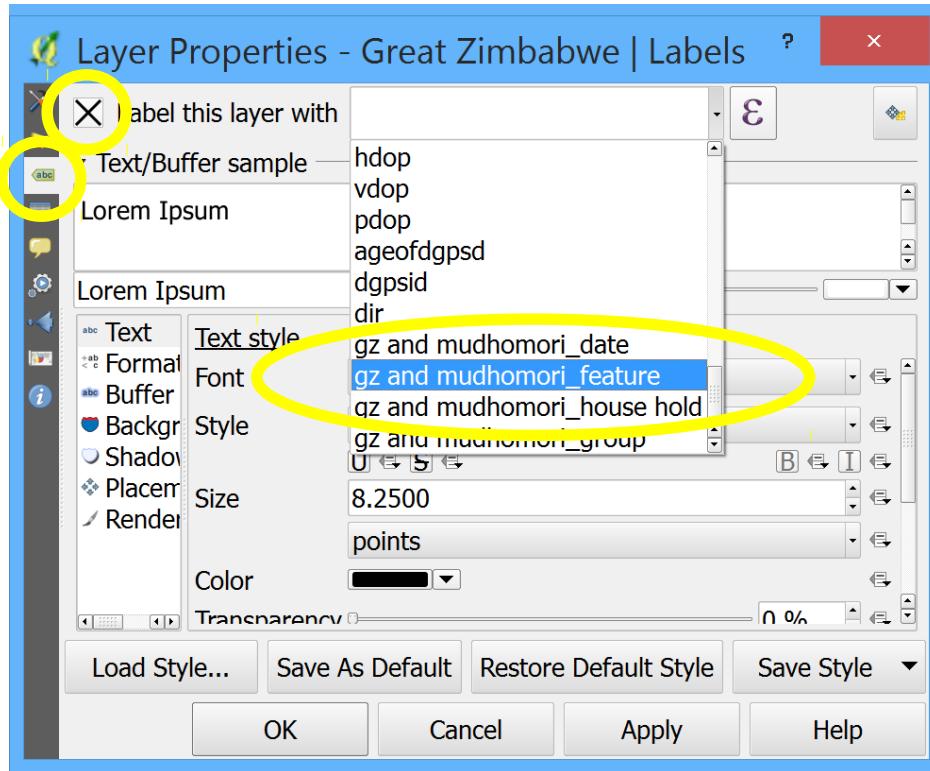
p	dgpsid	dir	gz and mudhomori_date	gz and mudhomori_feature	gz and mudhomori_house hold	gz and mudhomori_group
1	NULL	NULL	22 03 2015	toilets	zimbabwe	Great Zimbabwe
2	NULL	NULL	22 03 2015	third corner	zimbabwe	Great Zimbabwe
3	NULL	NULL	22 03 2015	terrace platforms	zimbabwe	Great Zimbabwe
4	NULL	NULL	22 03 2015	smelting workshop	zimbabwe	Great Zimbabwe
5	NULL	NULL	22 03 2015	shona village	zimbabwe	Great Zimbabwe
6	NULL	NULL	22 03 2015	royal court 2	zimbabwe	Great Zimbabwe
7	NULL	NULL	22 03 2015	royal court	zimbabwe	Great Zimbabwe
8	NULL	NULL	22 03 2015	kraal	zimbabwe	Great Zimbabwe
9	NULL	NULL	22 03 2015	Hilltop 6	zimbabwe	Great Zimbabwe
10	NULL	NULL	22 03 2015	Hilltop 5	zimbabwe	Great Zimbabwe
11	NULL	NULL	22 03 2015	Hilltop 3	zimbabwe	Great Zimbabwe
12	NULL	NULL	22 03 2015	Hilltop 2	zimbabwe	Great Zimbabwe

If you need to edit anything in the table, click on the pencil icon in the upper left: . Then you can type in the boxes the same way you do in a spreadsheet. Once you are done editing, click the save button and then click on the pencil icon again to stop editing.

Labeling points in QGIS

On the table of contents on the lefthand side of the screen, double (left) click on the name of the points that you want to label.

Go to the labels tab (the picture of the tag with 'abc' on it )

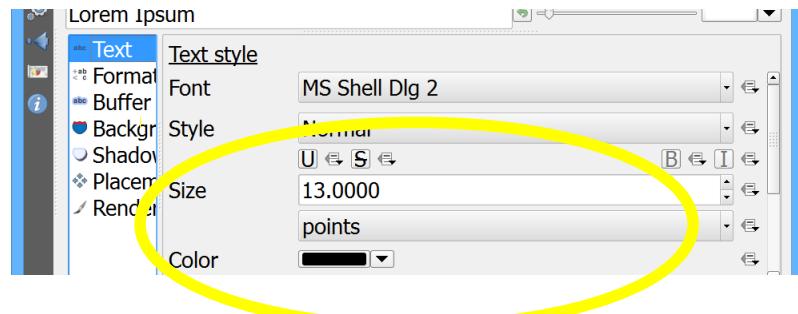


Check (click on) the box next to 'label this layer with'

Choose the name of the column that has the labels you want in it.

- “ident” is the code for the waypoint (like “BH1”)
- If you have joined a spreadsheet Comma Separated Values file to the points, you can use a description like “borehole” to label the points. These columns will be named “file name_column name.” For example, ‘gz and mudhomori_feature’ had the names of what the features were from the days we mapped objects in Great Zimbabwe and at Mudhomori.

You can change the size of the text by changing Size, and you can change the color of the text by clicking on the box next to Color and choosing a new color.

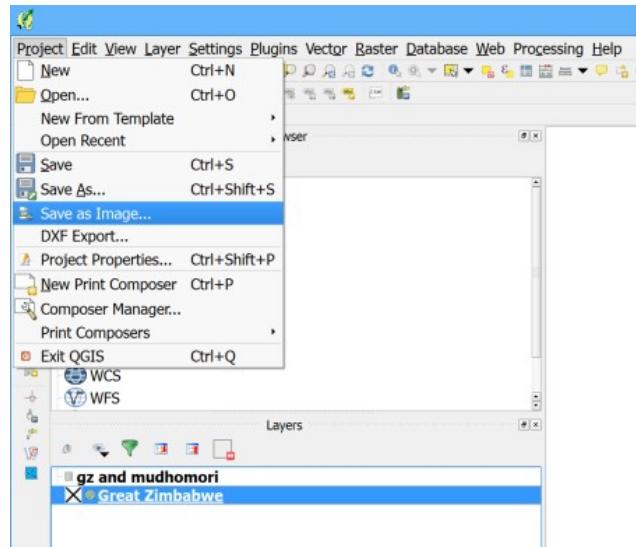


Click ok.

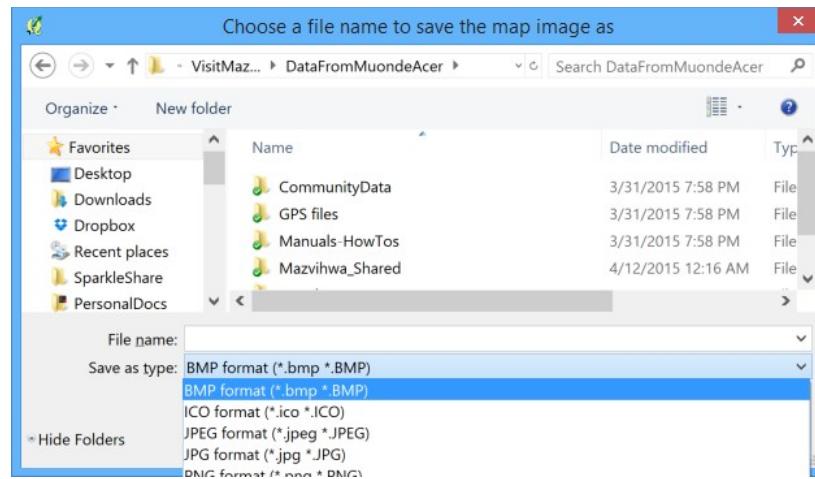
Making a quick map from the main program in QGIS

If you need to quickly make a map of some points you are working with, you can go to:

Project>Save as Image



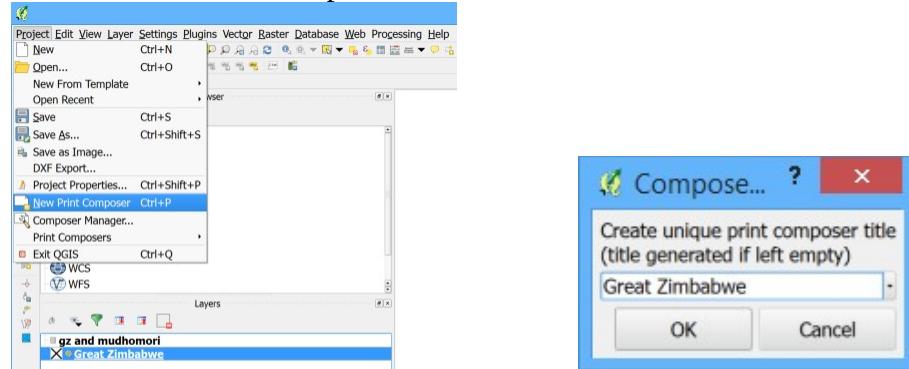
Give the image a name, and save it as a BMP format.



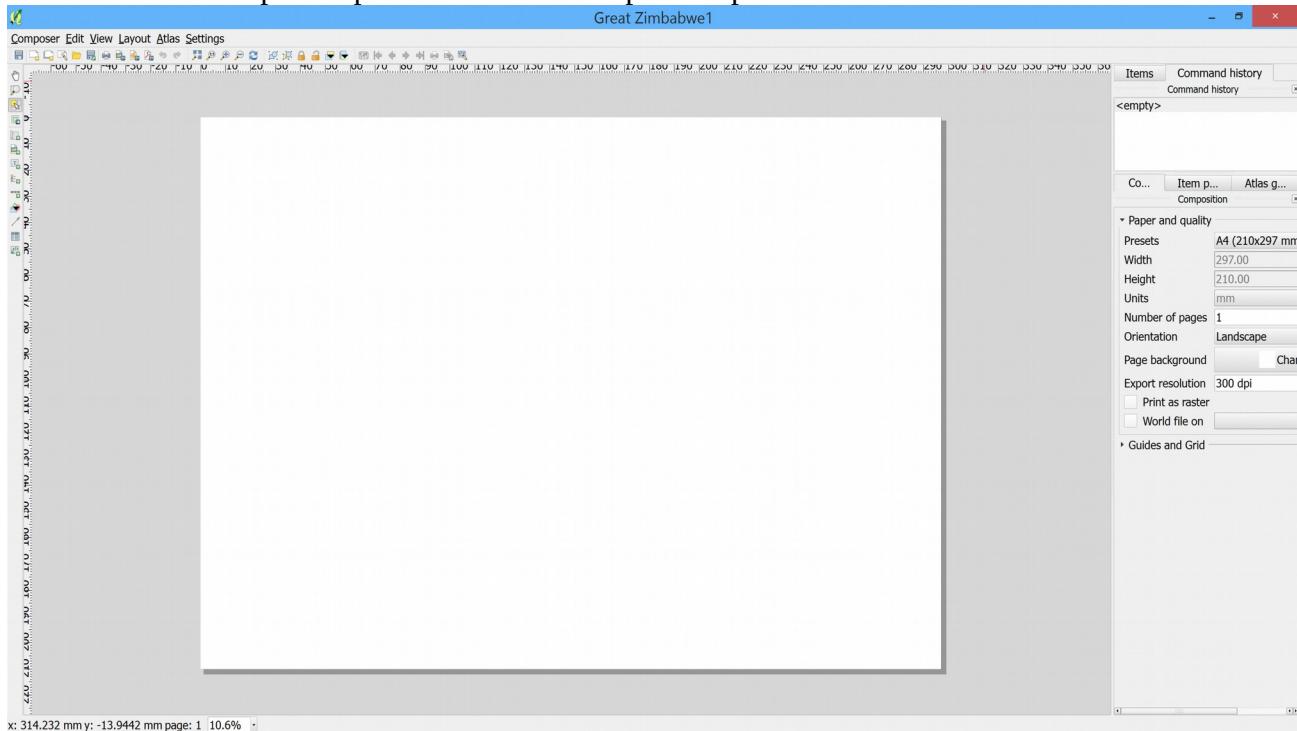
This image won't have a scale bar, legend, North arrow, or title, but it works to show something quickly to someone.

