SNAC workshop in Fieldmapping and GIS

Training Materials in QGIS, QField and OSMAnd

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Using GIS applications for field mapping – An introduction

This workshop will provide training in effective field mapping and GIS analysis using contemporary technology. With the advent of GNSS (Global Navigation Satellite Systems) integrated into smartphones, researchers can now systematically document field data, including accurate measurements, photographic evidence, and geolocation information. This capability facilitates robust analysis within Geographic Information Systems (GIS), thereby enriching research across diverse disciplines such as botany, ecology, archaeology, and urban studies.

Accurate field observations are critical for many field-based disciplines and serve as a foundation for innovative analytical methodologies. With skills in how to use this technology efficiently, researchers can significantly enhance their data collection and analysis processes.

As a leading open-source Geographic Information System (GIS) software, QGIS is the go-to tool for spatial analysis and mapping. This workshop will cover the use of QGIS in combination with mobile apps, QField and OSMAnd, to prepare for mapping in field and to manage, edit and visualise features mapped in field.

The materials provided for mapping include the following parts:

1- Introduction to QGIS

2- Field mapping with OSMAnd

3- Field mapping with QField

4- Import field data and make your own field map

5- QField – More to know

Software used in the course

For the workshop you need the following software

- QGIS – mapping software to display, analyse and visualize geographical data.
- OSMAnd – mobile app for mapping in field. It has important functionality like adding waypoints, track movements and adding notes, pictures, sound and videorecodings. No previous set up required before field work. However, data collected in field will most probably need editing and be supplemented with analog notes before final analysis and visualization in QGIS.
- QField – mobile app for mapping in field. It has important functionality like adding waypoints, track movements and adding notes, pictures, sound and videorecodings. Used in combination with QGIS highly customized field survey forms can be designed in advance of fieldwork. This requires basic GIS skills that you will have the opportunity to learn in this course. When field data is imported back into QGIS after field work it will contain all recorded attributes and be ready for further analysis and visualization.

Installation of QGIS

For the workshop, please, install **QGIS 3.34** Long Term Release (LTR).

https://www.qgis.org/en/site/forusers/download.html#

The LTR versions of QGIS offer stability and are supported with bug fixes and security updates for a longer period, making them ideal for professional use. Here's a simple step-by-step guide to get you started:

Visit the Official QGIS Website:

Start by navigating to the QGIS official website: www.qgis.org.

The LTR version is prominently featured and recommended for most users, especially those seeking stable environments for their GIS projects.

Choose Your Platform:

QGIS is versatile and available for various operating systems including Windows, macOS, and Linux.

Click on the appropriate download link for your operating system.

Download and Install:

For Windows, you will have options like 'Standalone Installer' or 'Network Installer'. Choose the Standalone Installer for a straightforward setup.

Follow the download instructions, which typically involve running an installer file. During the installation process, you can choose default settings or customize the installation based on your preferences.

Launch QGIS:

Once the installation is complete, launch QGIS from your applications menu or desktop shortcut.

Upon opening, you might be prompted to install additional components or plugins. You can choose to do this immediately or explore these options later.

Should you encounter any problems during the installation process, one helpful resource might be the following installation guide:

https://www.qgis.org/resources/installation-guide

Installation of OsmAnd

Android markets: Google play store, Huawei AppGallery, Amazon.

iOS: App store.

Read more about OsmAnd versions and Purchases.

Download maps

The OsmAnd app works with different types of maps, but it can only function fully with downloaded offline maps, so after the Get started screen you are prompted to download map of your region. You can choose a different region, restore from OsmAnd Cloud, or skip this step and download maps later.

Download maps is a necessary action for further using map and navigation in offline mode. Maps can be downloaded both by browsing through the regions list from the main menu and by clicking on the needed territory on the map.

The files are updated monthly based on OpenStreetMap. Searching files by address, name or coordinates offline is supported.

> Note: OsmAnd cannot work correctly without downloaded offline maps. Although the application supports Vector and Raster maps, it is strongly recommended to start working with vector offline maps to make all functions such as Search, Navigation, and Context menu work properly.

Installation of QField

Search for and install QField from google play or an app store of your choice.

Make an account on QFieldCloud when you have installed the app. From the first page you meet opening the app, choose QFieldCloud projects, and then “Register an account”. Fill the registration form and confirm your email before you try to log in.

Data for the course

Data for the workshop practicals is found in the folder “Data” that you will be copying from a hard drive that the instructor will share with you. **This instruction is found in the “Documents” folder under Data.**

Make a folder on your laptop/computer called SNAC_workshop where you store all the material from the workshop. Copy the entire Data-folder to SNAC_workshop folder. Save everything you generate during the workshop in this folder.

1. Introduction to QGIS

What you will learn:

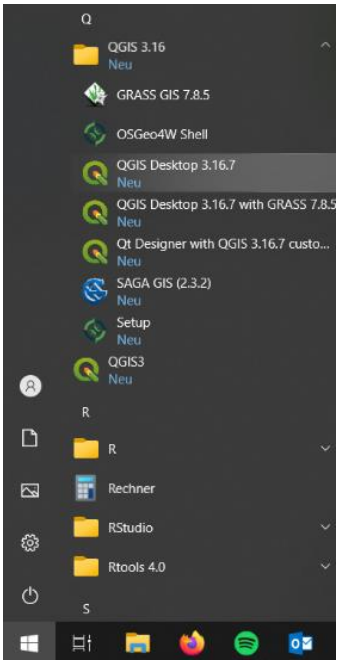
- Start QGIS 3.34 LTR (long-term release)
- Create a new map
- Add data layers
- Pan and zoom
- Change data symbology and display properties
- Select data
- Measure distances
- Create map layouts
- Add legends, titles, North arrows, and other elements
- Print a map to a PDF

What you'll produce

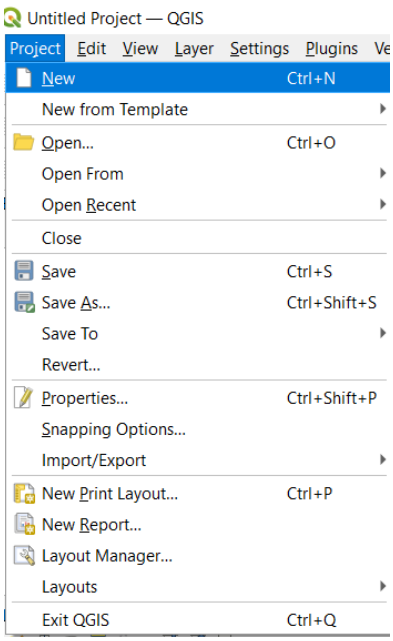
Two maps: one of lakes and roads and one of wetlands.

Start QGIS and add data

First, find the QGIS icon, shown to the right. The icon is often located as a desktop or taskbar shortcut, or in a QGIS folder. In Windows 7 or 10 it may often by found by left clicking on the Start button in the lower left of the screen and selecting QGIS 3.34 → QGIS Desktop 3. 3.34.



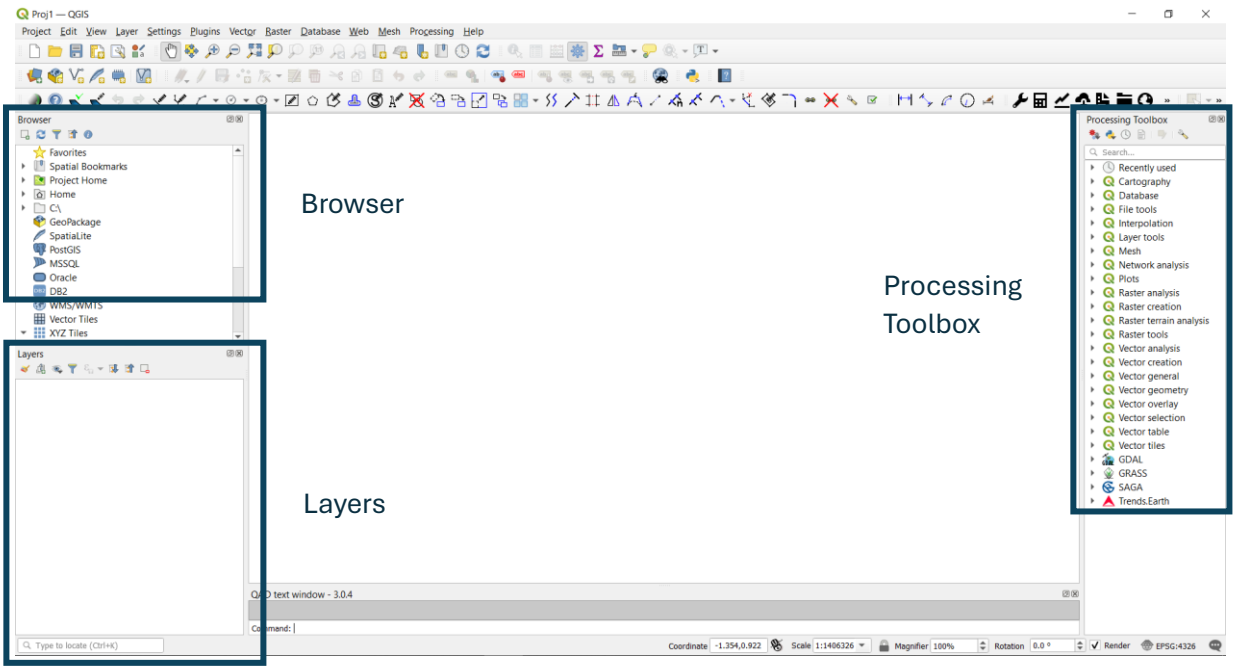
This will open the main QGIS window. You create a new, empty project by clicking on the very left menu *Project* → *New*.



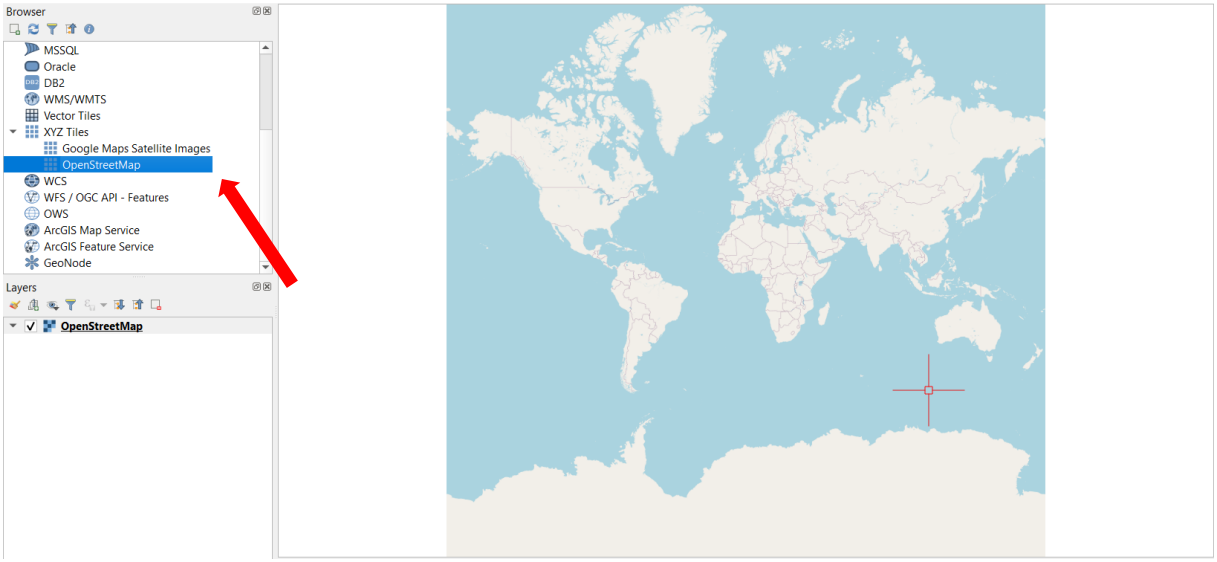
- We immediately save the new project via *Project* → *Save As*.
- Make sure to save the project in the **SNAC_workshop** directory and give it a proper name (e.g. "Proj1")!

You now see the main window of QGIS, as shown below. It contains quite a few components, including the menu bar at the top, a few more rows below with many icons, the *Browser* and *Layer* filed on the left as well as the *Processing Toolbox* on the right. Hint: The functionality, i.e. amount of icons in the upper rows is subject to additional plugins, so don't be confused if you don't see

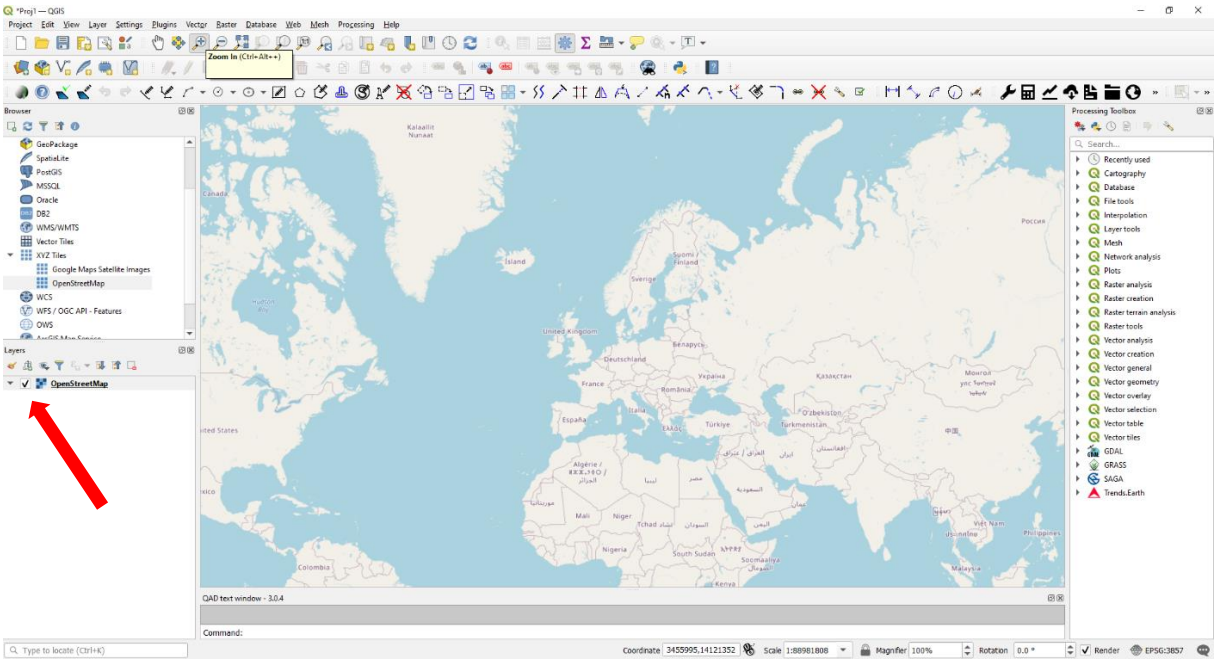
the exact same icons as shown. Moreover, the *Processing Toolbox* can be hidden; click on *Processing* → *Toolbox* to activate it.



Now we will focus on adding and displaying data. As an example, we insert a basic OpenStreetMap. In the browser go on *XYZ Tiles* → *OpenStreetMap*. There is also the option to add Google Maps Satellite Images.

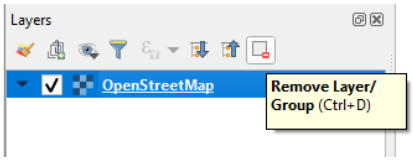


You can pan about the map by using the *Pan Map* function, which can be found in the first row. Adjacent, there are two magnifier symbols to zoom in and zoom out. By left-clicking on the map and hold-dragging on the map you can pan the map; zooming also works if you have a mouse with a mouse wheel. You can also play around with the other zoom/pan-tools: Next to the pan function you can zoom to a selected area, the icon on the far right zooms out entirely.

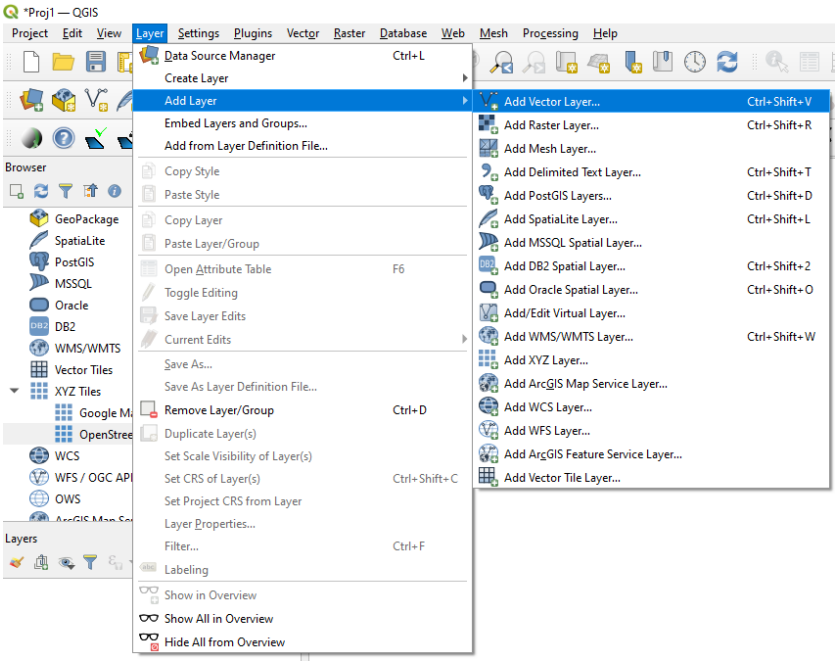


Click on the check box next to the OpenStreetMap layer, and note they toggle the layers' visibility on and off.

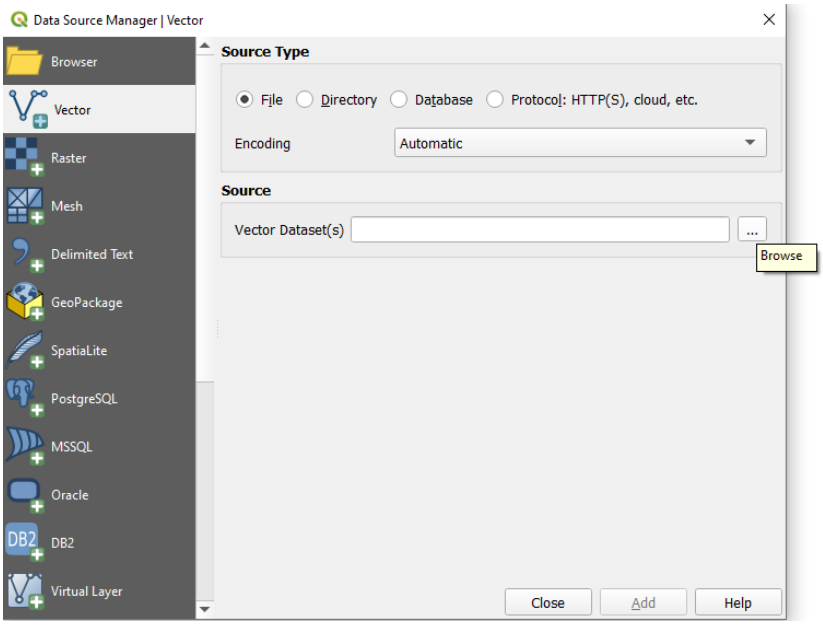
For now, we are removing this layer by left clicking on it and selecting *Remove Layer*, which is the far right icon in the Layers window.

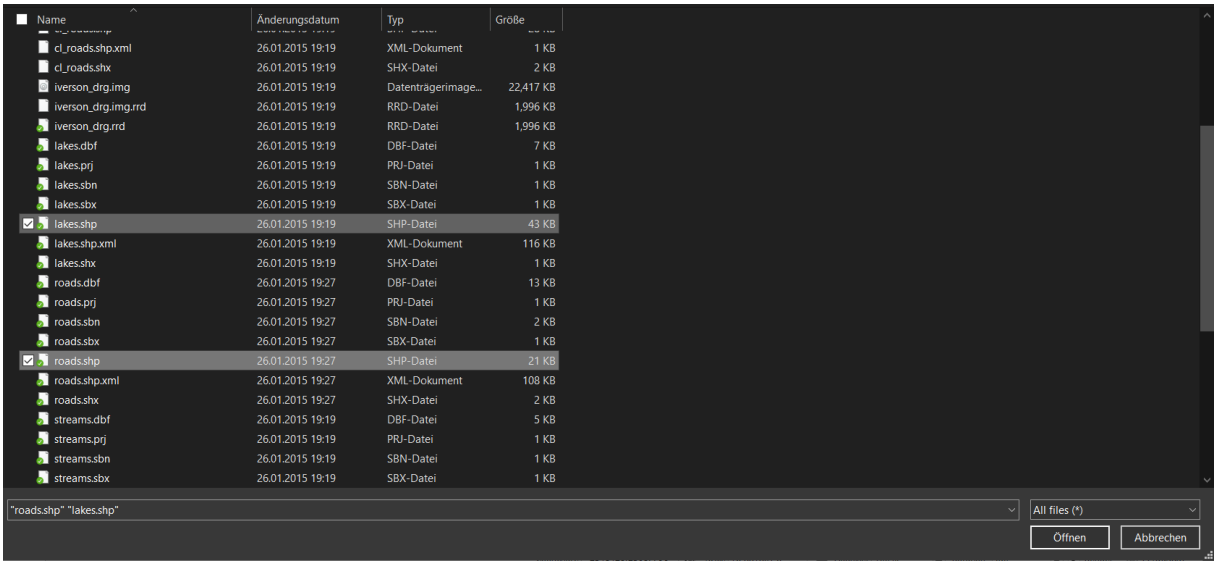


Now, we are using some data. Click on *Layer → Add Layer → Add Vector Layer*.

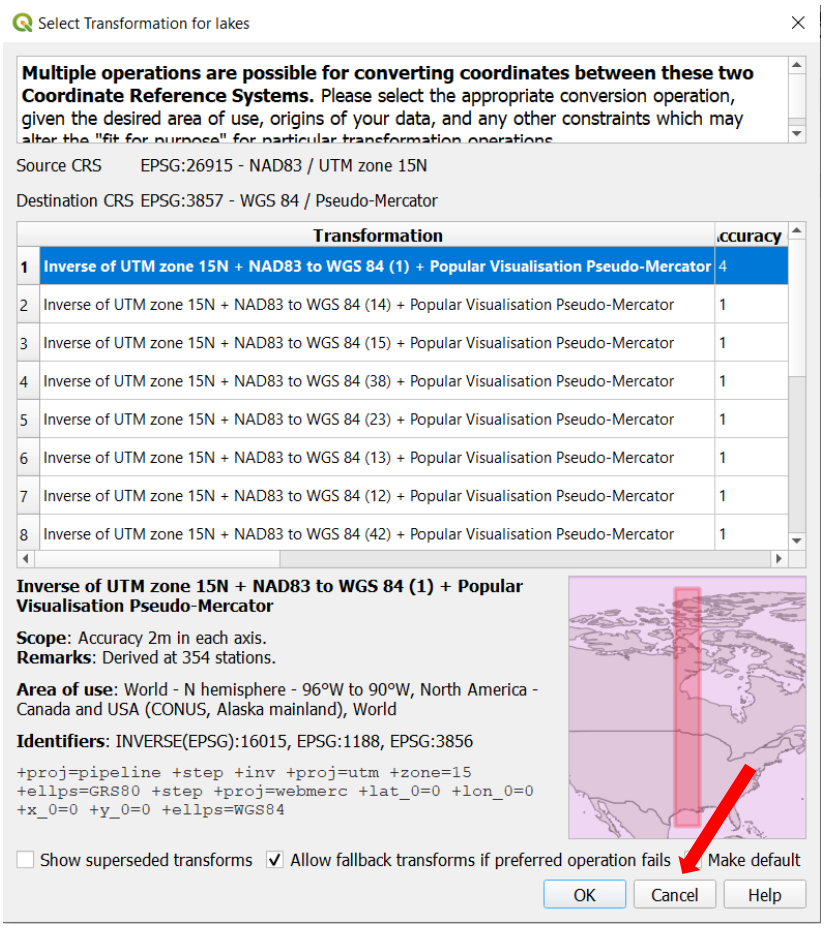


This will open the *Data Source Manager* window where you need to select the source of the data you would like to add. Click on the three dots in this window, navigate to the folder where you stored the data related to this exercise and choose *lakes.shp* and *roads.shp*



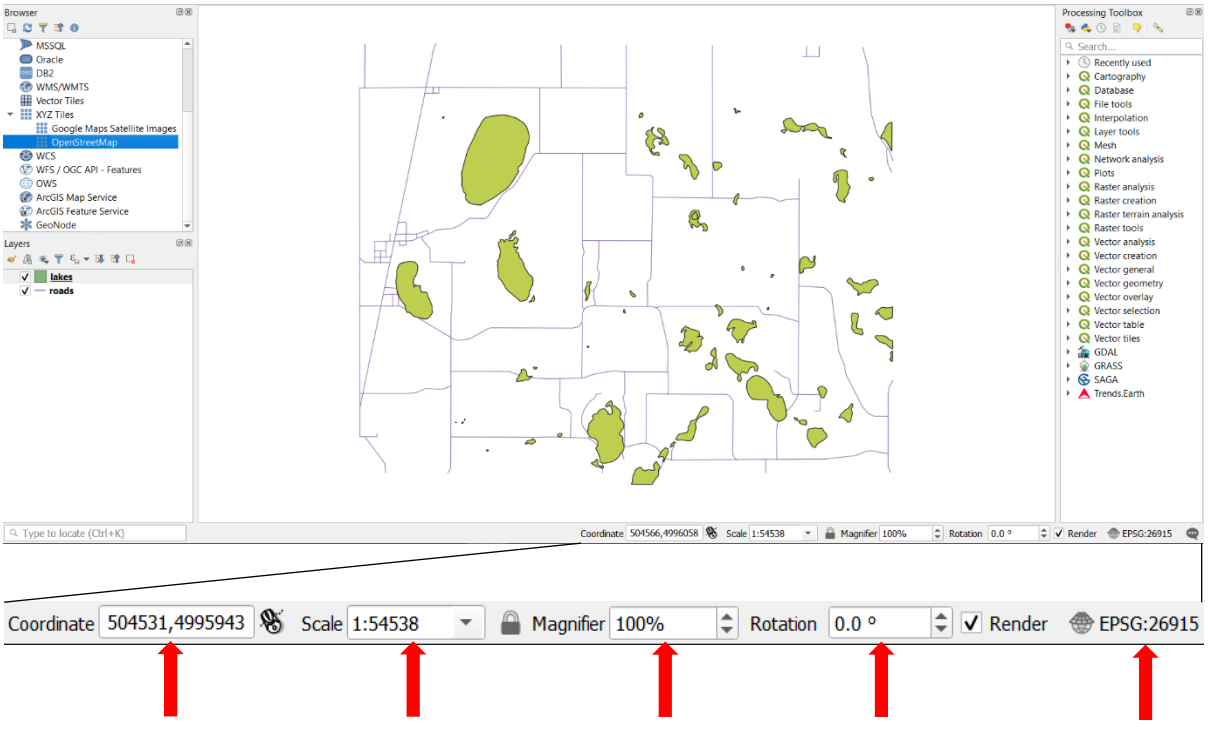


If you click on *Add* in the *Data Source Manager* window, most likely a window will appear that prompts you to decide on an issue concerning different coordinate systems. The coordinate system of the OpenStreetMap that we used earlier is *EPSG 3857* (WGS 84 / Pseudo Mercator), and QGIS assumes you would like to continue working in this coordinate system. The input data belongs to another reference system (UTM zone 15N), so QGIS suggests transforming the data into the destination CRS of the OpenStreetMap. However, we do not want that, because we are going to work in the coordinate system of the input data (*EPSG 26915*). Click on Cancel.



You can now close the *Data Source Manager* window.

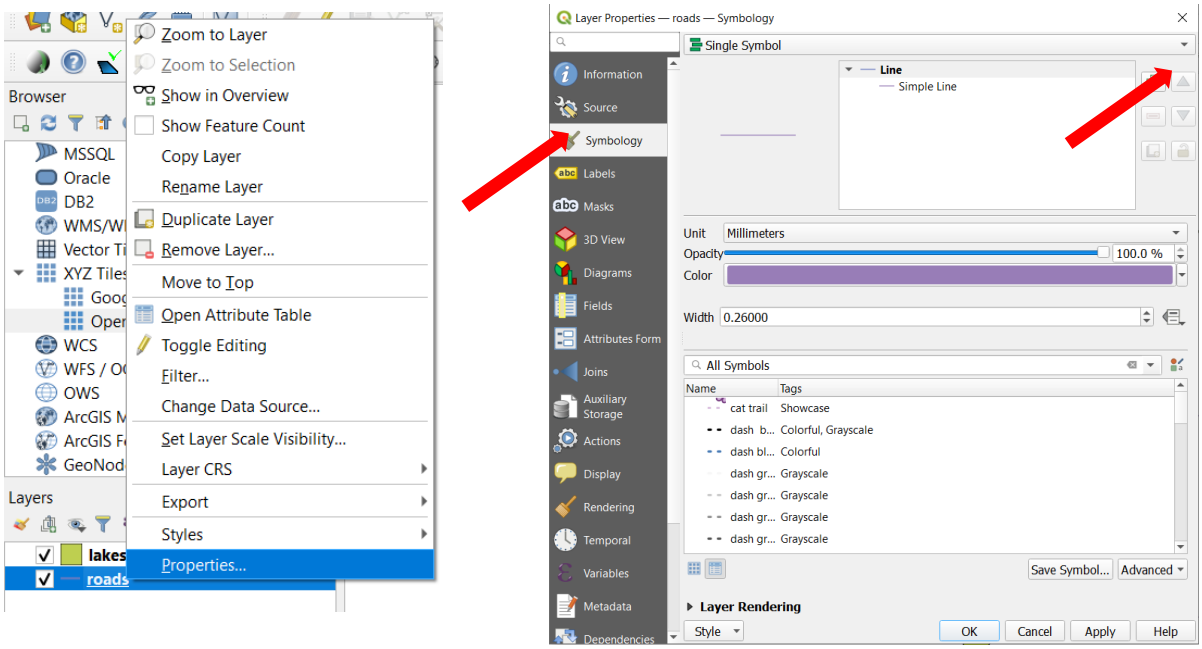
This will add this data to your project and it appears in the middle of the QGIS window.



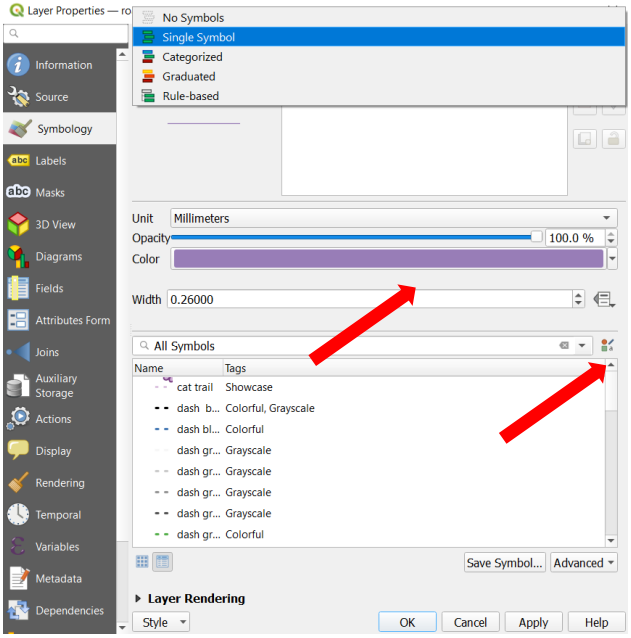
There are also useful tools along the bottom of the main window, see above. The coordinates (X, Y) are provided on the very left. Next to that is the nominal scale, which can be selected via the dropdown menu by clicking on the arrow, or by typing one in directly. The magnifier shows the current zoom level; the rotation can be found adjacent. On the far right you see the coordinate reference system, which is in our case based on the just imported shapefiles. If you click here, a window will open, where you can select a different coordinate reference system for your entire project.