Using the Print Composer to make a map in QGIS

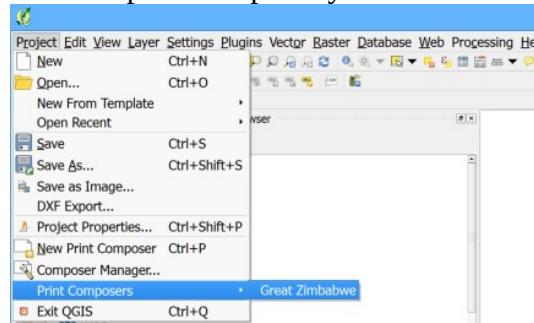
To make a nice map, use the Print Composer. Make sure to save your project before doing this. If this is the first time you are making a map for the project, you will need to go to Project>New Print Composer and name the new Print Composer:



Then the Print Composer opens with a blank map in a separate window:



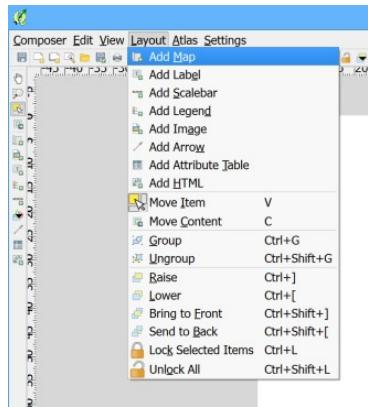
Make sure to save your project often (Composer>Save Project, or in the main QGIS window, Project>Save). The next time you want to work on the map for this project, you can go to Project>Print Composers>name of the print composer you made. For example:



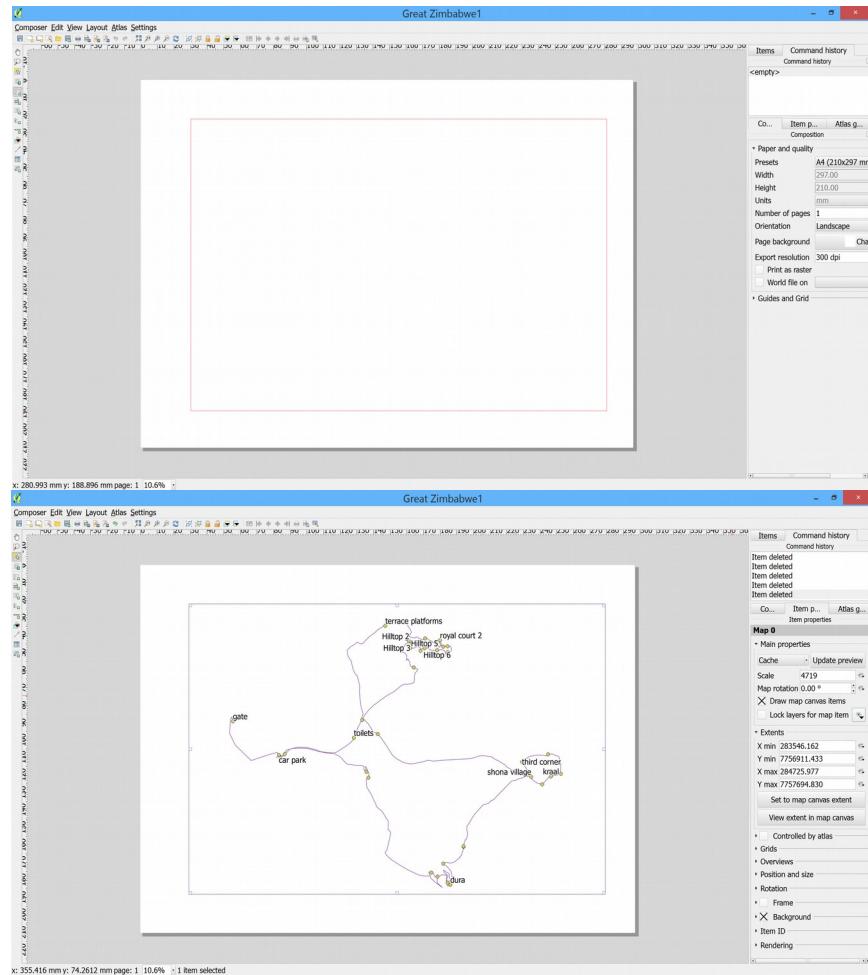
Then the Print Composer will open with the project you were already working on.

Adding a map to the Print Composer in QGIS

In the Print Composer window, go to Layout>Add Map



Click and drag (hold down the left touchpad button with one finger on one hand and move a finger from the other hand across the touchpad) to draw a box for where and how big you want the map.

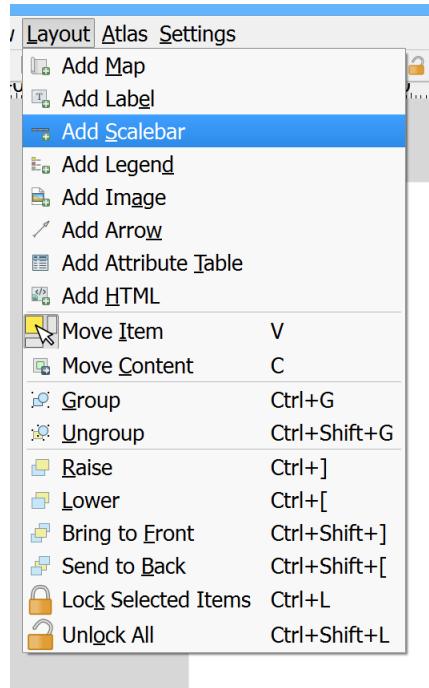


Make sure the map looks how you want it to look in the main QGIS window before you add it to the Print Composer window. You can click the refresh button in the Print Composer () if you make changes to the way the map looks in the main QGIS window, but it does not always work. You can always delete the map and add it again.

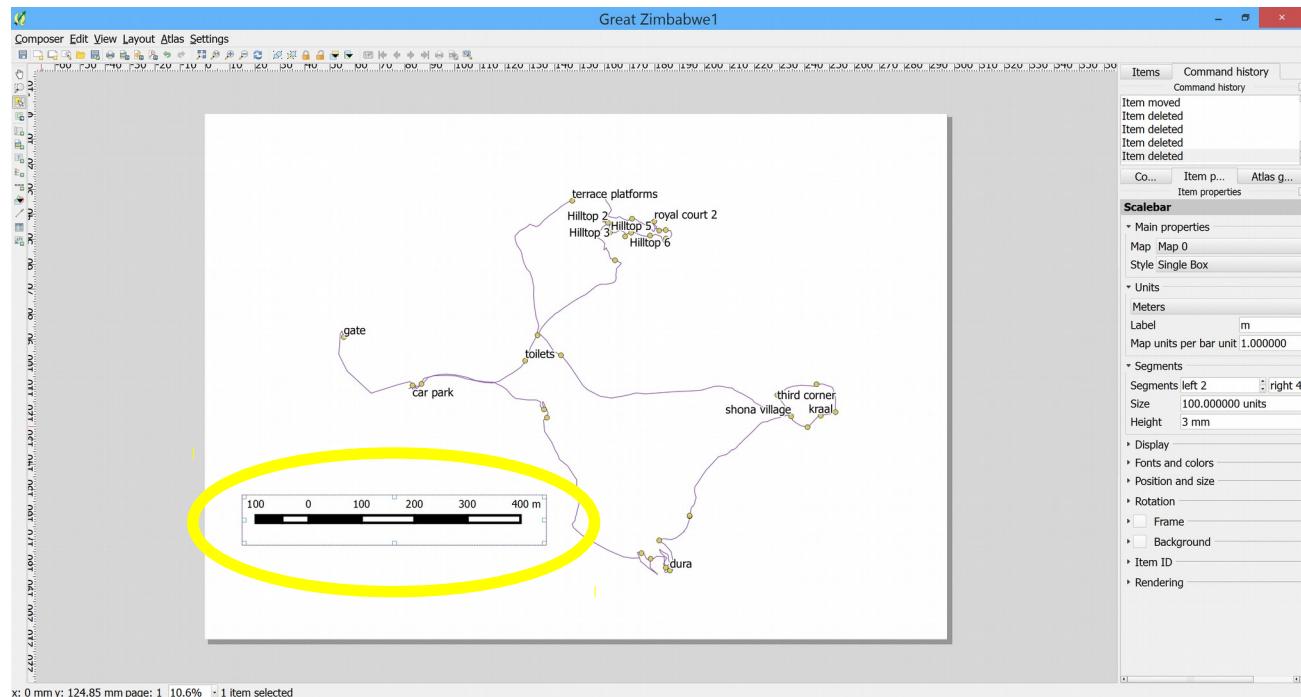
Adding a scale bar to the Print Composer in QGIS

A scalebar shows how big things are on your map. The computer draws a bar and labels it with how many meters long the bar is which helps you see how big things are on your map.

In the Print Composer window, go to Layout>Add Scalebar



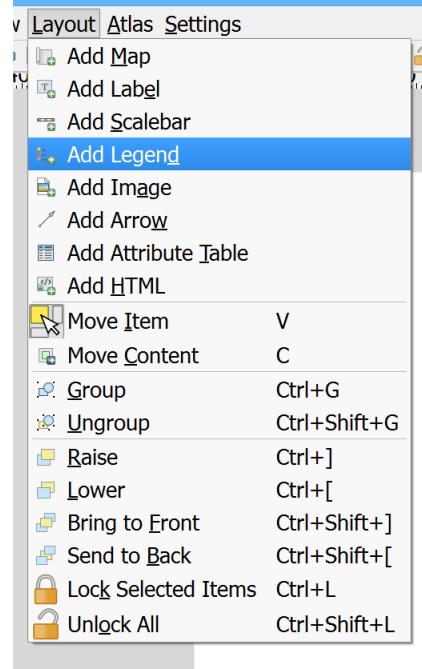
Click where in the map you want the scalebar to go.