Changing Layer Symbology

We can customize a layer's appearance. Right click on the *roads* layer we just imported, and navigate to *Properties*, then to *Symbology*.

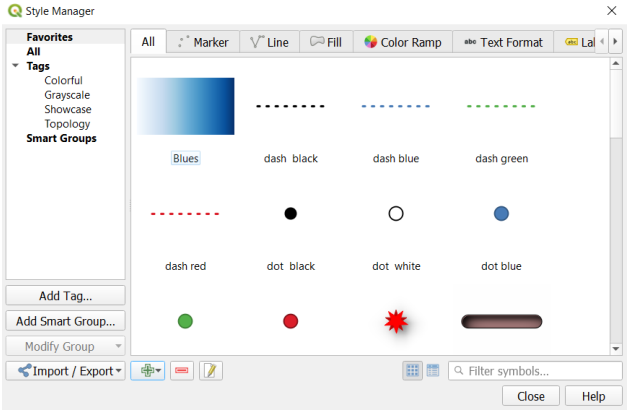


On the top of the window you can choose the general type of symbol, which is in our case just a single symbol. If you open the dropdown menu (see red arrow on the right picture on the previous page), you can see all types that are available (shown at right). This is especially useful when working with categorized data. The symbology is currently set to single symbol and we will leave it like this for now.

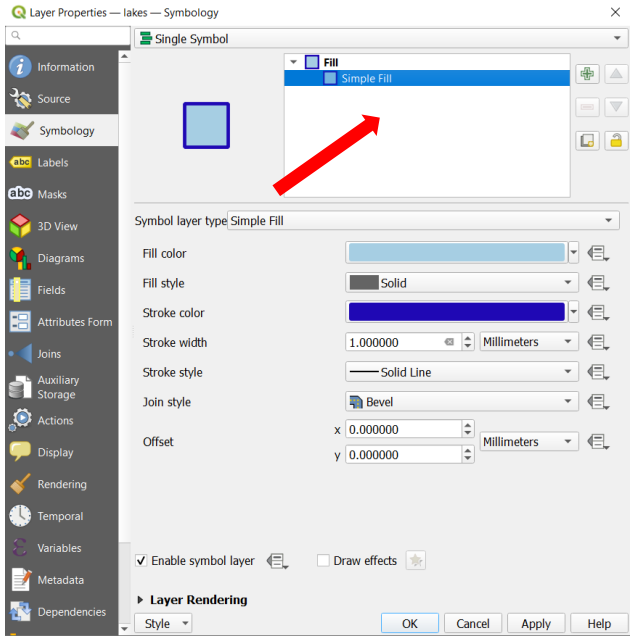


In the lower part of the window you can apply different settings to the line, i.e. its color, opacity and width. If you click on the color field (indicated by upper red arrow) another window will open, where you can specify the desired color.

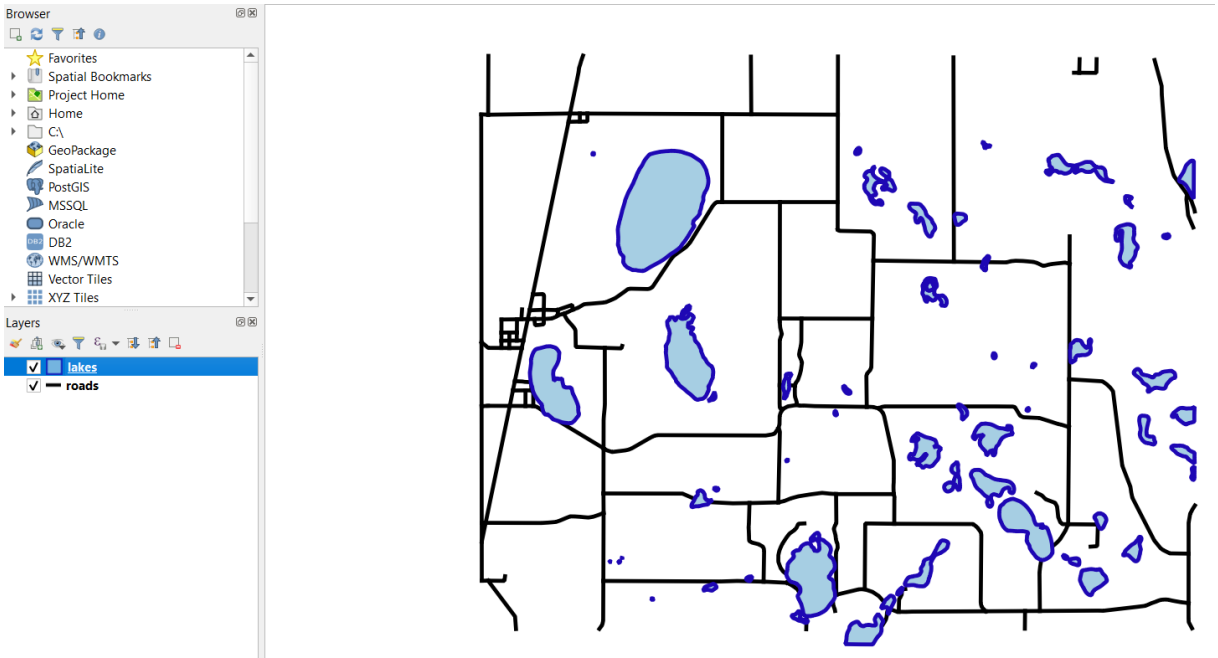
Moreover, you can define the appearance of the symbol by opening the *Style Manager* (indicated by lower red arrow). Here, it is possible to choose the appearance of the symbol out of a huge variety provided in different tabs (shown to the right). Although there are many options you can set, for now just choose black as color and 1 as width to specify roads.



Repeat this process for the *lakes* layer, specifying a light blue interior, and darker blue boundary for the lakes. Hint: if you have opened the *Symbology* tab in the *Properties* of the lakes' layer, you need to left click on the actual fill type in order to set the fill and stroke color (shown to the right).



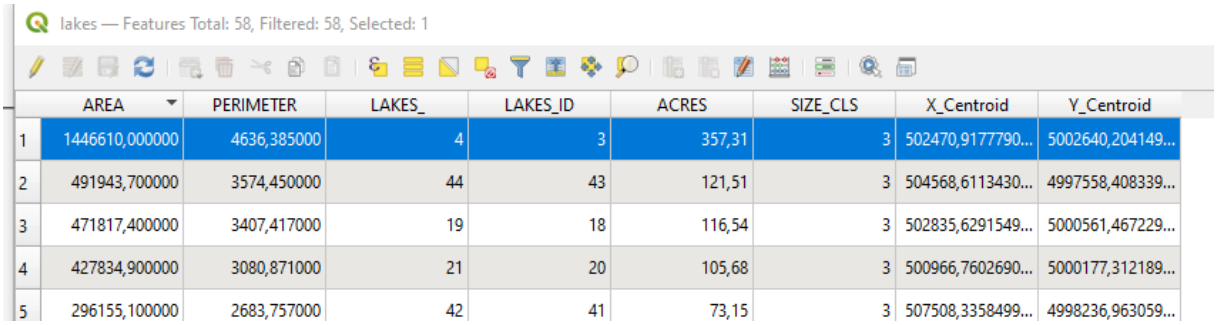
Now, your map should look something like the image below.



Inspect attribute table

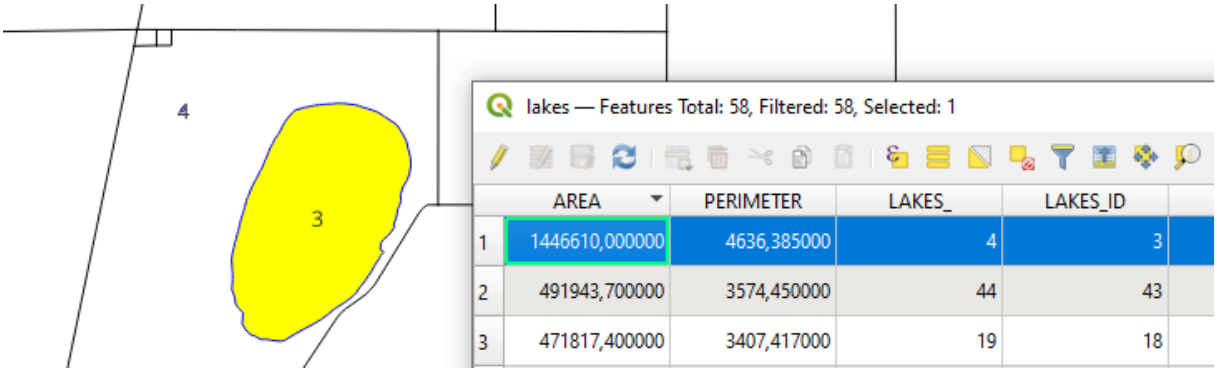
So far you have become familiar with the geometrical objects of the roads and lakes shape-files. As explained in the video material, geographical data consists of not only the geometry of the objects but also a description of *what* the geometrical objects are. This information is stored in an attribute table. You can click on any object in the map window and see its description from the attribute table. Choose the "identify features" tool and click on a lake or a road. A window called "identify features" will appear.

Another way to the see the attribute information is by selecting the layer of interest in the layers panel, right click and select "open attribute table". For the lakes the table looks like this



	AREA	PERIMETER	LAKES_	LAKES_ID	ACRES	SIZE_CLS	X_Centroid	Y_Centroid
1	1446610,000000	4636,385000	4	3	357,31	3	502470,9177790...	5002640,204149...
2	491943,700000	3574,450000	44	43	121,51	3	504568,6113430...	4997558,408339...
3	471817,400000	3407,417000	19	18	116,54	3	502835,6291549...	5000561,467229...
4	427834,900000	3080,871000	21	20	105,68	3	500966,7602690...	5000177,312189...
5	296155,100000	2683,757000	42	41	73,15	3	507508,3358499...	4998236,963059...

It contains information about the area and perimeter of the lakes as well as some other information, for instance the LAKES_ID that is an unique identifier for each object. You can sort each column in increasing or decreasing order by clicking on the column name. If you select a row, the corresponding object will be highlighted in the map window.



	AREA	PERIMETER	LAKES_	LAKES_ID
1	1446610,000000	4636,385000	4	3
2	491943,700000	3574,450000	44	43
3	471817,400000	3407,417000	19	18

Create a Layout

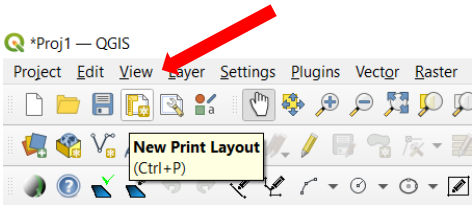
We often wish to create a map depicting our data, plus information such as title, legend, north arrow, and a scale bar. In GIS software, such a map is called a **map layout,** and it is a way of organizing and presenting geographic information in a clear and visually appealing manner. It involves arranging the necessary map elements on a page, such as:

- the map itself,
- grid
- legend,

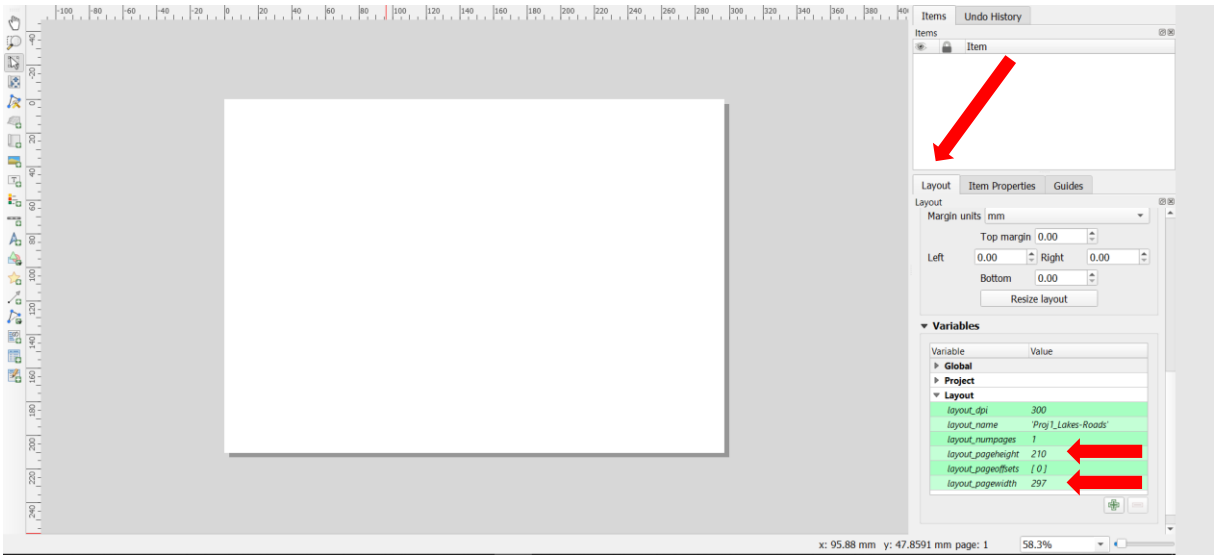
- scale bar,
- title,
- north arrow,
- source (CRS).

The layout is carefully planned to ensure clarity, readability, and to accurately convey the intended message or data to the map's audience. It's an essential part of map-making that focuses not just on showing geographic locations, but also on making the map easy to use and understand.

To do this here, first create a new *Print Layout* by clicking on the indicated symbol in the first row of icons. QGIS prompts you to insert a title for your map. Choose a proper name, e.g. *Proj1_Hugo_Lakes-Roads*.

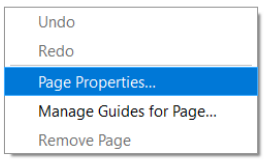


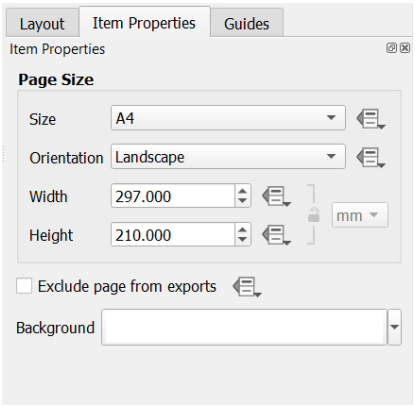
A new window pops up showing an empty canvas. Make sure to set the layout to landscape, because our data is rather wider than tall. Click on *Layout*, scroll down to *Variables* and check whether *layout_pagewidth* equals 297 and *layoutpageheight* equals 210 (see picture below).



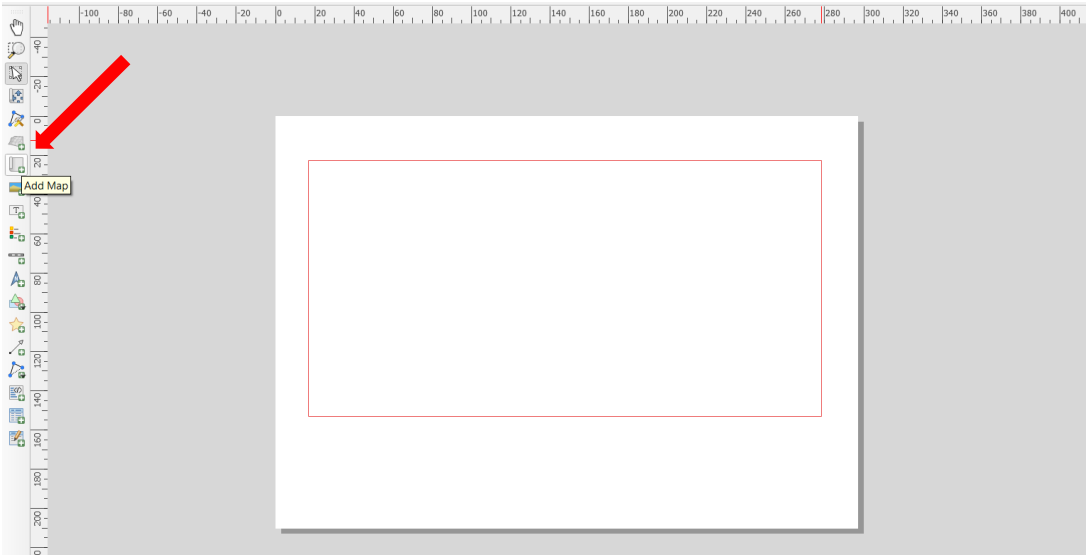
If that is not the case, change the layout by right clicking on the empty canvas in the middle, and navigate to *Page Properties* (shown underneath).

This will open the *Item Properties* on the right next to the *Layout* window itself. Here, you can choose the *orientation*, where we set it to *Landscape*.

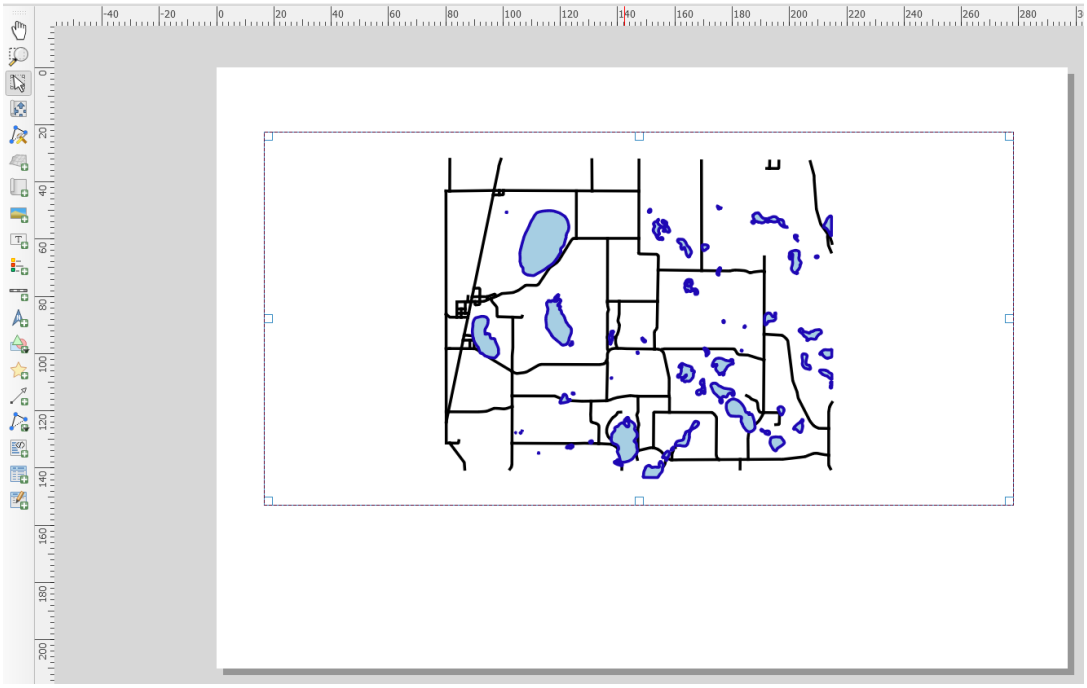




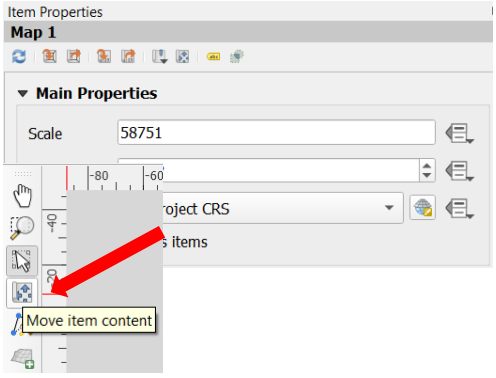
Now, we add a map via the icon on the left side like shown below. Left click on the empty canvas and drag the size of the map. Afterwards, the lakes and roads will appear.



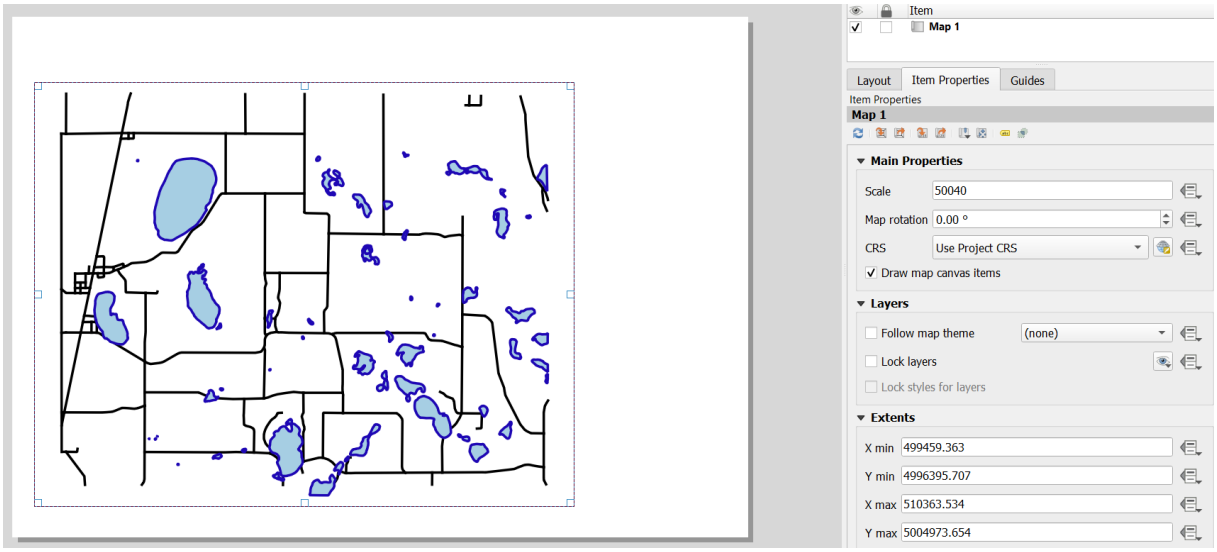
Now, your map should look something like the image below



It is advisable to **change the scale of the map**, because there is a huge white boundary that does not contain any information. Check the scale of the map in the *Item Properties* window (picture to the right). If you compare this to the scale in the QGIS main window, it probably differs. Adjust the scale in the Print Layout so that the white boundary shrinks. You can also use the *Move item content* function (toolbar on the far left



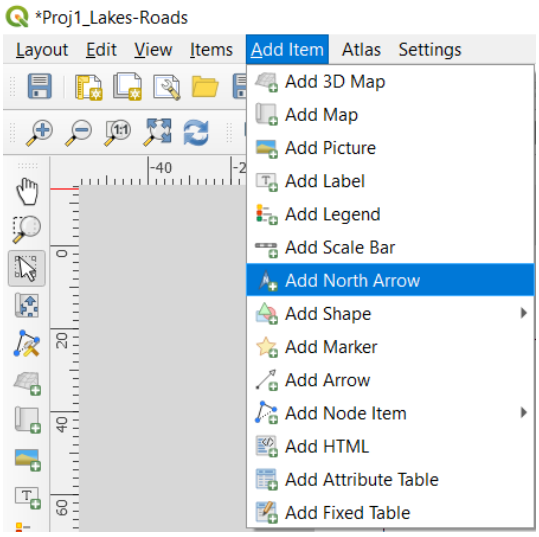
side) to move only the content of the map within the frame. Finally, drag the frame as big as necessary.



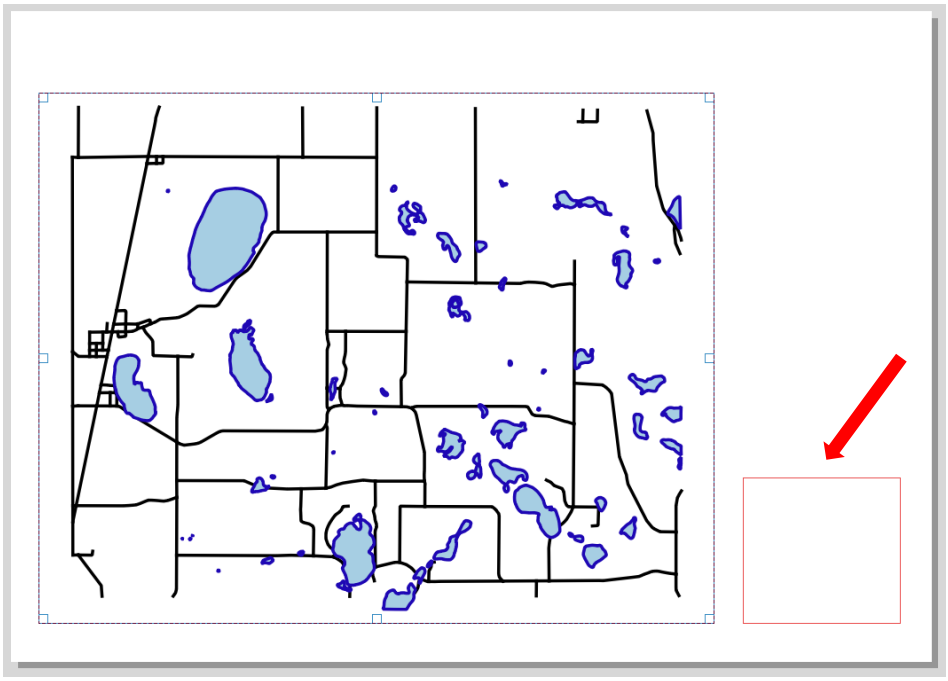
We add the most common layout elements such as

- a north arrow,
- a scale bar,
- a legend and
- a descriptive text.

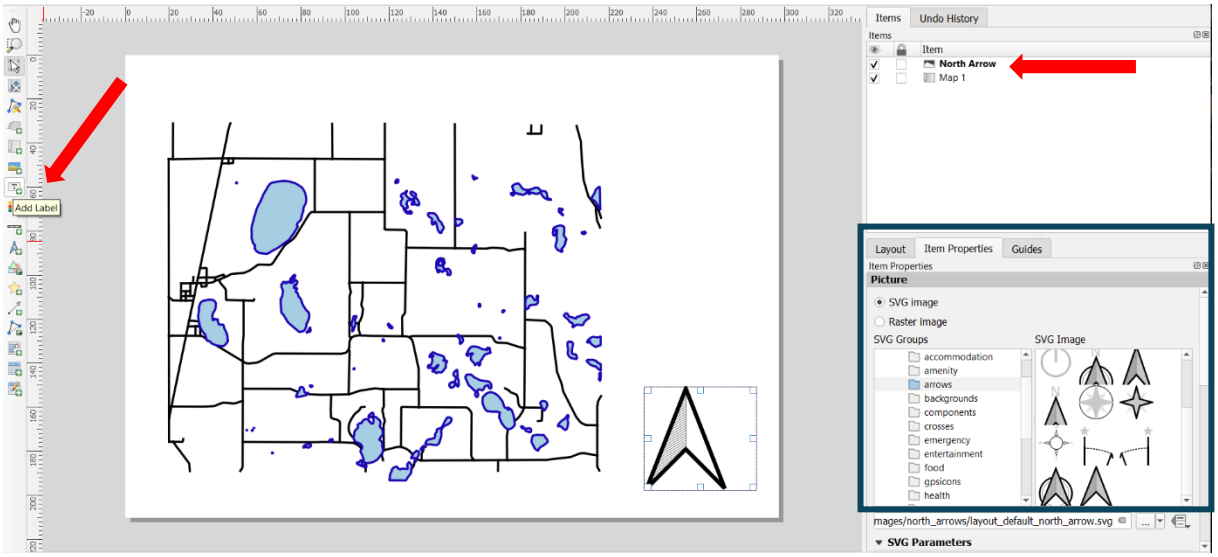
Let's start with **the north arrow**. To add new elements to the map, we go to *Add Items* in the main menu on top of the window. Then, click on *Add North Arrow*. Hint: adding a north arrow is also possible by clicking on the corresponding icon in the icon list on the left side.



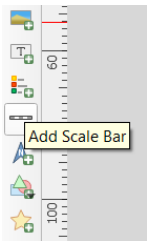
You can now drag a frame that will contain the north arrow like shown beneath (red arrow / red box).

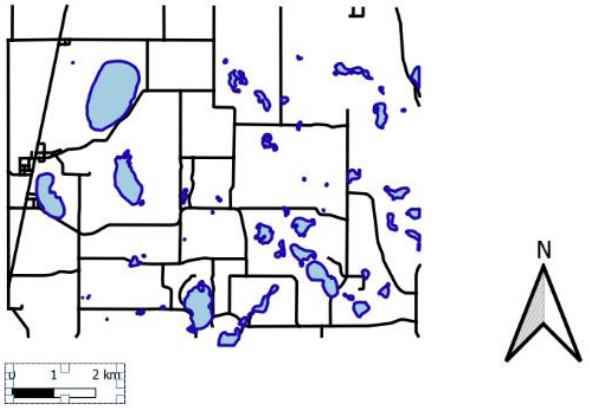


You should see a default north arrow in the box you just created. Note this new element in the *Items list* on the top right of the window. You can choose from different types of north arrows like shown below (blue box).

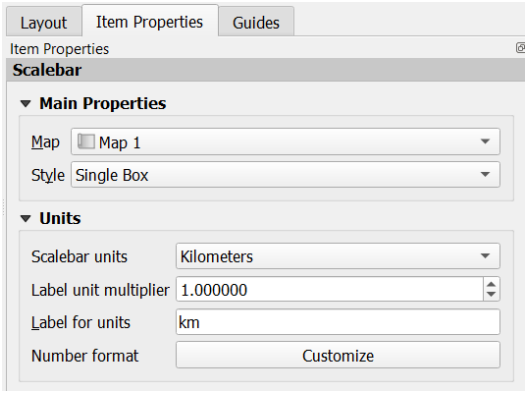


We also would like to add a scale bar. You can click on the *Add Scale Bar* icon or go to the drop down menu *Add items* → *Add Scale Bar*. You can drag the desired size of the scale bar and place it in the main window (picture on the far right).

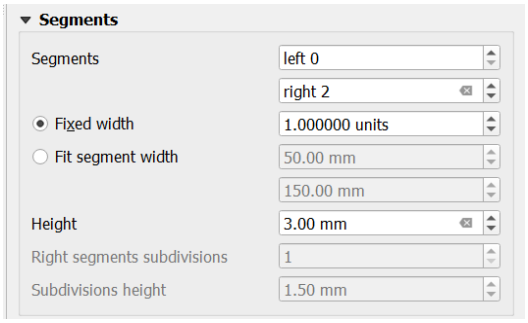




Formatting a scale bar is a bit more complex than a north arrow. Open the *Item Properties* to see what we can set. In the *Main Properties* you can decide to which map it should be linked. Moreover, you can specify the *Style*. We keep the current settings, but it is useful to keep these things in mind, especially if you are working with more than one map. Below we can set the *Units*, e.g. kilometers. Depending on the scale of the map, it might be necessary to adjust it.