Adding a legend to the map in the Print Composer in QGIS

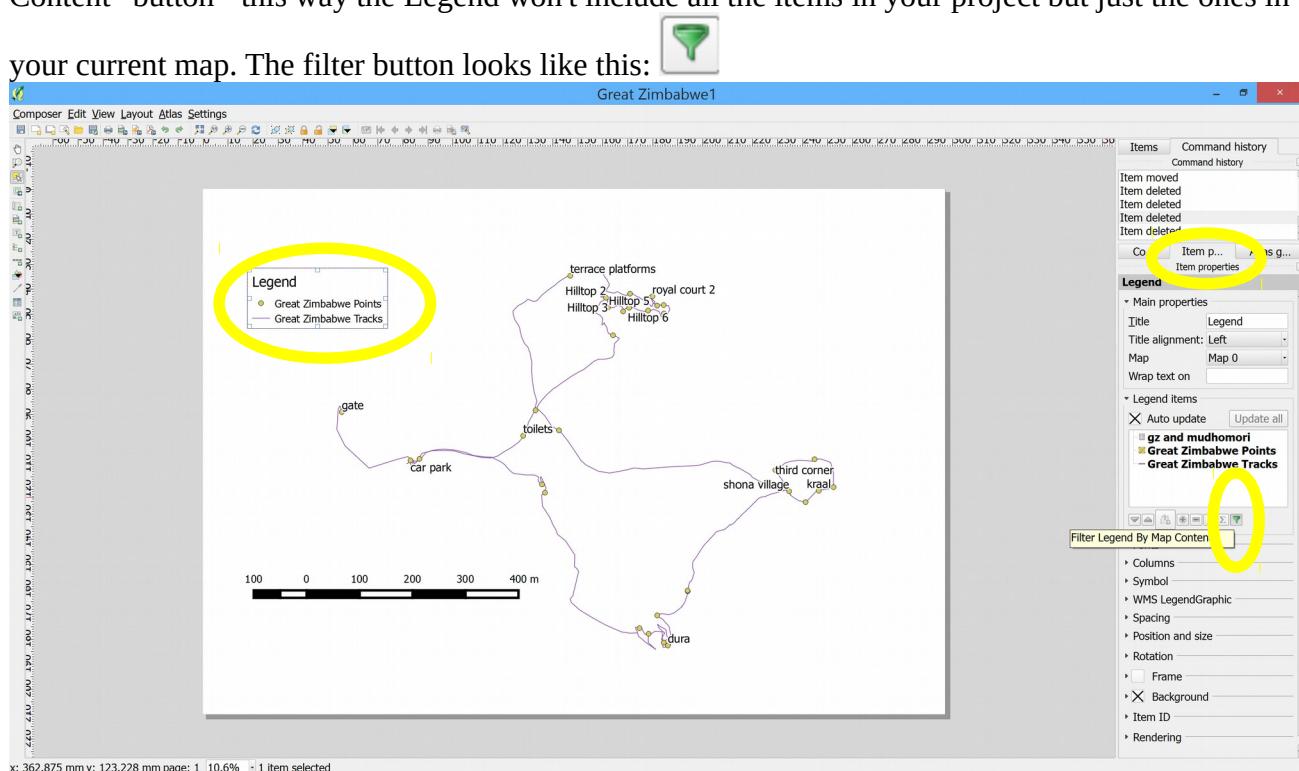
A legend lists all the objects in your map. If you only have one set of points in your map and you have labeled them individually already, you do not need a legend. If you have more than one object, a legend is very helpful to know which object is which. The legend uses the names in the “Layers” table of contents in the main QGIS window. If you need to change the name, right-click on the layer name and select “Rename” and change the name to the one you want. Then press the “Enter” key.

To add a legend, in the Print Composer window, go to Layout>Add Legend



Click and drag to place the legend on the map. Click on the legend. Then, on the right-hand side of the Print Composer, click on the “Item Properties” tab. Then click on the “Filter Legend By Map Content” button - this way the Legend won't include all the items in your project but just the ones in

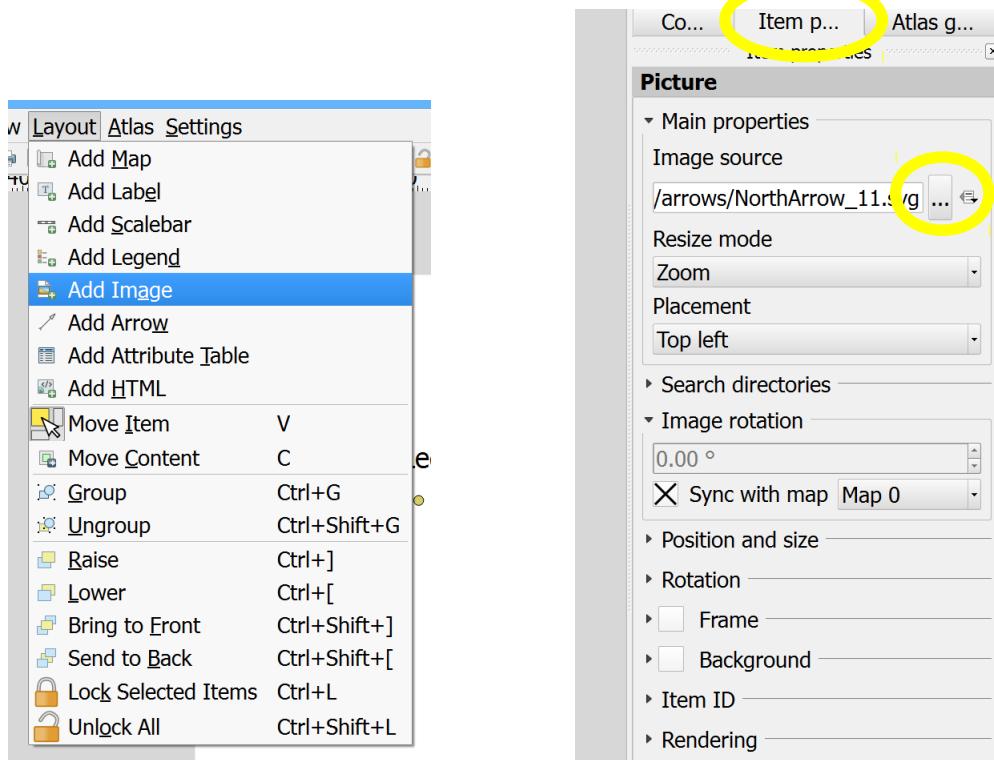
your current map. The filter button looks like this:



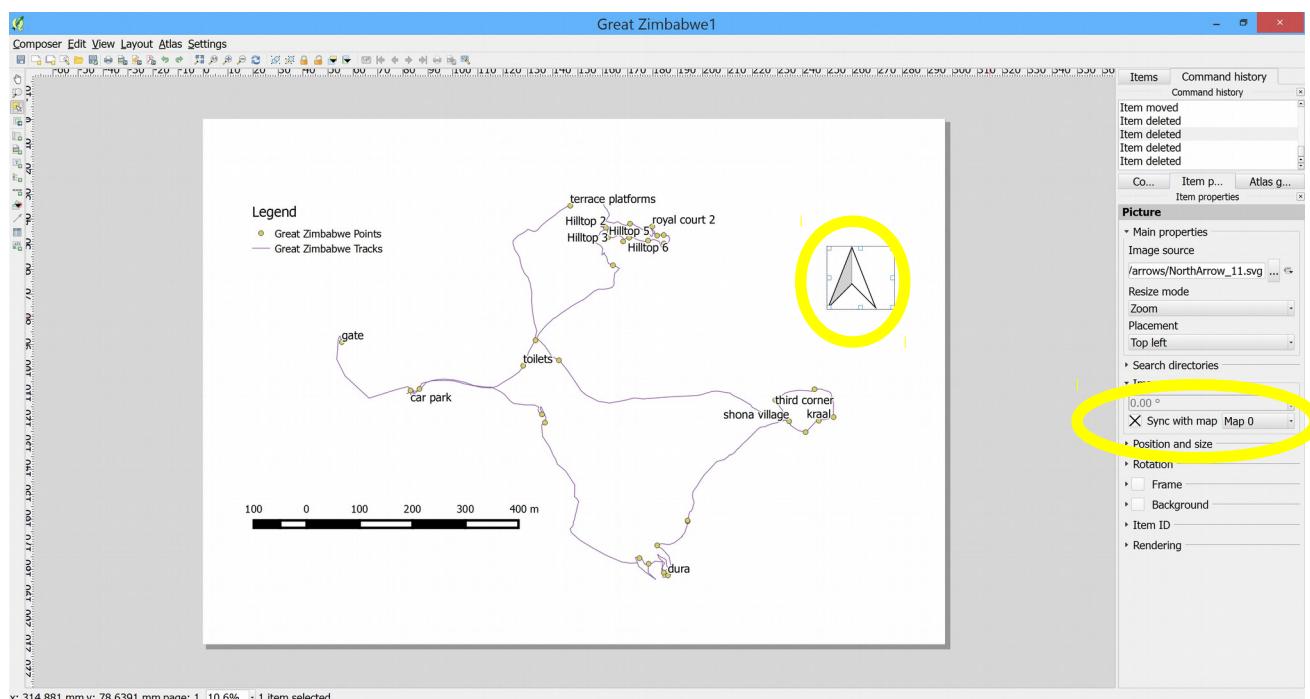
Adding a north arrow to the map in the Print Composer in QGIS

A North arrow indicates that which direction North is on the map. In QGIS, you do this by adding an image of an arrow and then checking the option to synchronize the rotation of the image with the map. Add an image by going to Layout>Add Image and clicking and dragging. Then in the “Item

Properties” tab on the right, click on the  button below “Image Source.”



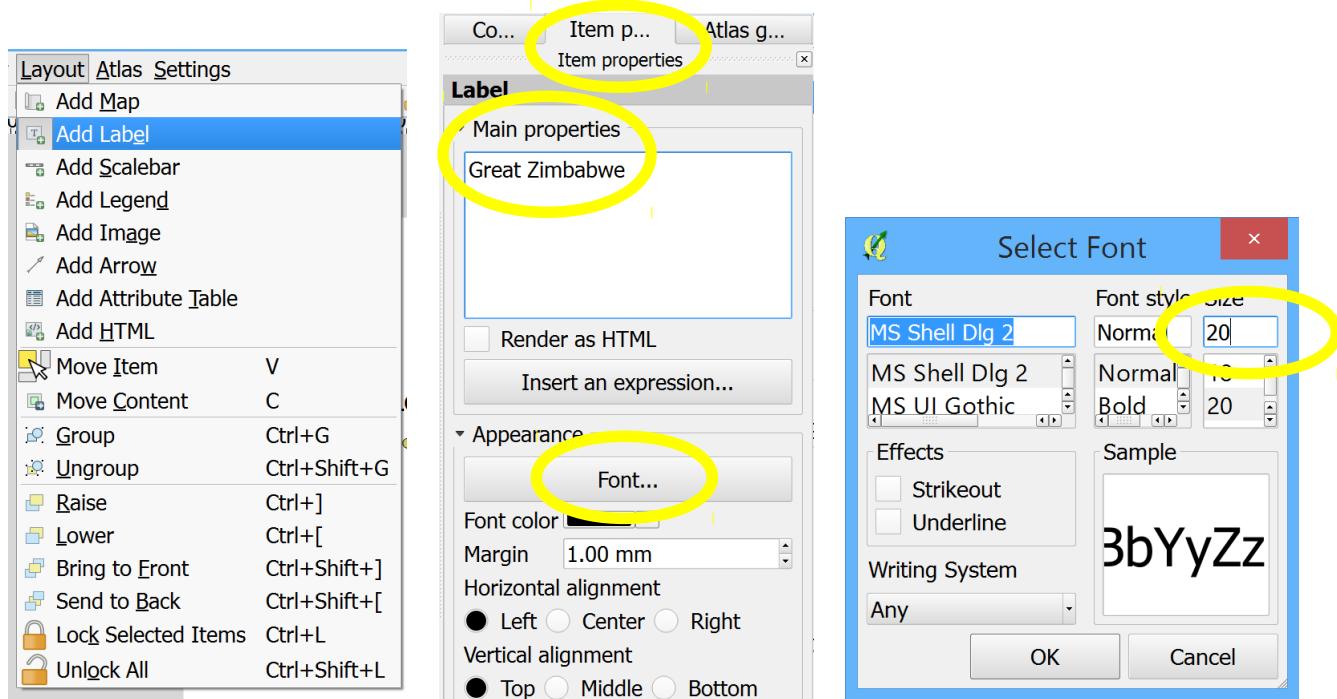
Then browse to find an arrow file in the Documents folder called “Arrows” and finally check the box that says “Sync with map” in the “Image Rotation” section.



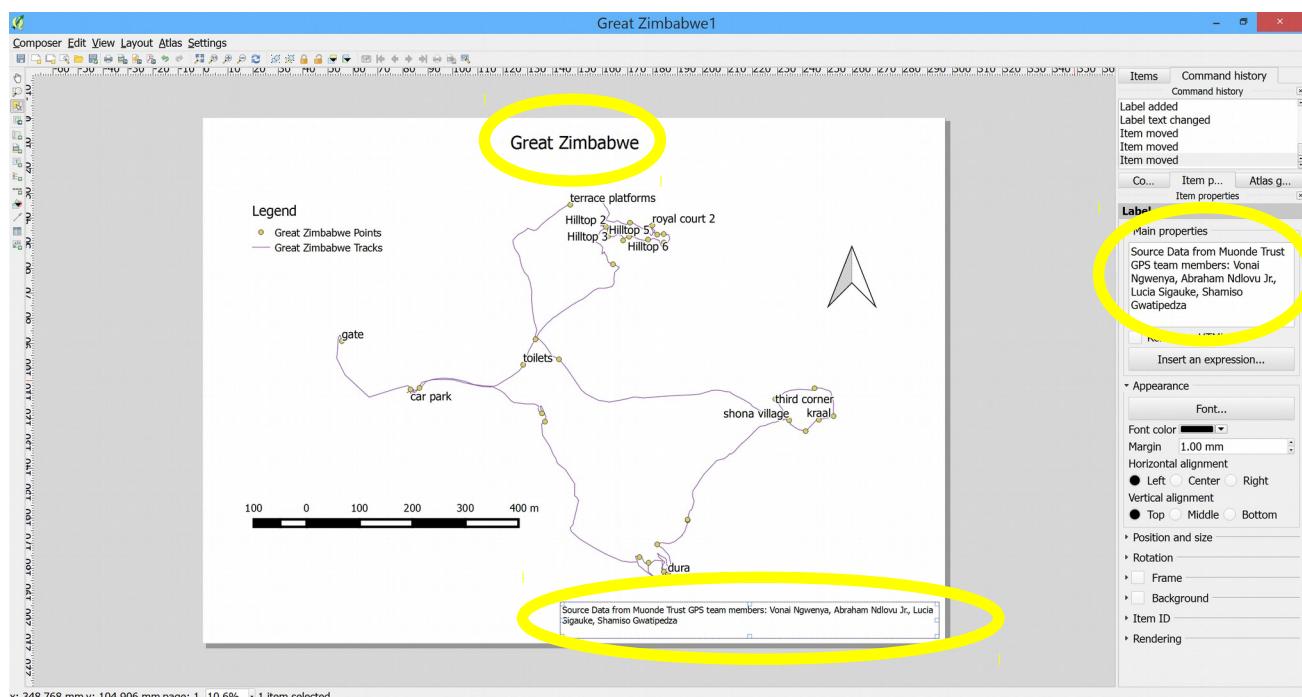
Adding a title and map source information in the Print Composer in QGIS

You want to give your map a title which says what it is. You also need to include information on the source of the data in your map.

To add text: Layout>Add Label and then click and drag to add a title. Then click on the text and on the right-hand side of the screen, click on Item Properties, and click on the text under “Main Properties” - then you can change the text to be the title of your map. Then click on “Font” and you can make the font larger (for the title)



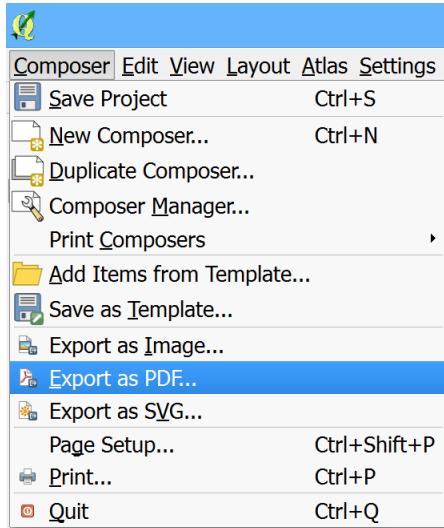
Then you can add text to the bottom of the map that says who made these points and tracks, and if you have added any images, where they came from.



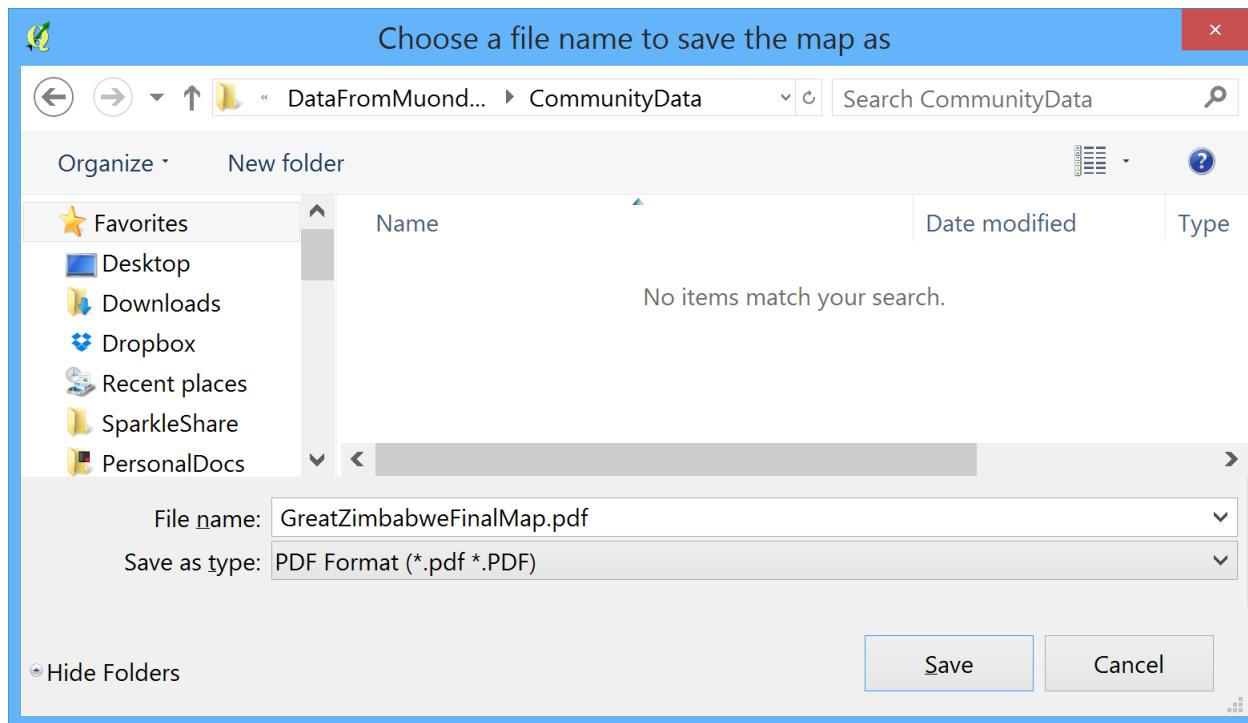
Exporting the map in the Print Composer in QGIS

Once you have all the pieces on your map (Map, Legend, Scale Bar, North Arrow, Title, and Source Information), then you can export it.

Go to Composer>Export as PDF...



Then give the file a name, and save as type: PDF format.



You can also save the map as an image. Go to Composer>Export as Image... Then give the file a name, and save as a BMP.

BMP is a raster (picture) format. PDF is a vector format. PDF will be a clearer map and takes up less space on the computer, so it is recommended.

Other tips for how to use QGIS

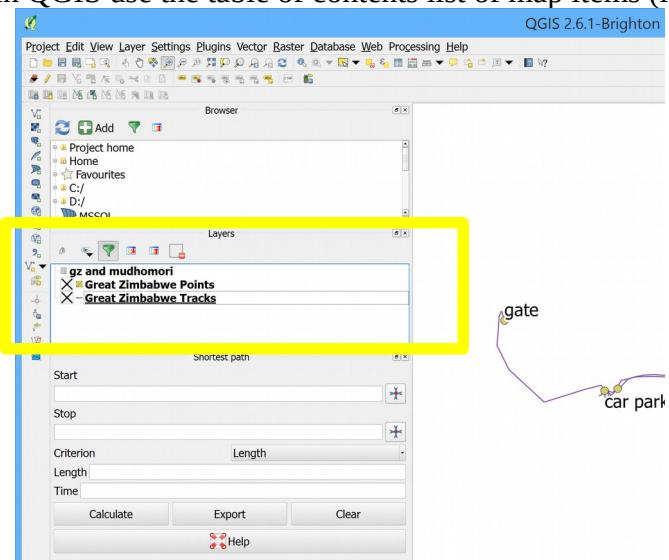
Zooming:

When you have selected the zoom in or zoom out tool, you can click and drag to draw a box and zoom to a particular area, or you can just click the map once and the map will zoom in or out one step.