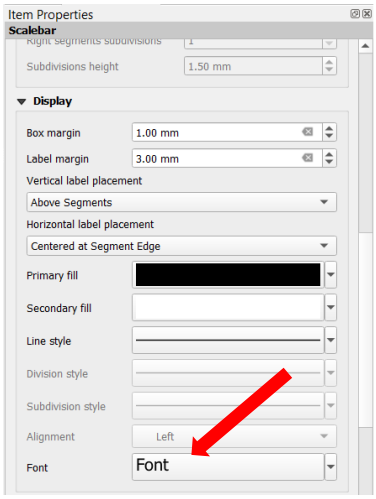
You can also change the appearance of the *Segments*, e.g. amount, position and width. Currently, there are two segments on the right side. Decide on a proper way according to your map / data you want to present. For instance, a *Label unit multiplier* of 1, increasing the *number of segments* to 5 with a *fixed width* of 1 units will result in the following scale bar:



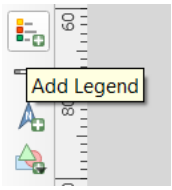
Hint: the scale bar is of course linked to your map and therefore to its scale. The scale bar changes dynamically when changing the scale of the map. In this example, the shown scale bar is subject to a map scale of 1:50,400.

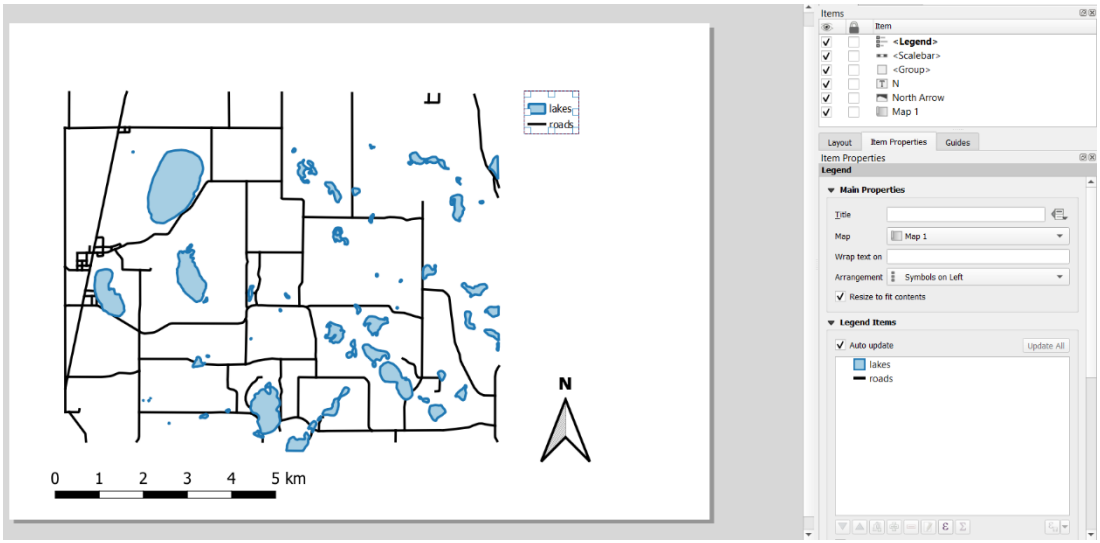
It is also advisable to change the font, as the default is too small in most cases. Scroll down to *Display* in the *Item Properties* window of the scalebar.

Make sure your scalebar is properly formatted. The primary criteria are readabilty and clarity. The default is often placed with too small font, or odd break values.



Most maps need a legend as well. You find the correct tool in the left toolbar: Clicking on the *Add Legend* tool activates the cursor as a crosshair, and allows you to click-drag on the layout to place a legend.



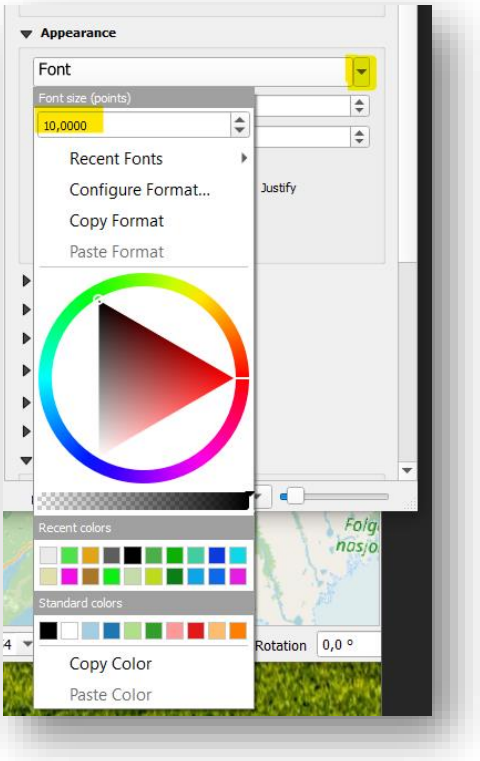


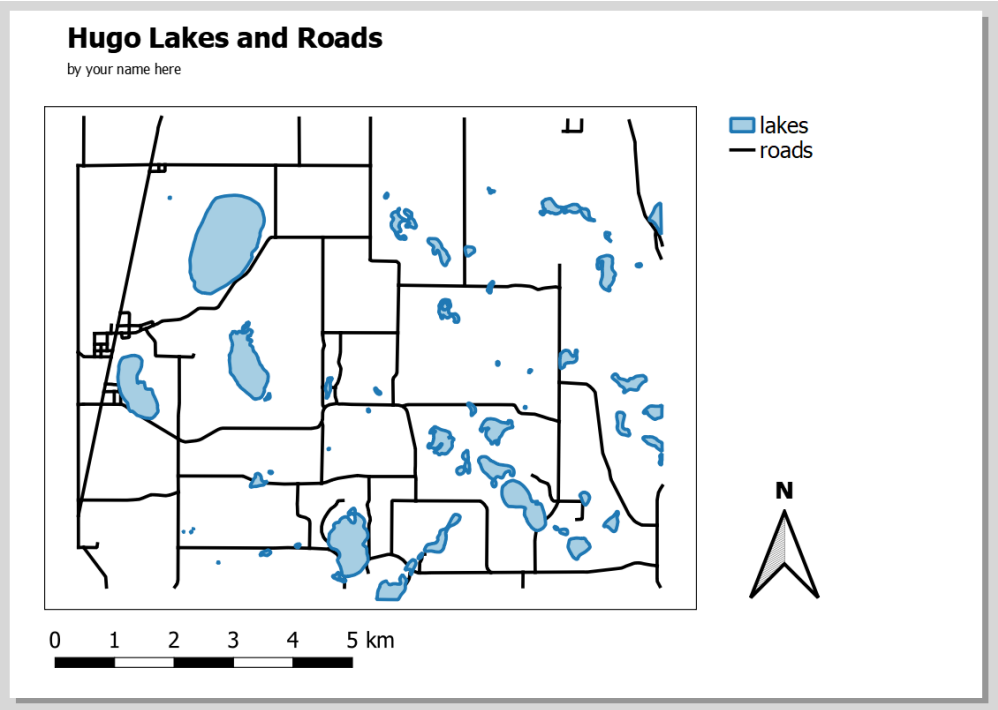
Again, choose a proper format for your legend (i.e. increase the font). Hint: in the *Item Properties* window of the legend scroll down to *Fonts and Text Formatting*.

Now add a title to your map  (use *Add Label* on the left toolbar to do so). Change its text as well as font and size in the item's properties You can add your name in the same manner.

Make sure your map has a title, legend, north arrow, and a scale bar. These elements should be reasonable and well-positioned.

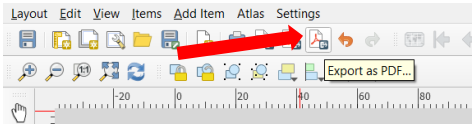
Your layout should look something like the image below, but you don't have to match it exactly of course. Just make sure to include the required elements, listed above. We encourage you to use different fonts, colors, north arrow, and a scale bar, or at least peruse what are available.



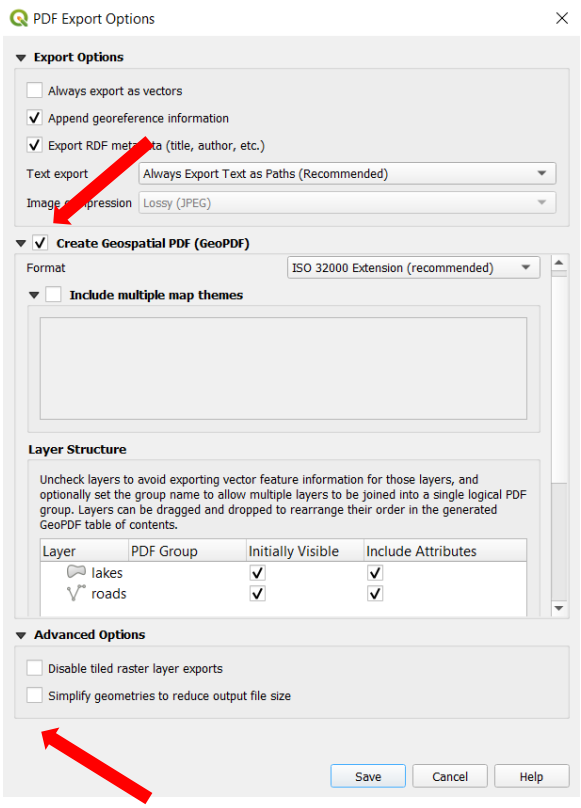


Export map as a PDF file

Let's export the map to a PDF file. Click on the *Export as PDF...* icon in the toolbar on top.



You will be asked to give a file name; choose a proper name e.g. *Proj1_Hugo_Lakes-Roads.pdf* and save the file in the directory of your project. After clicking on *Save*, QGIS opens a new window where we can set the *PDF Export Options*.



QGIS offers to save the file as Geospatial PDF. It is not necessary, but at least useful to save it as GeoPDF. Basically, a GeoPDF is like a normal PDF file. However, it contains additional functionality. A GeoPDF directly saves the spatial coordinates of the area / map. Accordingly, the file is immediately assigned to its correct locations. PDF software like Adobe Reader has special tools to measure distances, which can be used if the file is a GeoPDF.

It is advisable to remove the tick at the bottom so that QGIS don't simplifies geometries to reduce the output file size.

Note: every setting is dependent on your specific task and desired result. If your map is very complex, i.e. it contains many layers in a high

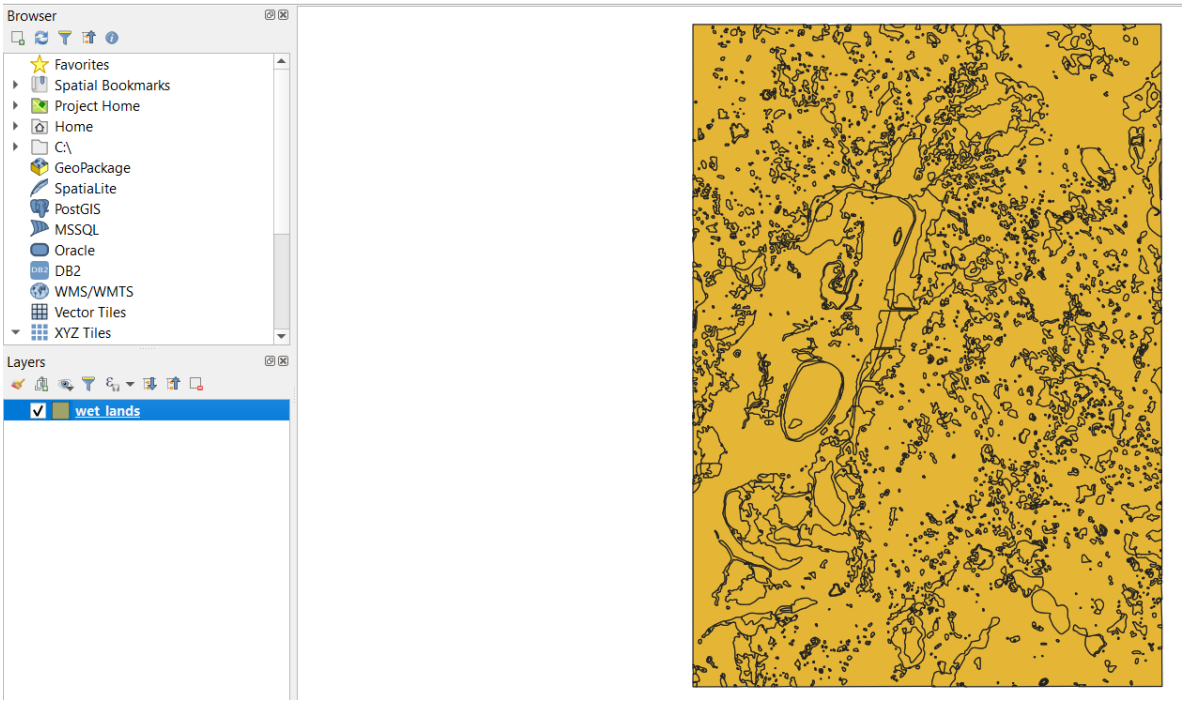
resolution, it can also be useful and time saving to simplify geometries and / or save it as normal PDF!

We keep all other settings. Click on *Save*, if you are done. Also, remember to save your project frequently while working. Save and close your project.

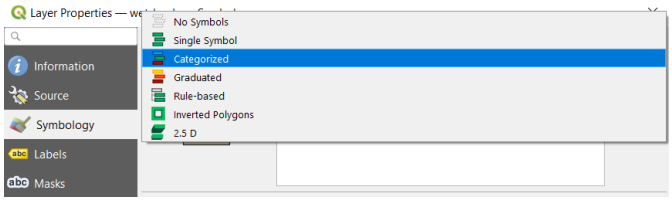
Symbolize Categories

You just learnt how to make a map and symbolize simple features. In this section you will learn how to symbolize features that have different categories.

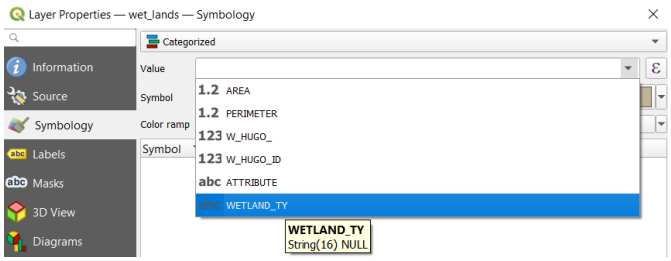
Create a new project named something like “Wetlands_proj” and add the layer “wet_land.shp” from the project directory. This layer shows polygons for wetlands near Hugo, Minnesota. Hint: if you are unsure how to add the layer, check the previous assignment. In case QGIS wants to transform coordinates between different reference systems, cancel this step. You should see something like this underneath:



Right click on the *wet_lands* layer, go to *Properties* → *Symbology*. Click on the dropdown-menu at the top of the window to apply *Categorized* symbology.