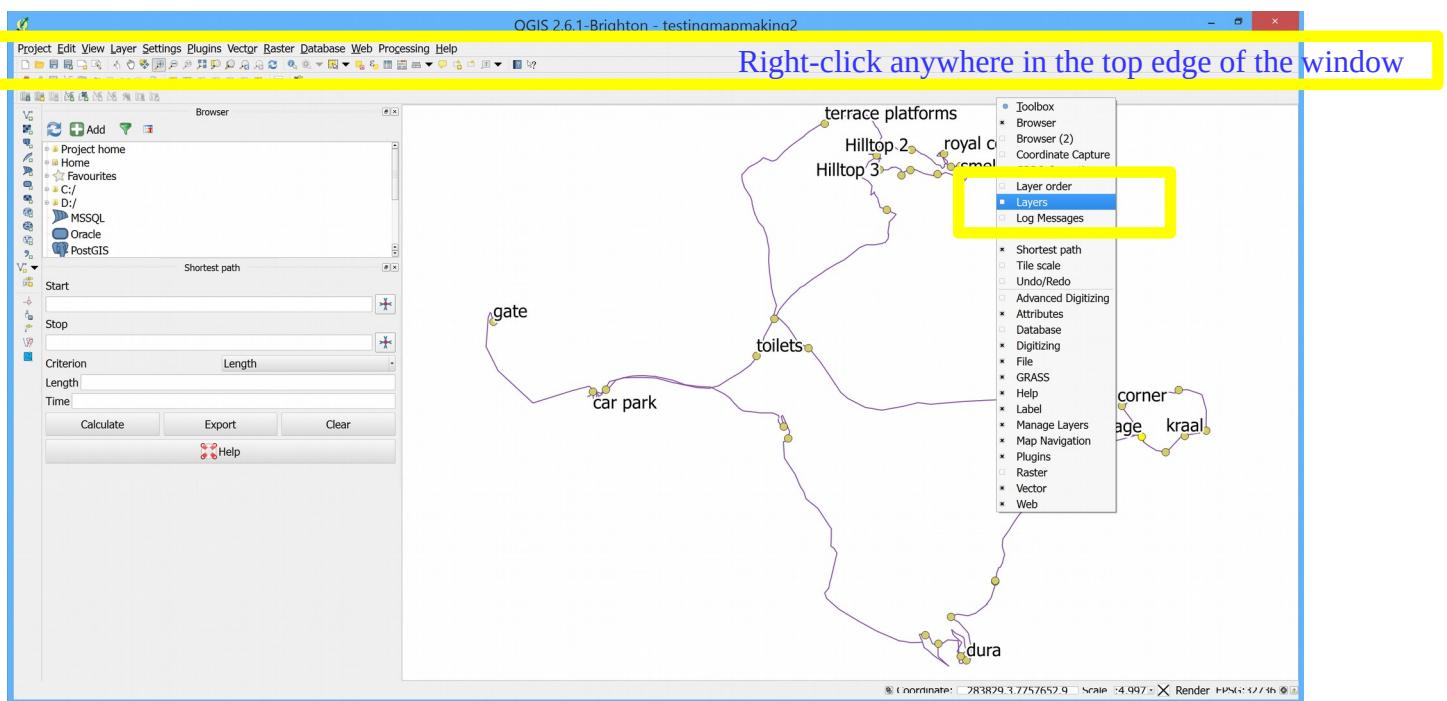
The “Zoom Last” button is helpful if you accidentally zoom or click the map and end up looking at something different than you wanted to. Zoom last will go back to the part of the map you were looking at right before you clicked.

Table of contents:

Many activities you do in QGIS use the table of contents list of map items (layers):



If you somehow close this part of the window, you can get it back by right-clicking anywhere in the top edge of the window, and then clicking on “Layers.”



How to make a map showing different kinds of Muonde Projects in QGIS

Once you have mapped many of the Muonde related projects in Mazvihwa (and beyond!), it would be helpful to make a map showing where they are. You could show this map to other communities, or to the farmer's union, or to AgriTex, or to Friends of Muonde and other visitors. You could show it to all the members of the Muonde team to see how well everyone is doing, and to the other community members who have Muonde projects to see how they are a part of a larger project. You can think of lots of other people you would want to show it to – these are just some ideas.

This may also be a good way for the GPS team to teach the other Muonde team members how to use GPS – you can go map all the contours with the peggers and water managers, for example, or all the stone walls with the stone-wallers. Remember that if you map many many objects in one map, the waypoint codes still need to be unique!

One thing that will help you make a nice map of many small things over a large area is to use different symbols for different types of objects. Then you can show where all the Phiri pits are, or all the dead-level contours are, or all the domestic architecture projects are. Labeling each point with the words like “borehole” or “stone kraal” will make the map look confusing. This how-to sheet shows you how to use different colors for the different kinds of projects. First you need to make the categories that you will use to tell QGIS which projects are the same kind of project (and should be the same color).

How to make a set of categories in the spreadsheet in LibreOffice Calc

The first thing you need to do is to record what category or kind of project it is in a new column in the spreadsheet. Be totally sure that you spell the name of the kind of project the same way every time, and remember that it is case-sensitive! So you could call things “Stone wall” but make sure you don't write “stone wall” or “stonewall” sometimes – the computer will think those are three different things even though they are not really three different things.

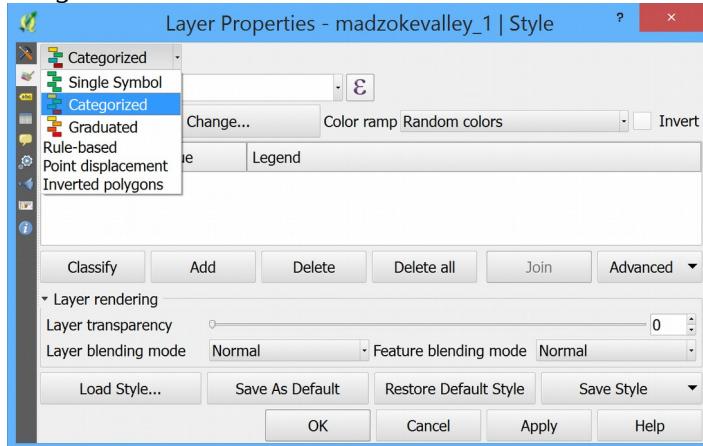
Sometimes the name of the feature and the kind of feature will be the same thing. But sometimes you can give more detail when you say what the feature is, like what kind of domestic architecture project it is, so the column called “kind” should be more general.

	A	B	C	D	E
1	Date	Waypoint	Feature	Owner	Kind
2	2015-05-10	PP1	Phiri Pit	Person 1	Phiri pit
3	2015-05-10	DL1	Dead level contour	Person 1	Dead level contour
4	2015-05-10	PP2	Phiri pit	Person 2	Phiri pit
5	2015-05-10	SW1	Stone wall	Person 2	Stone wall
6	2015-05-10	SW2	Stone wall	Person 3	Stone wall
7	2015-05-10	DL2	Dead level contour	Person 4	Dead level contour
8	2015-05-10	PP3	Phiri pit	Person 4	Phiri pit
9	2015-05-10	DA1	Chimney	Person 4	Domestic architecture
10	2015-05-10	DA2	Separate kitchen	Person 5	Domestic architecture
11					

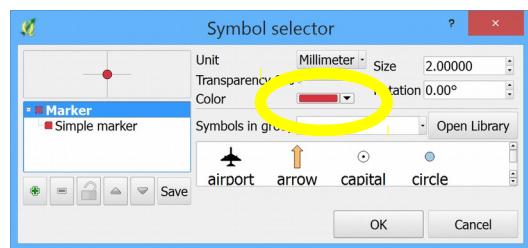
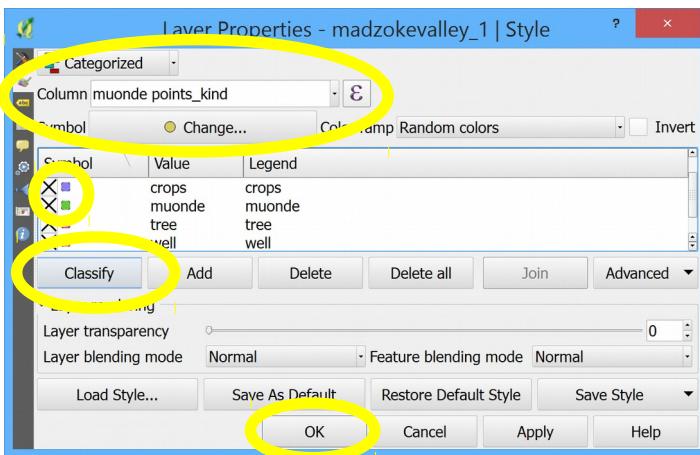
Then export that spreadsheet as a text csv and then add the layer to QGIS. Then make the join between the GPS points and the spreadsheet.

How to change the symbology/colors for different kinds of objects in QGIS

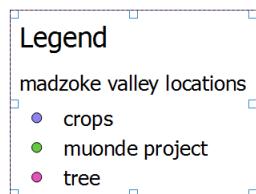
After you have joined the layer to the text csv, click on the layer you want to change. Go to symbology () and click on the box with the drop-down menu which usually says “Single Symbol” by default. Click on “Categorized” instead.



Then in the box next to “Column” pick the name of the column with the category in it (like “kind”). Then click the button called “Classify.” QGIS will then list all the different categories in that column. You can uncheck the ones you don't want to label (like “well”) and you can change the text in the legend if you want (double-click on the word to change it). You can also choose the colors by double clicking on the small colored box, and choosing a new color and clicking “ok.” When you are done with changing the names and colors, click “ok.”

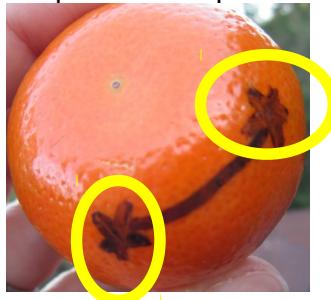


Now when you create the map legend in the print composer, the legend will list all the colors:

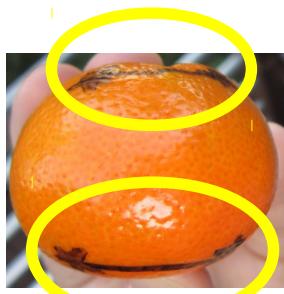


What is a map projection (Coordinate Reference System)?

The Earth is a sphere: round like an orange (ranjisi). A map is flat, like a piece of paper. Measuring the distance between two points on a sphere can be difficult.



When you peel an orange you can smash the peel flat on the table afterward like a map, but it has gaps because you can't really make a round thing flat. It means that, depending on how you peel the orange and smash it flat, different points aren't the same distances away from each other as they were on the orange. In the image below on the left, the two pairs of points are similar distances from each other before they are peeled, but afterward they are very different distances from each other.



Latitude and longitude, the coordinates (location) from the GPS, are coordinates on the orange/ranjisi. When we want to calculate a distance in meters or an area in square meters we need something flat like the map. So we need to “project” the sphere/earth/orange/ranjisi onto a flat surface, and we will have good results in some places and bad results elsewhere (some parts will be stretched). QGIS does the mathematics to change latitude and longitude into flat coordinates in meters (smashing the ranjisi).

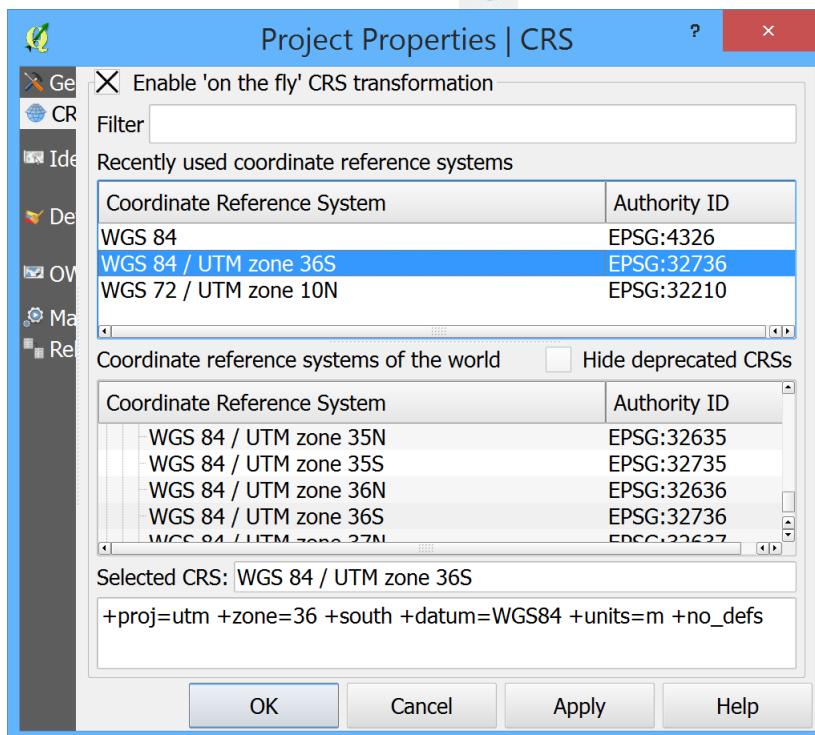


(Note: Jon peeled the orange like a flower. One of his many skills! The orange was tasty.)

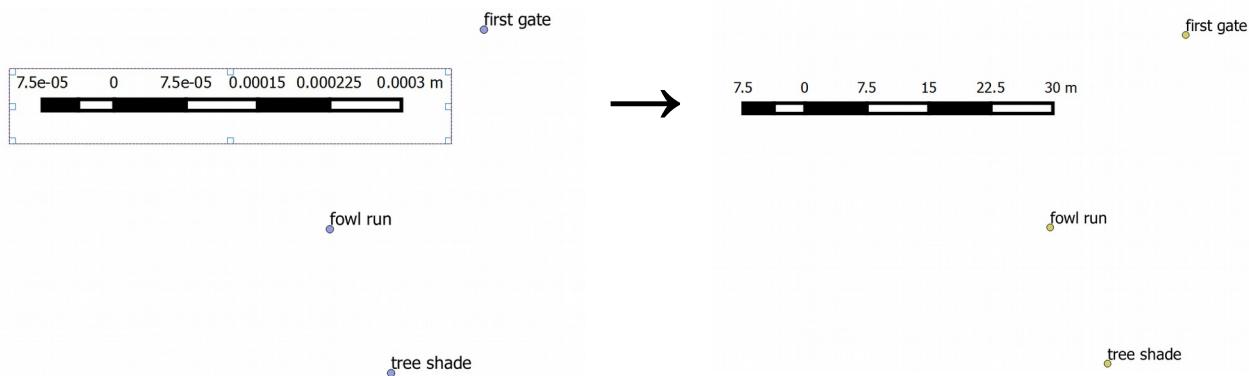
Setting the projection (Coordinate Reference System) in QGIS

Universal Transverse Mercator Zone 36 South (UTM zone 36S) is a good choice for a map projection. It will make distances around Mazvihwa accurate while distances elsewhere (like San Francisco) would be very wrong (stretched). This is because UTM is designed so that each Zone puts a different part of the world at the top of the orange/ranjisi, where the points are not very stretched apart. Zone 36 South is designed for Zimbabwe to be at the top of the orange. San Francisco is in Zone 10 North.

To set the projection (Coordinate Reference System, or CRS) for your project file in QGIS, go to Project > Project Properties. Then click on the “CRS” () tab.

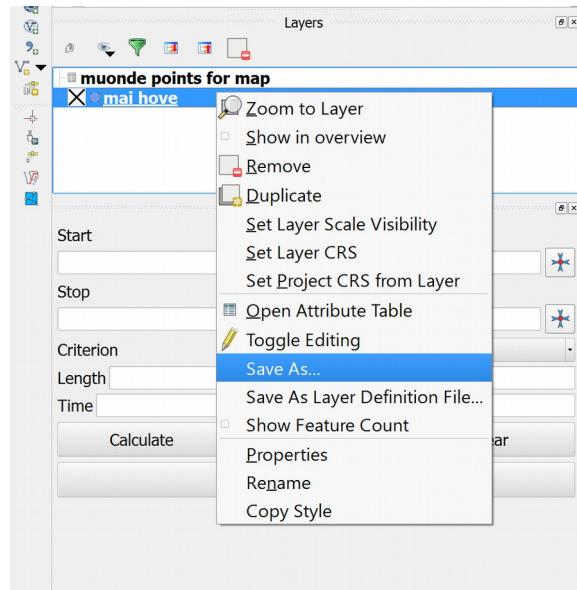


Check the box next to “Enable ‘on the fly’ CRS transformation” and then select WGS 84/UTM zone 36S. (WGS means “World Geodetic System” and is the mathematical model the computer uses for the shape of the earth). If you can’t find UTM zone 36S under “Recently used coordinate reference systems” you can look in the list of “Coordinate reference systems of the world” to find it. Then click OK. Once you have done this, then when you add a scale bar to your map, the scale bar should be in meters and should make sense.

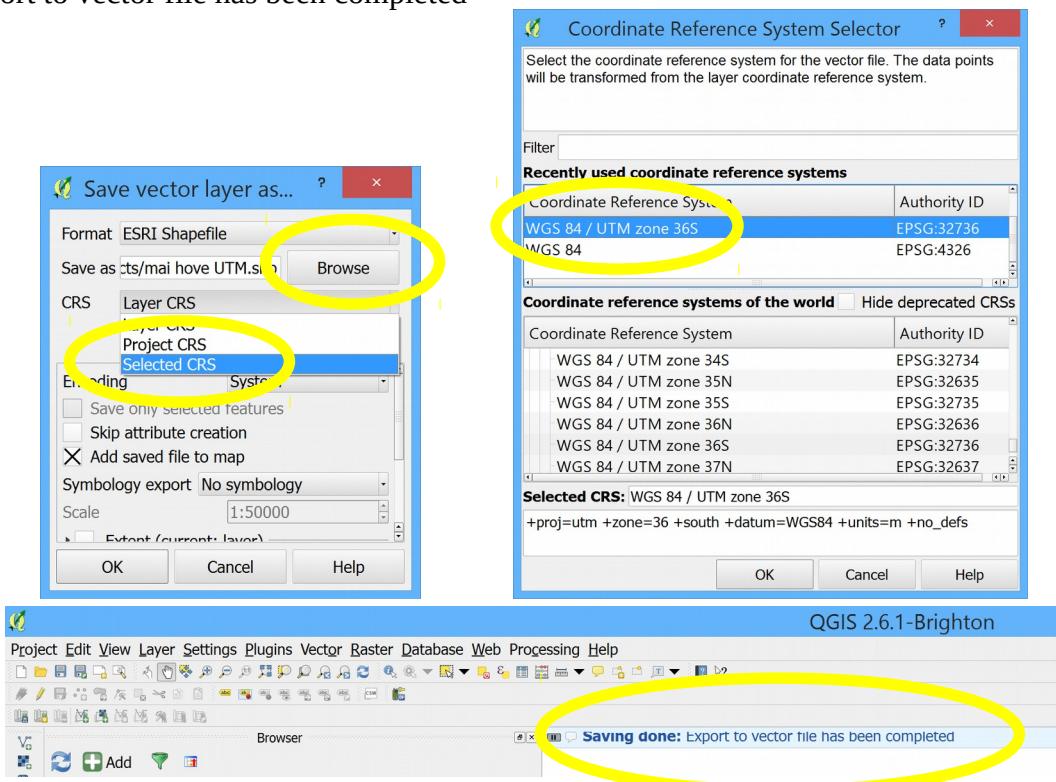


Projecting a layer into UTM zone 36S in QGIS

The GPS units record latitude and longitude, so you will need to project them into Universal Transverse Mercator (UTM) Zone 36 South in order to be able to calculate areas or lengths. You will create a second version of your points, lines, or polygons in UTM. Right-click on the name of the layer in the Layers table of contents and click “Save As”:

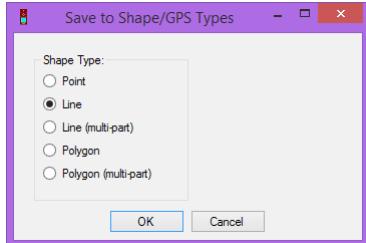


Click on “Browse” and save this file with the other GPS data files. Enter a file name - add “UTM” to the filename so you know which versions of your points are projected and which are in latitude/longitude (ranjisi) coordinates. In the box next to “CRS” click on “Selected CRS” and then click the button which says “Change...” Then in the new window, click “WGS 84/ UTM zone 36S” and then click OK. Click OK again and a message will pop up at the top of the window saying “Saving done: Export to vector file has been completed”



Calculating the area of a polygon or length of a line in QGIS

To find out how large a field, bindu, or grazing area is, record a track walking around it. Then when you download the track, download only that track and when DNR GPS asks how to save it, say “Polygon.”

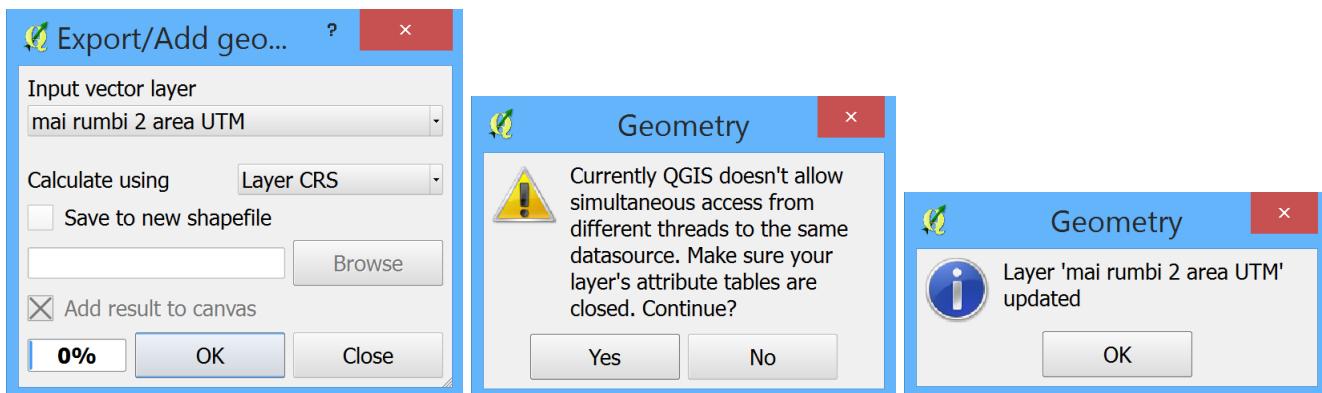


To find out the length of a contour, walk along the contour and save that track separately. Then in DNR GPS download only the tracks from the contours you want to measure. Download tracks as “Line.”

For either lines or polygons, then project the layer into UTM so you can calculate distances and areas.