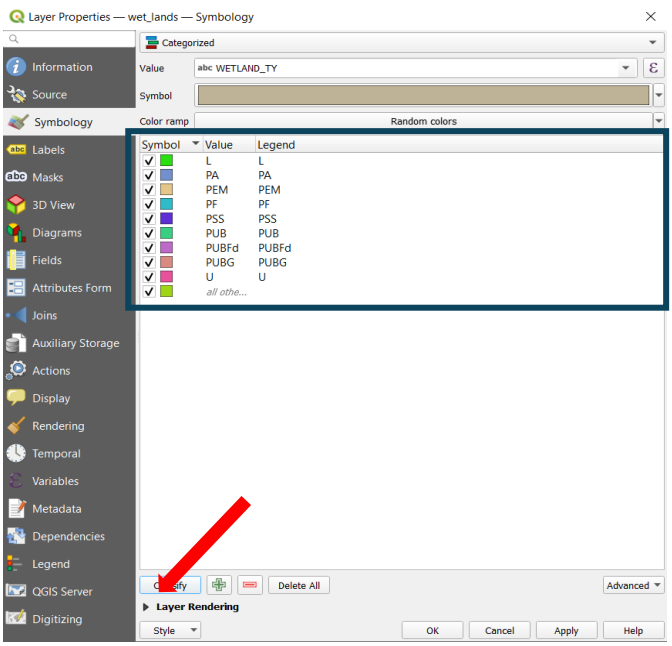


Choose *WETLAND_TY* in the dropdown menu of *Value*.

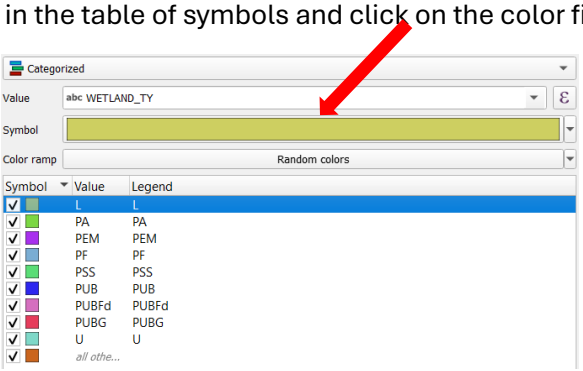


There are no values yet, because they first need to be classified. Therefore, click on *Classify* at the bottom of the page.

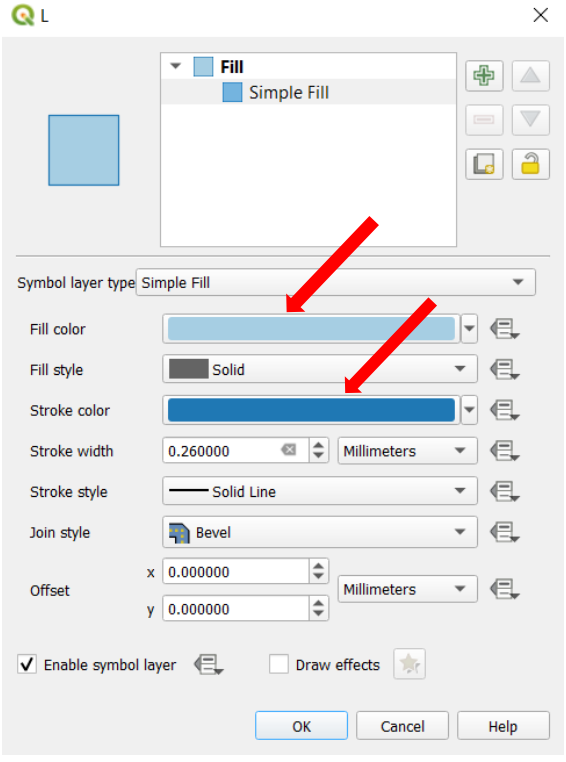
The assigned color scheme is displayed for each category (see at right). You often have a large number of categories and want to change colors for some of them.



Let's assign the lakes (L) a blue color, and since the *U*-value (which means uplands) is such a large part of the map let's apply a rather bright color to make the map more readable. Mark the *L*-value in the table of symbols and click on the color field on top of the window (red arrow).



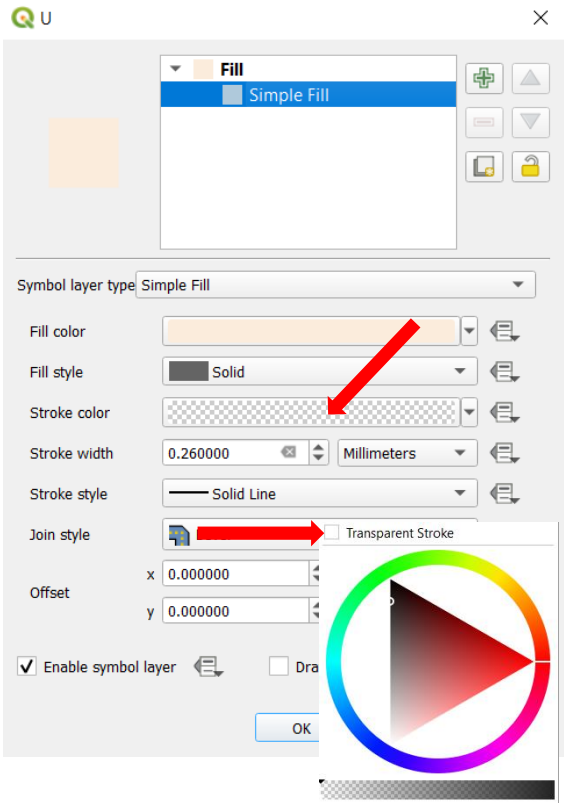
Another window will pop up showing the color properties of *L*. For now, we'll choose a light blue lake color, and a darker blue outline for the lakes and keep the outline width as is. Hint: to be able to change the color click on the color field (indicated by red arrows). Apply by clicking on *OK*.

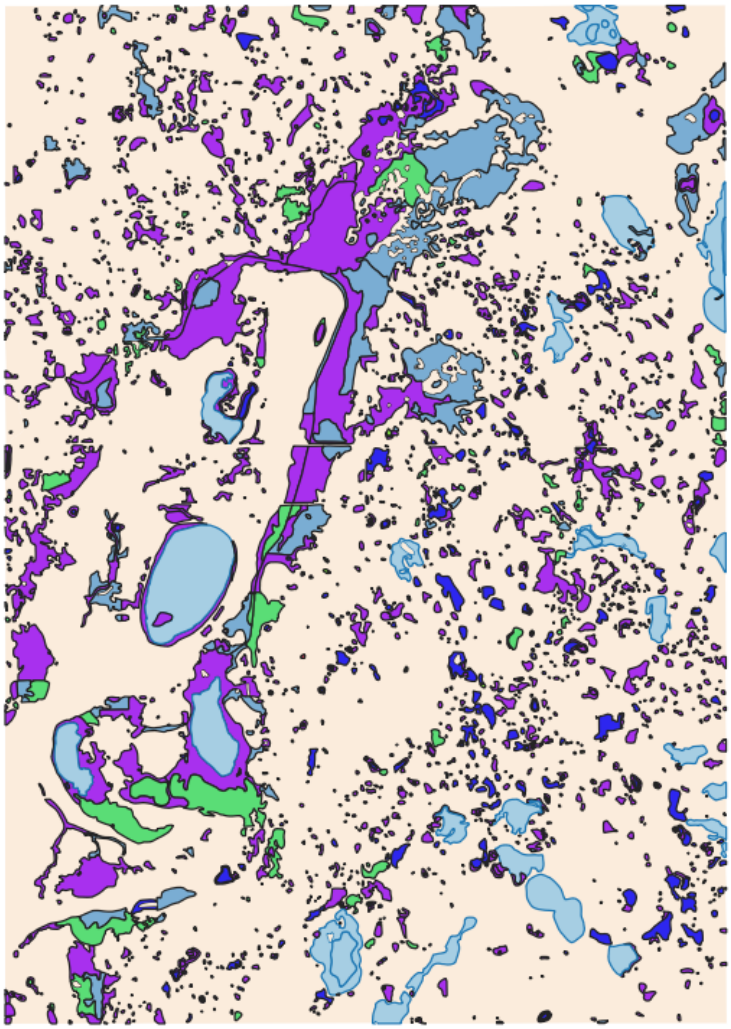


Now, let's assign another color to the uplands (*U* symbol) as well. It's the same procedure: click on *U* in the list like shown above, open its properties and adjust the fill and stroke color. We would like the *Stroke color* to be transparent. Hint: click on the dropdown menue (red arrow) and activate *Transparent Stroke*. The fill color could be in a light tan color.

Your map should look something like the figure below. Don't worry if your wetlands polygons are a different color, just make sure the lakes and uplands are assigned correctly.

Save the project with your data, close it and continue with the instructions below.

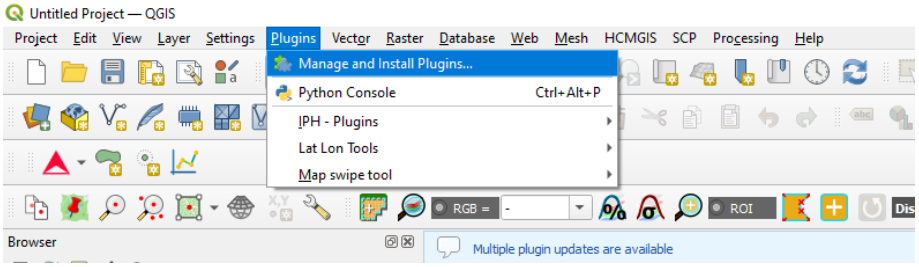




Adding basemaps via plugins

There are different ways to **add basemaps** to your project. You have already seen how to add from the XYZ-tiles option. You can also add via plugins, i.e. small program additions to QGIS. A very convenient one is the QuickMapServices plugin.

To activate it, navigate to **Plugins → Manage and install plugins.** Via the header **Not installed** → search for **Quick map services** in the search bar.



Click on “Install”. After it installed, you should be able to find QuickMapServices button in the Web Toolbar

Click on the left button and navigate to **Settings** in the drop-down menu. From here, go to “More services” and click on **Get contributed pack**. In the adjacent **Visibility tab** you can choose which basemaps you want to turn on and off.

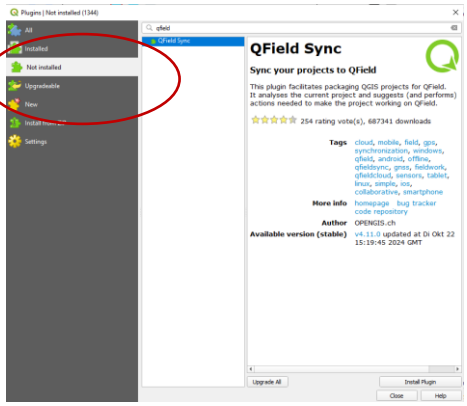
Save your changes.

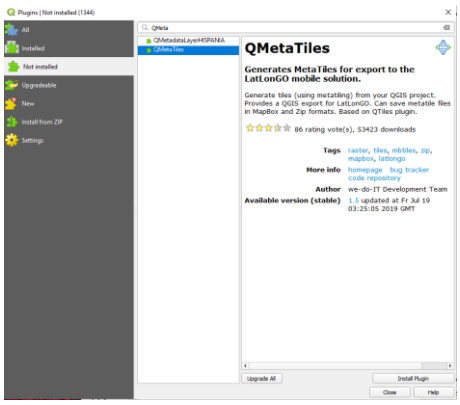
Installation of Plugins needed for the Workshop

In the following section we will install another two Plugins that will be needed during the course.

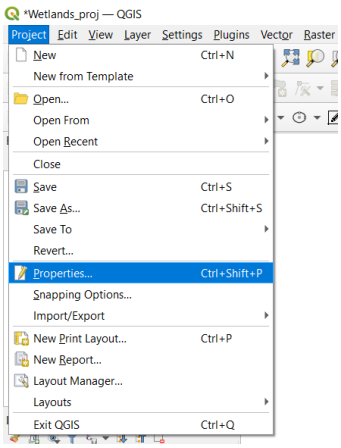
Navigate to **Plugins → Manage and Install Plugins**. Via the header “Not installed”, search for QField Sync and click on Install Plugin.

Do the same for QMeta Tiles.





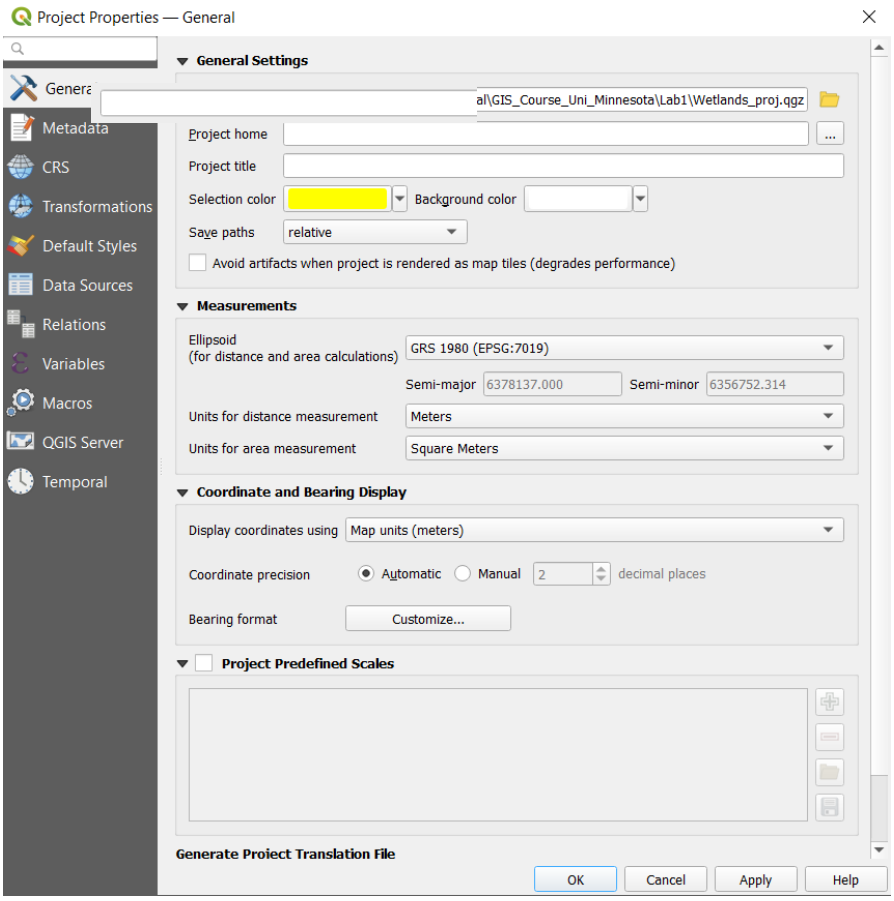
About Project Properties



QGIS offers a range of settings to adjust several properties of your project. Let's check this out. Go to *Project* → *Properties*.

These settings are related to your entire project. You can, i.e. adjust the properties of the measurements such as the units for distance and area measuring.

There are also other interesting tabs like *CRS* and *Transformations*. These two are related to the coordinate reference system of your project. Make yourself familiar with these *Project Properties*.

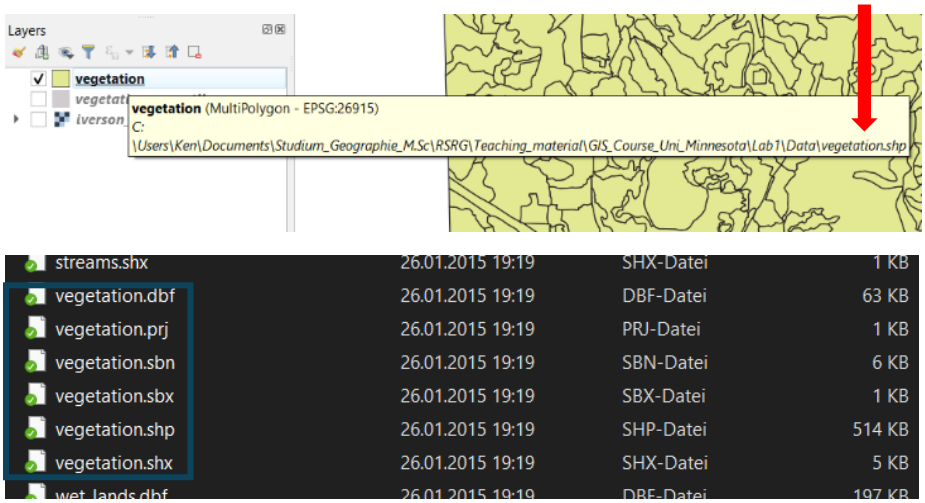


About Shapefiles

You may wonder about the data layers you have used for your maps, e.g., *Lakes*, *Roads*, and *vegetation*. These layers are shapefiles, an early format defined by *ESRI* for storing spatial data, and now a common standard for distributing and saving spatial layers.