Then go to Vector > Geometry Tools > Export/Add Geometry Columns...

Select the UTM polygon layer you want to calculate the area for, and click OK. A warning will pop up – make sure you have not left the attribute table open in another window – then click “Yes.” Another window will open saying “Layer <layername> updated” Click OK. Then click Close.



Now open the attribute table. For the polygon, you will see a column called “area” and another column called “perimeter.” The units will be in square meters for “area” and meters for “perimeter.” For the line, there will be only one new column, called “length,” in meters.

time	desc	link	AREA /	PERIMETER	LENGTH
15/...	NULL	NULL	7358.761230	341.804084	88.141552
15/...	NULL	NULL			59.522516

We learn from this calculation that Mai Rumbi's bindu is 7360 square meters in area, and that Chirindira's contours are 88 meters long and 60 meters long.

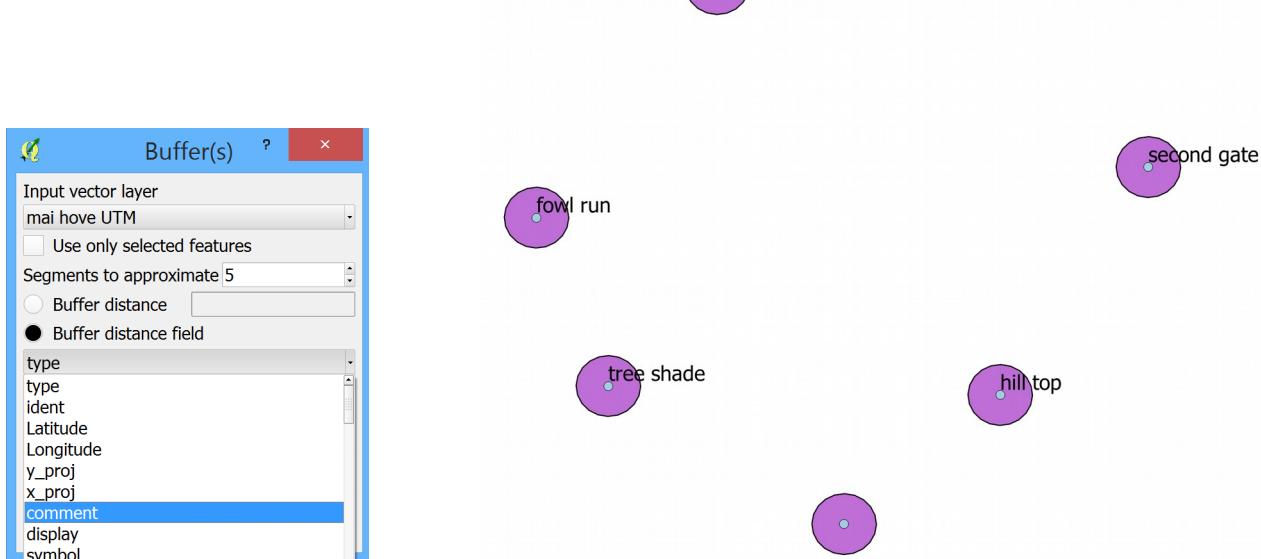
Calculating a buffer around a vector

A buffer is a polygon which is slightly larger everywhere than the points, lines, or polygons it surrounds. It is like wrapping blankets around the points, lines, or polygons. For example, in community planning and architecture, a buffer can be used to make sure that planned buildings are not too close to a river. We will use buffers to show the uncertainty or error in our GPS calculations.

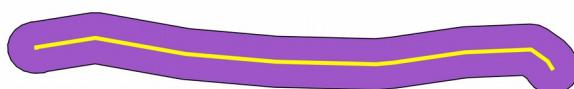
We know there is uncertainty in our GPS locations. In the Satellite menu on the eTrex 10, you will see a number of meters listed under the word “GPS” - this number is the GPS uncertainty. The GPS can't know exactly where you are, even when it can see many satellites. In research, we want to know how well we know our numbers. We will start by looking at it on the map.

First make sure your vector file (points, lines, or polygons) are projected into UTM. Then go to Vector> Geoprocessing Tools> Buffer(s)

Now select the layer you want to buffer. You have two choices to say how wide a buffer you want to make around your vector layer. You can write in a number to make all the buffers the same (like, “3” for a 3-meter buffer), or you can use a column in your data set to say how big the buffer is. Because you have written the GPS uncertainty in the “Note” field of the GPS, we will use that measurement of uncertainty in this example (putting a buffer around the points at Mai Hove's home). Then when the GPS uncertainty is not the same for every point, we can use the real values instead of guessing that it is always 3. Click the button that says “Buffer distance field” and choose “Comment.” Give the buffer layer “output shapefile” a new name, like “Mai Hove UTM buffer,” click OK, and then click Close.



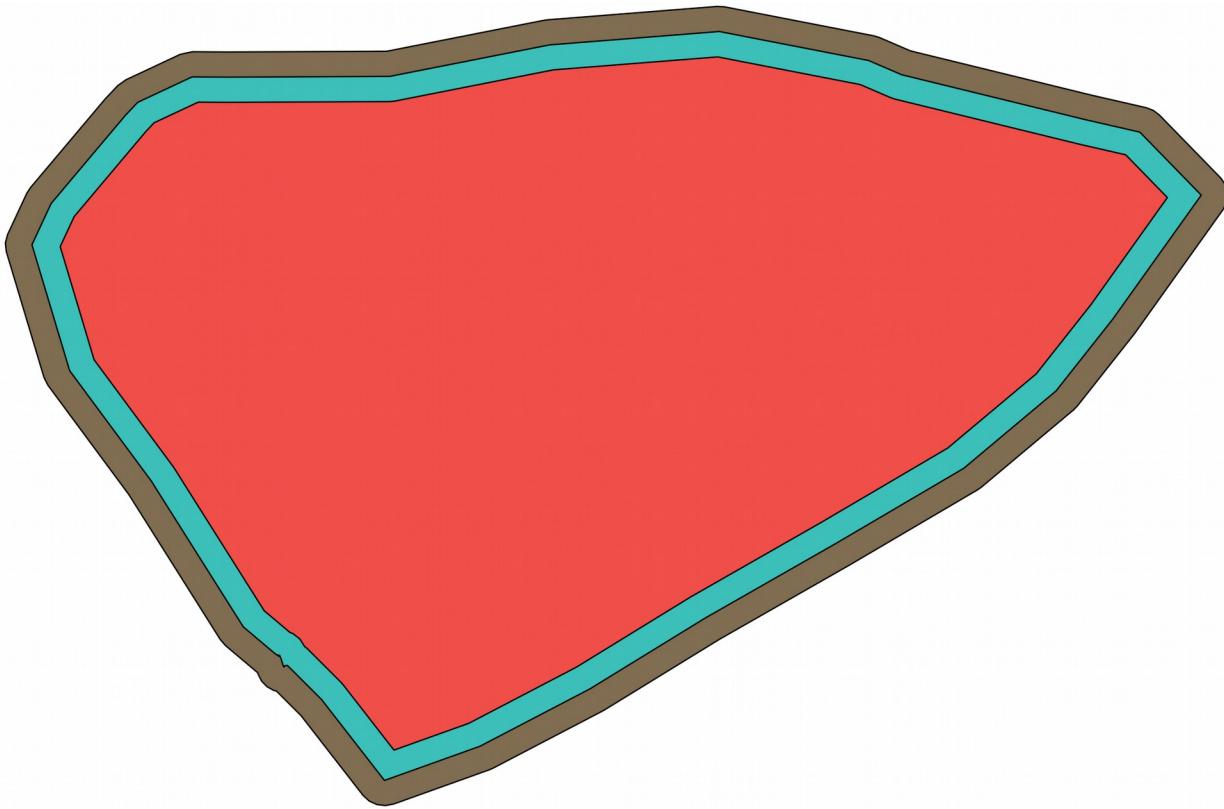
The actual location of the light blue point is somewhere inside the purple circle, and the circle represents the uncertainty about where the point really is. Here is an example of a buffer around a line:



Calculating the uncertainty/error in the area of your field in QGIS

When we walk around a bindu, we know the GPS doesn't know exactly where we are. GPS accuracy in Mazvihwa is usually 3 meters – the minimum (or best) accuracy that the eTrex 10 can provide. When we calculate the area of someone's bindu or field, we want to know how much error there is in that calculation from the GPS not knowing exactly where we are. So we will use a 3-meter buffer inside and outside the polygon of the bindu to see how small the bindu area could be or how large it could be because of the GPS uncertainty. That represents our uncertainty in the area based on how we measured.

Walk around the bindu, field, grazing area, or village and save that track. Download only that track to the computer and use DNR GPS to save it as a polygon. Add the polygon to the map in QGIS, and project it into UTM coordinates. Then go to Vector > Geoprocessing Tools > Buffer(s), choose your file, and enter into the "Buffer distance" field "-3" to create the inner buffer – you could have been walking 3 meters inside the fence and the GPS could still have recorded the same track. Give the output shapefile a name like "Mai Rumbi Area UTM inner buffer" and click ok. Then change the name back to "Mai Rumbi Area UTM" and change the buffer distance to "3" and give that output shapefile a name like "Mai Rumbi Area UTM outer buffer" (you could have been 3 meters outside the fence and still recorded the same track) and click OK. Then click Close.



The light blue area is the polygon we made of Mai Rumbi's bindu. The red area inside is the inside buffer, and the brown area is the outside buffer. Now calculate the area of the red polygon and the area of the brown polygon using Vector > Geometry Tools > Export/Add Geometry Columns...

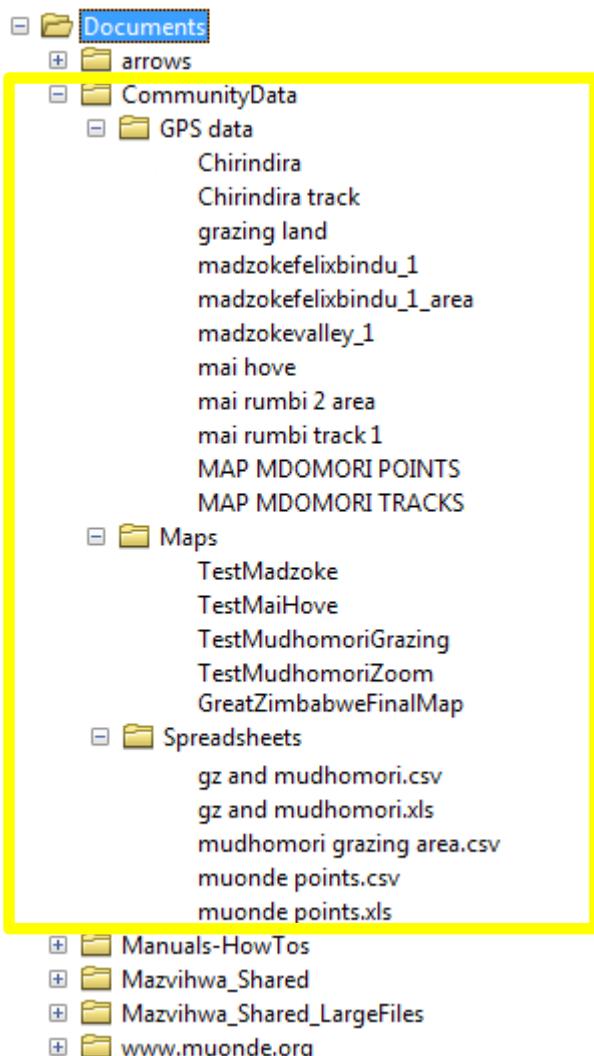
We learn from this calculation that Mai Rumbi's bindu could actually be between 6368 square meters and 8409 square meters. You can use this information when determining how many cattle can be in a grazing area or how much seed you need for a field. And you know how certain you are of the answer.