A shapefile is actually a cluster of files. You can see this below. In the first picture you can see the layers window of the previous project. Here, the vegetation layer consists of *one* file (*vegetation.shp*). However, if we take a look at the file directory in Windows Explorer (blue frame, picture on the bottom), we can see several files with the name vegetation, each with different extensions. In addition to the .shp, there is a .dbf, .prj, .shx, and others. A complete shapefile is made up of several files, at a minimum a .shp, .shx, and .dbf files. If you ever copy shapefiles using

File Explorer or another generic file management tool, you need to copy ALL THE FILES, NOT JUST THE .SHP FILE. Otherwise, your copy will likely be incomplete, and useless.



Later in the course you will learn about the geopackage format. This is a database format. Databases allow you to store large amounts of data in one file. Thus they can be very helpful for GIS applications.

Unlike Shapefiles, GeoPackages can contain more than one data type (vector and raster, as well as tables) and these even in different coordinate systems!

Some free GIS-data

Here are a few examples for free GIS data, that may be interesting for some future projects.

Free GIS Data for Globe: https://freegisdata.rtwilson.com/

Africa Specific Data: https://digital-africa.co/en/

Data link: https://docs.digitalearthafrica.org/en/latest/data_specs/index.html#elevation

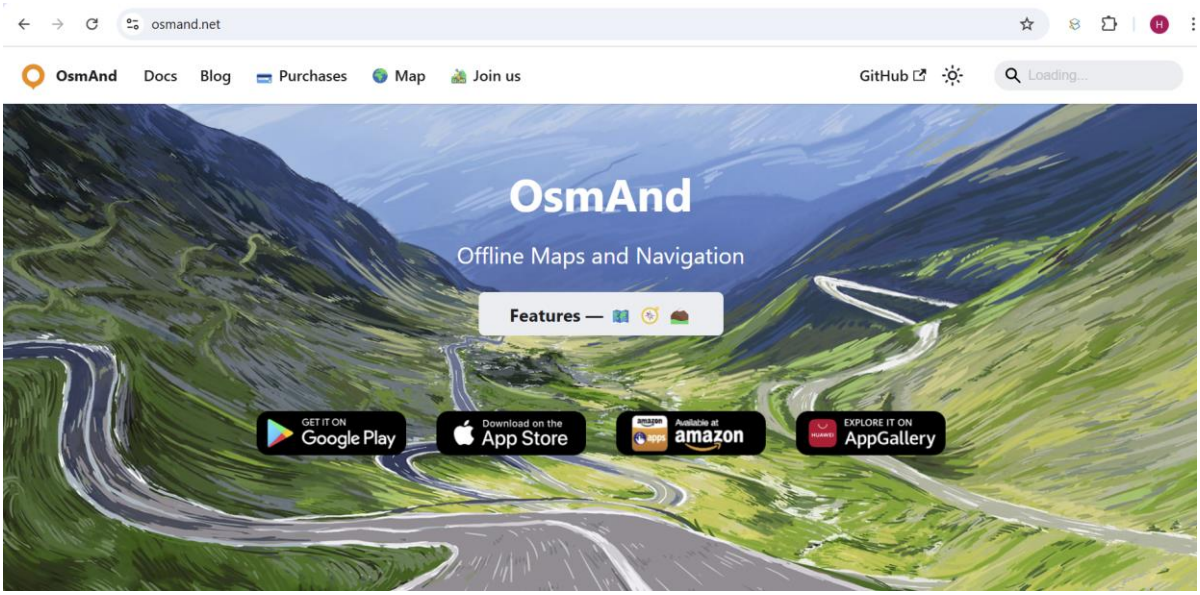
More data is available via ESRI Africa Geo Portal: https://www.africageoportal.com/

You have now learnt important basics in QGIS. In the next sections you will be introduced to the field mapping apps OSMAnd and QField and how these can be used in combination with QGIS to make field mapping more convenient and efficient.

2. Field Mapping with OsmAnd

About OsmAnd

- OsmAnd (OpenStreetMap Automated Navigation Directions) is an application for maps and navigation based on OpenStreetMap data.
- OsmAnd is a versatile, open-source map and navigation application available for Android and iOS devices.
- It leverages data from OpenStreetMap (OSM) to provide detailed, offline maps and navigation services.
- One of the best navigation Apps for smartphones.



Key features

- Offline Maps: Download and store maps for any region worldwide, enabling navigation without an internet connection.
- Navigation: Offers turn-by-turn voice guidance for various modes of travel, including driving, cycling, walking, and public transportation. Features like lane guidance, street name display, and estimated time of arrival enhance the navigation experience.
- Map Customization: Choose from different map styles tailored for activities such as touring, nautical navigation, skiing, and off-road adventures. Overlay multiple map sources and adjust transparency to suit your preferences.
- Points of Interest (POIs): Access a vast database of POIs, including attractions, restaurants, health facilities, and more. Search by address, name, coordinates, or category.
- Route Planning and Recording: Plan routes with multiple waypoints, record GPX tracks, and manage them within the app. Visualize route data such as elevation changes and distances.

- OpenStreetMap Integration: Contribute to OSM by editing maps, adding POIs, and uploading GPX tracks directly from the app.
- Versions and Pricing:
- Free Version: Provides access to core features

Begin with OsmAnd

- Install OsmAnd

Android markets: Google play store, Huawei AppGallery, Amazon.

iOS: App store.

Read more about OsmAnd versions and Purchases.

- Download maps

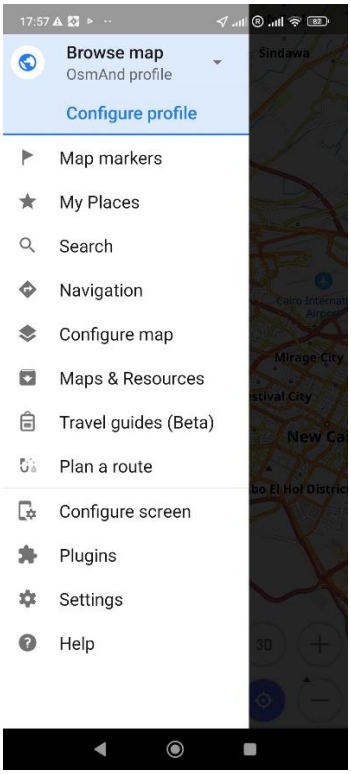
The OsmAnd app works with different types of maps, but it can only function fully with downloaded offline maps, so after the Get started screen you are prompted to download map of your region. You can choose a different region, restore from OsmAnd Cloud, or skip this step and download maps later.

Download maps is a necessarily action for further using map and navigation in offline mode. Maps can be downloaded both by browsing through the regions list from the main menu and by clicking on the needed territory on the map.

The files are updated monthly based on OpenStreetMap. Searching files by address, name or coordinates offline is supported.

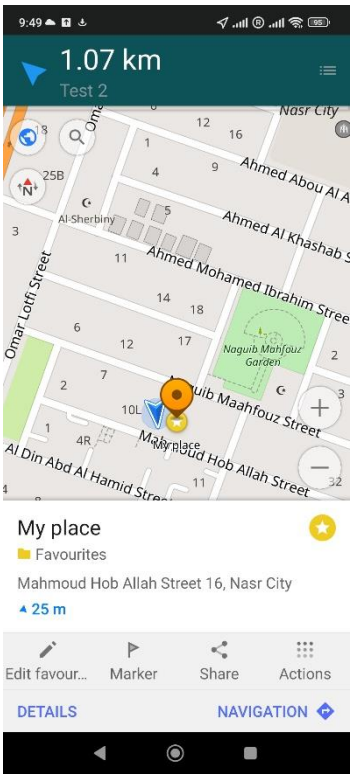
> Note: OsmAnd cannot work correctly without downloaded offline maps. Although the application supports Vector and Raster maps, it is strongly recommended to start working with vector offline maps to make all functions such as Search, Navigation, and Context menu work properly.

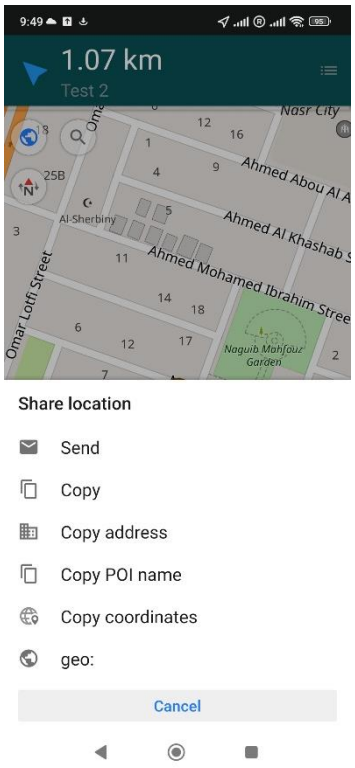
Get access to all features via main Menu

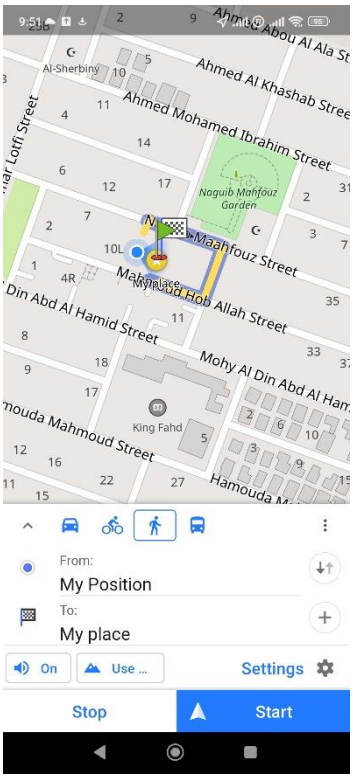


Marking a Point (Waypoint)

1. **Open OsmAnd** on your device.
2. Navigate to the location on the map or let OsmAnd detect your current location.
3. **Add a Marker**:
    - **Long-Press on the Map**: Tap and hold the location where you want to add a point. A pin or marker will appear.
    - **From Current Location**:
        - Tap the **"My Location"** button (usually a circle with a dot).
        - Once the map centers on your location, long-press on the blue marker.
4. **Save the Point**:
    - Tap on the marker that appeared.
    - Select **Save Point** or **Add to Favorites** (the option depends on your OsmAnd version).
    - Name the point for easy identification later (e.g., "Farm Field 1" or "Water Source").
5. **Managing Saved Points**
    - Go to **Menu → Favorites** or **Saved Places** to view all your marked points.
    - You can edit, delete, or navigate to any saved point.







Go to point

1. Open OsmAnd

- Launch the OsmAnd app on your device.

2. Search for Your Location

You can search for a location in several ways:

- **By Name**: Tap the **Search** icon (magnifying glass), enter the name of the place, and select it from the results.
- **By Coordinates**:
  1. Tap **Search → Categories → Coordinates**.
  2. Enter the latitude and longitude of the desired location.
- **By Point on the Map**:
  1. Long-press on the map where you want to go.
  2. Select **Navigate to Here** from the popup menu.

3. Plan the Route

- After selecting the destination, tap **Directions** or **Navigate**.
- OsmAnd will calculate the route based on your current location (or a manually set starting point).

4. Adjust Navigation Settings

- Choose your **transport mode** (e.g., walking, driving, cycling).
- Set preferences:
  - Avoid toll roads.
  - Prefer shortest/fastest route.

- Enable voice guidance.

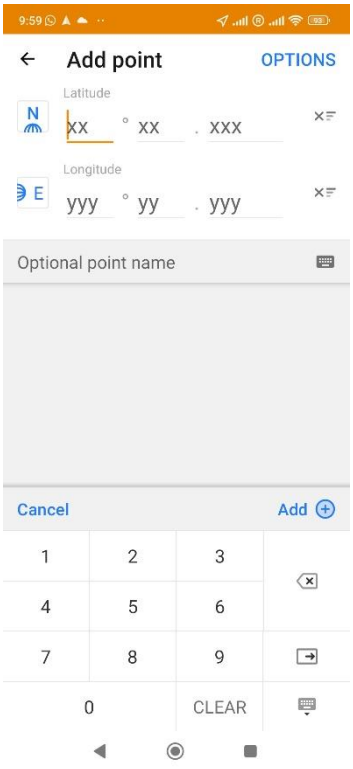
5. Start Navigation

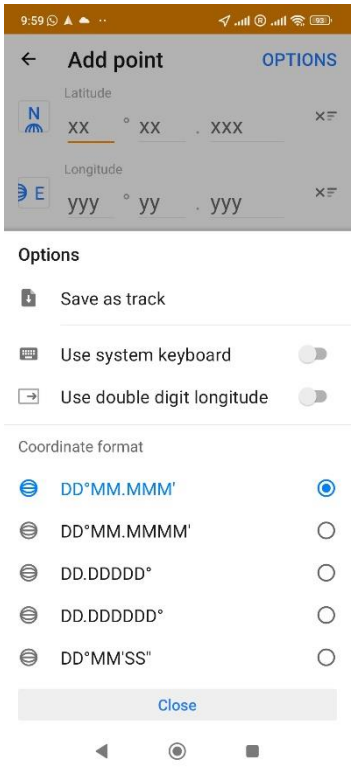
- Tap **Start** to begin navigation.
- Follow the turn-by-turn instructions and the map display.

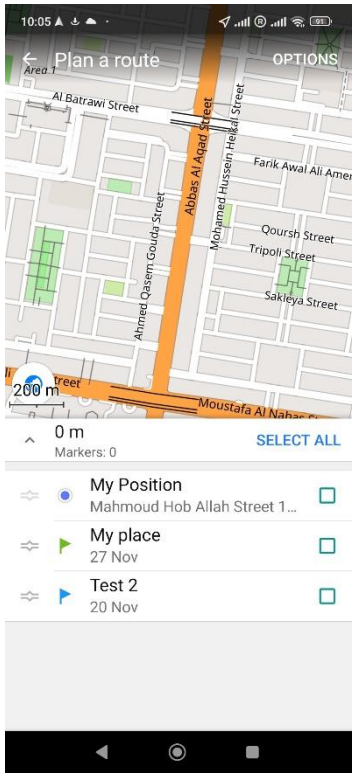
6. Offline Navigation

If you're navigating offline, ensure:

- You have downloaded the relevant map for the region under **Menu → Download Maps**.
- Offline routing is enabled.







Tracking

To create a track in OsmAnd (record your movement or define a route), follow these steps:

1. Enable Track Recording

1. Open **OsmAnd** on your device.
2. Go to **Menu → Plugins**.
   - Ensure the **"Track Recording"** plugin is enabled.
   - If not, tap to enable it.

2. Start Recording a Track

1. Tap the **Menu** (three lines or dots, depending on your version).

2. Select **"Track Recording"** or the dedicated button for it (a red circle or stopwatch icon).
3. Tap **"Start"** to begin recording your track.
- The app will track your movement and display the path on the map.
- You can pause and resume recording as needed.

3. Stop and Save the Track

1. Once you're done, return to the **Track Recording** menu.
2. Tap **"Stop"**.
3. Save the track by giving it a name and choosing a folder (e.g., "My Tracks").