How to organize your files in order to make backup copies

Some of the files on your computer are very large, like image and video files. Other files are smaller, like spreadsheets or GPS data. The best thing to do is to make a redundant copy of all these files somewhere else so if your computer has a problem you will not lose your work.

On the Muonde GPS computer, the large files are the images and maps. These are already copied somewhere else (Friends of Muonde has copies in California). So the files you need to copy to make backups are the small ones: the GPS data and the spreadsheets. These are the things the Muonde team has created.

What you want to do is to keep the GPS files all in one folder, and the maps you make in another folder, and the spreadsheets in another. Keep these files separate from all the other larger files. That way you will be able to copy all of the data onto a thumb drive and you won't use up all the space. Your files would be organized like this:



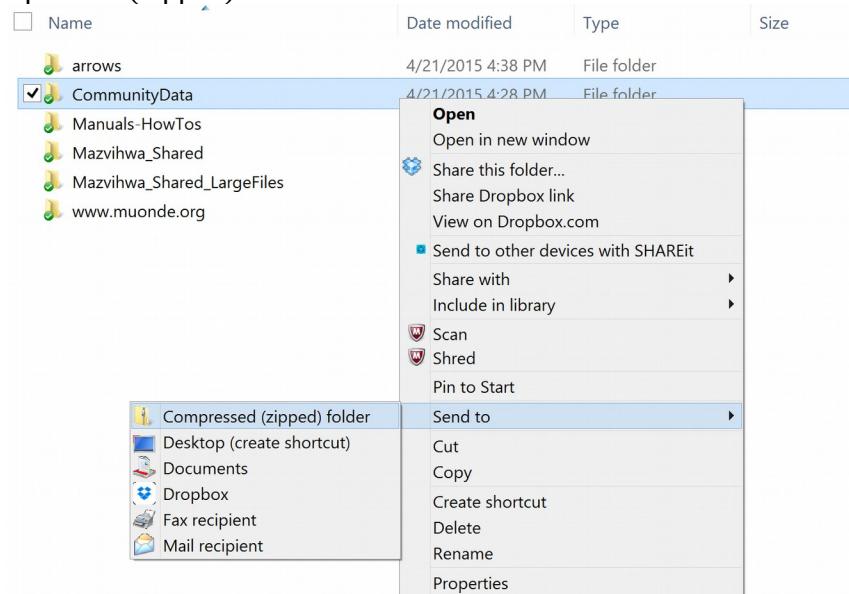
Put all the community data in a folder called “CommunityData” - then inside that folder, have one folder for the GPS points that you download with DNRGP, and one folder for the maps that you make out of those points, and one folder for the spreadsheets which have the other information about the points in them. When you want to make a copy of your data to back it up or send it to a Friend of Muonde, then you can copy just the Community Data folder (the part in the yellow box). Example files are shown in each of the folders (like “mai rumbi track” and “muonde points”)

How to copy files to an external drive and backup CommunityData folder

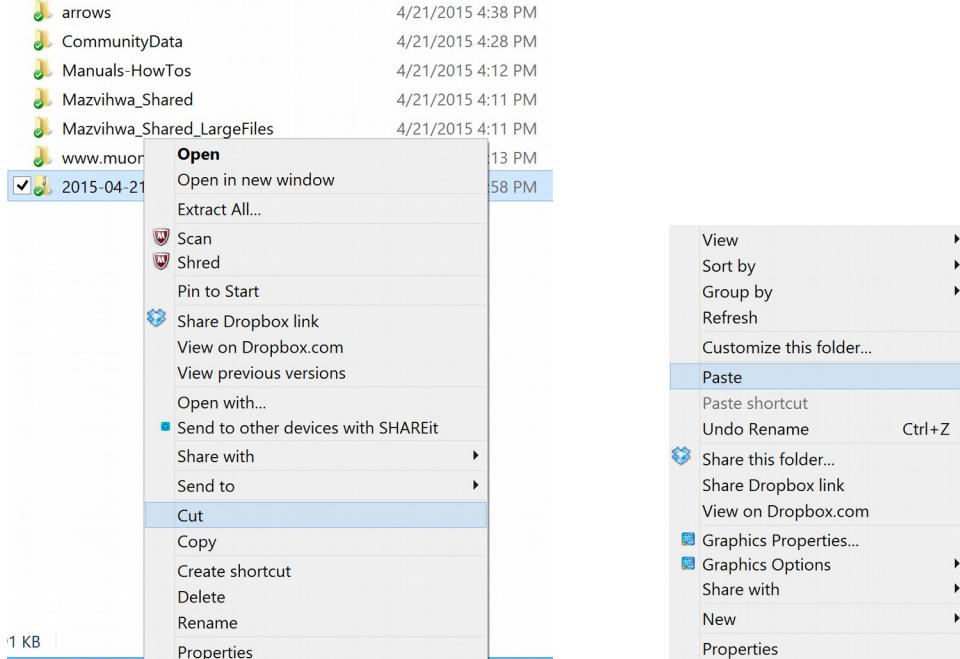
Each time you make new points, tracks, maps, or spreadsheets, copy the Community Data folder onto an external drive (thumb drive). Open a File Explorer window by clicking on the folder in the taskbar:



Double-click on “Documents.” Then right-click on the Community Data folder, go to Send To, and then click on Compressed (zipped) folder.



Windows will create a file called “CommunityData.zip”. Right-click on that file and click on “rename”. Rename the file to today's date. Then right click on the file and click on “cut.” Then use the File Explorer to go to the external drive, right-click in the empty part of the window, and click “paste.” Then safely remove the thumb drive.



The zip file of the most recent version of CommunityData can be emailed to Friends of Muonde.

Tips for good data-keeping habits

Your research will be better if you are careful how you record your data, keep track of it, and keep it safe (have backup copies in case something happens to the computer). You should also write information about the data in a document and in your notebook. Information about the data is called “metadata.” Metadata can describe what is in the columns of the spreadsheet or what names in one of the columns mean. For example, you might write down that the owner of a feature can be a village (“Mudhomori”) or an individual (“Abraham Mawere”). This helps people understand what you mean by “owner.” You should also write down your measurement methods so you can remember how you did a study when you look at your data again many years later, and also so visitors and collaborators know how to use your data. Scientific papers require careful description of the methods of the study.

Carefully name files and carefully name columns in a spreadsheet

Carefully naming your data files and making notes in your notebook about them can really help you remember later what each data file is. For example, calling a file “GPStracks1” does not say very much about what is in the file. Instead calling it “ChirindiraDeadLevelContourTracks” reminds you that these are tracks from Chirindira’s field and they represent the dead-level contours in his field.

When you were walking around with the GPS measuring the contours, you made notes about them in your notebook. Then you got back to the headquarters and downloaded the GPS data onto the computer and named them “ChirindiraDeadLevelContourTracks” like we just described. Now you can also write the name of the file you made in the notebook and write down which of the points or tracks from the notebook went into that file, making it easier for you to remember where the data went. You can then connect from the data in the notebook to the data in the computer by looking for the file with that name, or from the computer to the notebook by looking at the GPS waypoint codes (like “BH1”).

You also want to be careful about naming the columns in a spreadsheet. You need to name them so that you’ll be able to remember what is in each column, like “TreeDiameter_cm” which lets you know that the column contains the diameters of trees in centimeters.

Remember that the computer cares if something is upper case or lower case, so “Tree” is different from “tree.” Also, it is a good idea NOT to use spaces in **file names** or **column names**. Instead you can use underscores “_” or put the words together but capitalize each word, like “TreeDiameter.”

Keep the data tidy

It is better to do things the same way every time. So if one column is about tree diameters, you should put only diameters in that column. For example, if a tree can’t be measured, write “NA” (for “Not Applicable”) instead of writing a note about how it can’t be measured. You should try to have only one kind of data in each column (for example, only use numbers or only use words). Have a different column in the spreadsheet called “Notes” and say there why you couldn’t measure it (like “acacia bush at base of tree”). Put the units in the name of the column, like “TreeDiameter_cm” instead of writing “50 cm” in the column. Just write “50” in the column. Spell words the same way every time (“Mupani” “mupani” “mopane” “Mopane” all are different to the computer though they are the same to us). For words with different spellings, pick one spelling and always use that. Put in the notes column other spellings or other names. Make sure to check that different people taking data for the same project use the same names for the same things! See the example on the next page.

Date	Waypoint	Species	TreeDiameter_cm	Note
2015-05-31	EC10	Eucalyptus	NA	Can't measure, acacia bush at base of tree
2015-05-31	MU14	Mupfura	30	Also Mukumbi

You can use spaces in the data part of the columns (just not in column **names** and not in the file names). In that case, make sure to use the space every time. See how in the next example, “Borehole well” has a space in both versions, and “Abraham Mawere” has a space in both versions, but “Date”, “WaypointCode”, “Feature”, and “Owner” do not have spaces in them. Also, always write dates the same way. A good way is Year-Month-Day separated by dashes, like “2015-03-15” or “2016-12-31”

Date	WaypointCode	Feature	Owner
2015-04-30	BH1	Borehole well	Mudhomori
2015-04-30	AB1	Kraal	Abraham Mawere
2015-06-12	BH2	Borehole well	Madzoke
2015-06-12	AB2	Main gate	Abraham Mawere

Each feature you measure should have a unique code. It can be short (for example, because the GPS thumb stick is hard to use), but still needs to have a different code from other objects that sound similar. “BH” could mean “Borehole well” or it could mean “Beulah’s house” so make sure you make different codes for different things and write out what they are in your notebook and spreadsheets.

Keep more than one version of a file and back data up

When you want to change something or add something to an existing spreadsheet or vector data file, you should save it as something new. For example, when we corrected the code from being lower case (bh1) to upper case (BH1), we made a new file. This is in case you make a mistake when you add or change something – then you can put it back to the original version if you need to. When you make a new version of the file, you can save the name as something like “MuondePoints_v2” for version 2, for example. So you should keep more than one version – but always make it clear which version is which! You should also keep notes in your notebook and computer methods document about what the difference is between the different versions. For example: “MuondePoints_v1 contains all the points from our first GPS lesson, including the waypoint code on the GPS, the owner of the feature, the name of the feature, and the date we marked the waypoint. MuondePoints_v2 is the same file but with the waypoint code changed to be upper case rather than lower case.”

You should back up your data every day you add new data or clean up old data – this means making a copy onto a thumb drive every day you work on the data files. See the how-to sheet for how to back up files. You should also organize all your files (GPS data, spreadsheets, documents, and maps) so that you can find them when you need them. This also makes it easier to back them up.