4. View and Export Tracks

- To view saved tracks:
    1. Go to **Menu → My Places → Tracks** (or a similar section).
    2. Select the desired track to view it on the map.
- To export the track for use in other tools:
    1. Tap on the track.
    2. Choose **"Export"** and save it as a **GPX** file.

5. Manually Create a Track

If you want to create a route (track) manually:

1. Tap **Menu → Route Planning**.
2. Add waypoints by tapping points on the map or searching for locations.
3. Save the planned route as a track for later use.

Tips for Creating Tracks

- Use **Points of Interest (POIs)** to add stops or markers along the route.
- Customize your recording settings (e.g., GPS accuracy, recording interval) under **Settings → Track Recording** for better results.

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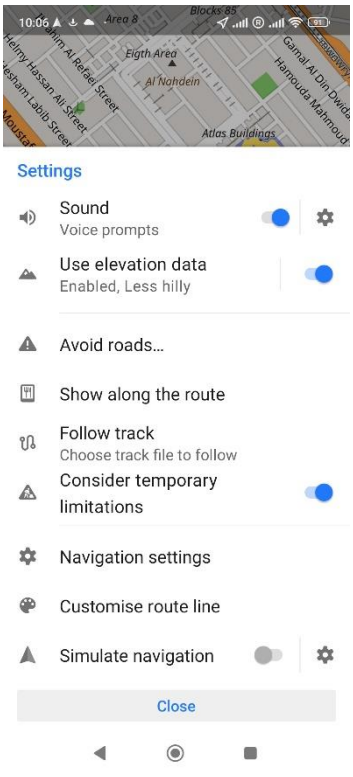
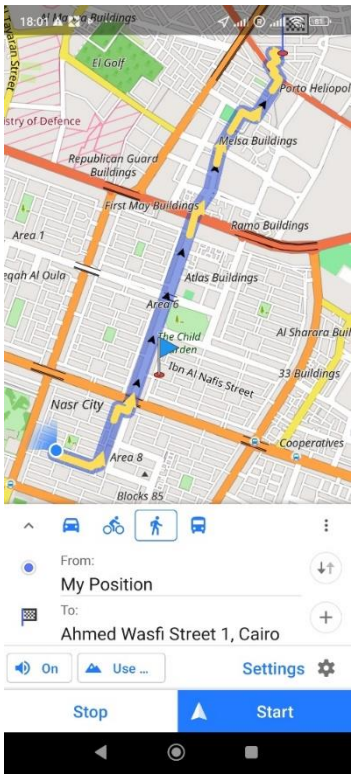
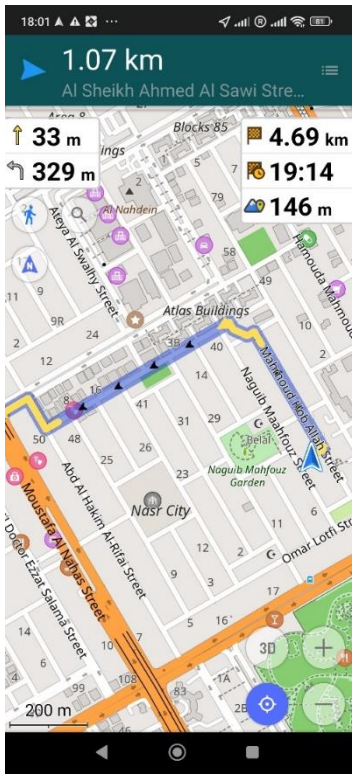






Accuracy

The **accuracy** of track recording in OsmAnd depends on several factors, such as GPS signal quality, device hardware, and settings. Here's how to ensure the highest accuracy when creating a track:

1. Optimize GPS Settings

1. **Enable High-Accuracy GPS Mode**:
    - On your device, go to **Settings → Location** (or similar).
    - Set **Location Mode** to **High Accuracy** (uses GPS, Wi-Fi, and mobile networks).
2. Use **External GPS Receivers** if your device's GPS isn't reliable.

2. Adjust OsmAnd Track Recording Settings

1. Go to **Menu → Settings → Track Recording Settings**.
2. Optimize these parameters:
    - **Recording Interval**:
        - **Time-Based**: Set to record every 1 second for high precision.
        - **Distance-Based**: Set to record every 5 meters or less.
    - **GPS Accuracy Threshold**: Reduce the threshold to a smaller value (e.g., 5 meters) to exclude imprecise points.

3. Improve Signal Reception

1. **Clear Sky View**: Ensure there's minimal obstruction (e.g., buildings, trees).
2. Avoid tracking indoors or in areas with poor satellite visibility.
3. Enable **Glonass or Galileo** (if your device supports it) for additional satellite systems.

4. Use OsmAnd Plugins

- The **"Track Recording" plugin** in OsmAnd is designed to handle GPS data more efficiently. Make sure it's enabled.

5. Monitor GPS Accuracy During Tracking

1. Tap on the GPS icon or location status to view current accuracy.
2. Wait for the GPS accuracy to stabilize before starting the recording (e.g., below 5 meters).

6. Post-Processing

If your track includes inaccurate points, you can:

1. Edit the track using tools like **QGIS** or **GPX editors**.
2. Use **OsmAnd's "Snap to Roads" feature** for smoother tracks when appropriate.

Expected Accuracy

- With optimal settings, you can achieve 2-5 meters accuracy in open areas.
- In urban or forested areas, expect less precision (5-20 meters).

Downloading data and importing to QGIS

The simplest method is to export a profile with the necessary data: Menu → Settings → Export → select the data that you want to export. Alternatively, you can backup all your data from the previous device by copying the folder located in Settings → OsmAnd Settings → Data storage folder (default path: Android/data/net.

To **download data from OsmAnd** and **import it into QGIS**, follow these steps:

1. Recording or Collecting Data in OsmAnd

1. **Record Tracks**:
   - Enable the **Track Recording Plugin**.
   - Record your movement or manually create a route and save it.
2. **Save Points**:

    - Use the **"Add to Favorites"** or **"Save Point"** feature to save specific locations.
3. **Export Data**:
    - Go to **Menu → My Places → Tracks** (or **Favorites**, if you saved specific points).
    - Select the track or points you want to export.
    - Export them as **GPX files**.

2. Transfer Data to Your Computer

1. **Export via Email or Cloud**:
    - Share the exported GPX file via email, Google Drive, or other cloud services from your mobile device.
2. **Direct Transfer**:
    - Connect your phone to your computer using a USB cable.
    - Navigate to the OsmAnd directory (usually under Internal Storage/OsmAnd/tracks).
    - Copy the GPX file(s) to your computer.

3. Import Data into QGIS

1. **Open QGIS** on your computer.
2. **Add Vector Layer**:
    - Go to **Layer → Add Layer → Add Vector Layer**.
    - Choose **File** as the source type.
    - Click **Browse** and locate the exported GPX file.
3. **Select Data from GPX**:
    - When importing a GPX file, you may see options like:
        - **Waypoints**: Saved points of interest.
        - **Tracks**: Your recorded path.
        - **Routes**: Planned routes.
    - Select the layer(s) you want to load and click **OK**.

4. Customize and Analyze the Data

- **Style the Data**:
    - Right-click on the layer in the Layers Panel and select **Properties** → **Symbology**.
    - Customize the color, line style, or marker shape for better visualization.
- **Attribute Table**:
    - Open the **Attribute Table** to view metadata (e.g., time stamps, elevation).
- **Perform Spatial Analysis**:
    - Combine your imported GPX data with other GIS layers (e.g., satellite imagery, administrative boundaries).

5. Optional: Reproject the Data

- GPX files are usually in the **WGS 84 (EPSG:4326)** coordinate system.
- If needed, reproject the layer to match your project's CRS:

- Right-click on the layer → **Export** → **Save Features As**.
- Choose the desired CRS (e.g., UTM).

6. Download OpenStreetMap Data (Optional)
For a more detailed base map:

1. Use QGIS's **QuickOSM Plugin**:
   - Install it via **Plugins → Manage and Install Plugins → QuickOSM**.
   - Query and download OSM data for specific areas directly into QGIS.
2. Or, download OSM data in formats like **.PBF** or **.OSM** from platforms like Geofabrik and load it into QGIS.

Exporting and importing Google Earth data into OSMAND

1. Export Data from Google Earth

1. **Open Google Earth Pro** on your computer.
2. **Create or Select Data:**
   - Create points, paths, or polygons using the drawing tools.
   - Right-click on your created features in the "Places" panel and choose **Save Place As...**.
3. **Save as KML/KMZ:**
   - In the dialog box, choose **KML** (Keyhole Markup Language) format.
   - Name the file and save it to a known location on your computer.

2. Import Data into OSMAND

1. **Transfer File to Mobile Device:**
   - Connect your phone to the computer and transfer the KML file to a known folder on the phone.
   - Alternatively, use cloud storage or email to send the file to your device.
2. **Open OSMAND App:**
   - Launch **OSMAND** on your phone.
3. **Import the KML File:**
   - Tap the **Main Menu (three horizontal lines)** in the top-left corner.
   - Select **My Places** or **Favorites**.
   - Tap the **Import** button (folder icon with an arrow).
   - Navigate to the folder where the KML file is stored and select it.
4. **View Imported Data:**
   - After importing, your Google Earth data should appear on the map as favorites, tracks, or waypoints, depending on its content.

3. Field mapping with QField

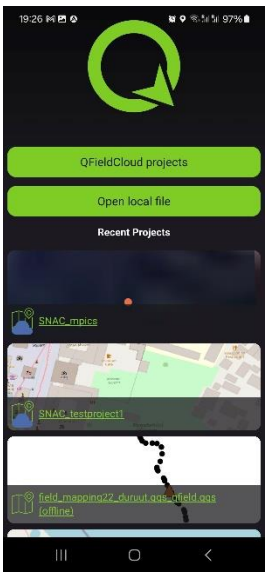
Introduction to QField

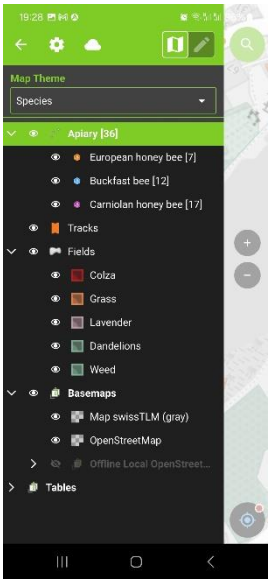
Open QField on your mobile device and explore the app as we go through it below.

Open a QField project

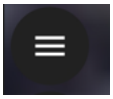
- search for and open the QField app on your smartphone
- On the first screen you see, choose *open local file* > *sample projects* > *Bee Farming*

Below you see screenshots of the welcome page and the project page with layers in QField





- If you work with a cloud projects, it is opened by choosing *QField cloud projects*.

Main menu is available from this symbol  in upper left corner

- It display maplayers and main options, including settings (1) and choice between browse and digitize mode (2)
- 

Settings (1) – this is where you choose different settings for QField

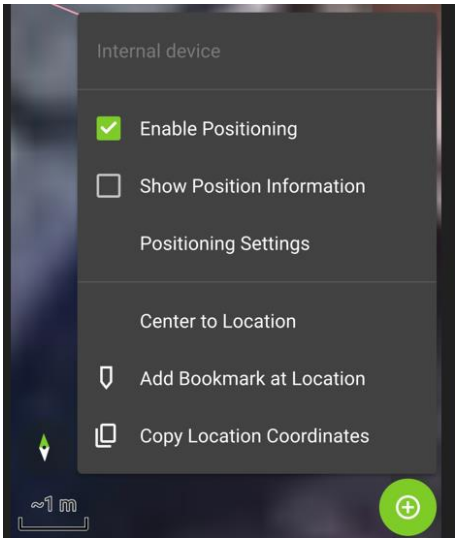
- General
  - Fast editing mode – when activated it provides auto-save like functionality
  - Allow finger tap – when activated editing with fingertapping is possible
  - Maximized attribute forms – convenient to activate if the project has long forms
- Positioning
  - Activate accuracy indicator – will show the signal quality
- Variables
  - Nothing needs to be adjusted here

Navigation in the map

Use fingers to zoom in/out, or + / - button 

Activate GNSS

Tap positioning symbol in lower right corner  to activate the internal GNSS – hold symbol to see options like *settings* and *enable/disable positioning*.

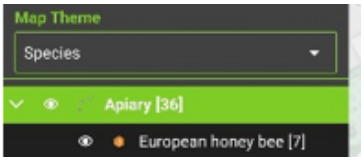


Locking/Unlocking coordinate cursor

Tap/untap coordinate cursor symbol  to lock/unlock the cursor to the GNSS position in the map display. If the coordinate cursor is locked, a new observation will be added at the GNSS location. If the coordinate cursor is unlocked, a new observation can be added anywhere in the map. You select the position by moving the cursor/map to the position of interest.

Adding features

- *Digitize mode* must be activated in the main menu 
- Choose layer to be edited by marking it in the layer panel
- Use green + symbol in lower right corner to start editing; a cross hair cursor will appear. Press to add feature
- Fill form that appears and press tick mark in upper left corner to save.



Practical Task

- Explore the map and functionality in the app on your own
  - tap on points and polygons and see what kind of information is stored
- add features to the Apiary layer

- notice the type of information and how it can be added to the survey form, for instance for
    - number of boxes:
    - species of bees:
    - beekeeper
    - infected

Further information

If you want more information about QField, this presentation online gives a nice overview:

https://docs.google.com/presentation/d/e/2PACX-1vTpKzkE5hNacnM2vs1n474ataaNl1_jALcdHSrTGcRGaQBCnG3pSUCNhGS8XMd55ubEN9qtXaxTkjm3/pub?start=false&loop=false&delayms=3000#slide=id.g19d62a80706_0_326

You will also find documentation of QField at https://docs.qfield.org/

QField - Designing customized forms

The design you just explored in QField is set up in QGIS. The type of information you can fill in a form is decided by the aims of your fieldwork. In this section you will learn how to make layers with fields that can contain exactly the information you want to collect.

When you specify the fields needed, it is important to choose the correct *data type*. Data type decides which type of information that can be saved in the field. If for instance you want to add a textual description, the field must be of data type *text (string)*. **For more info, revisit video PLANNING FIELD MAPPING.**

You can add as many fields as you like in a layer, and with any combination of data types. As mentioned above this is decided by the aims of your field mapping project.

In addition to the fields you specify, there is one field that always needs to be present in a layer. This field is automatically generated by QGIS when you make a new layer and is called FID. This gives a unique code for each feature that is added to the layer. If you use a notebook to add additional observations during fieldwork, note this unique FID down, as this will be the key to connect notes to your spatial data.

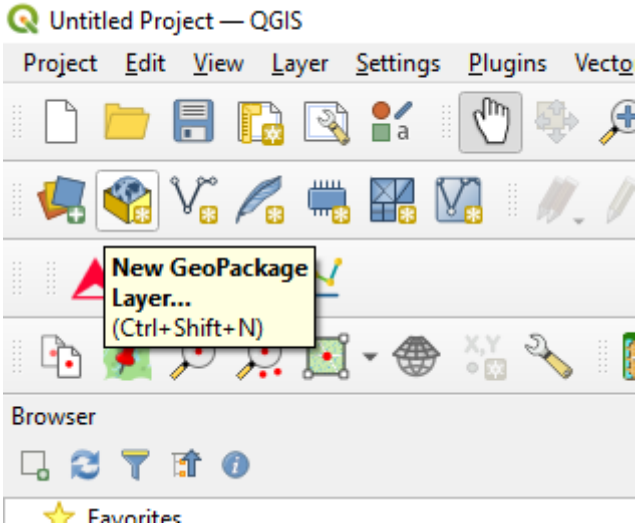
Making a GeoPackage database

In order to use QField for field mapping, you have to design your own survey form. That means to decide which features that shall be mapped, like you just have explored with the Bee Farming project in QField. The process for doing so is **explained below**.

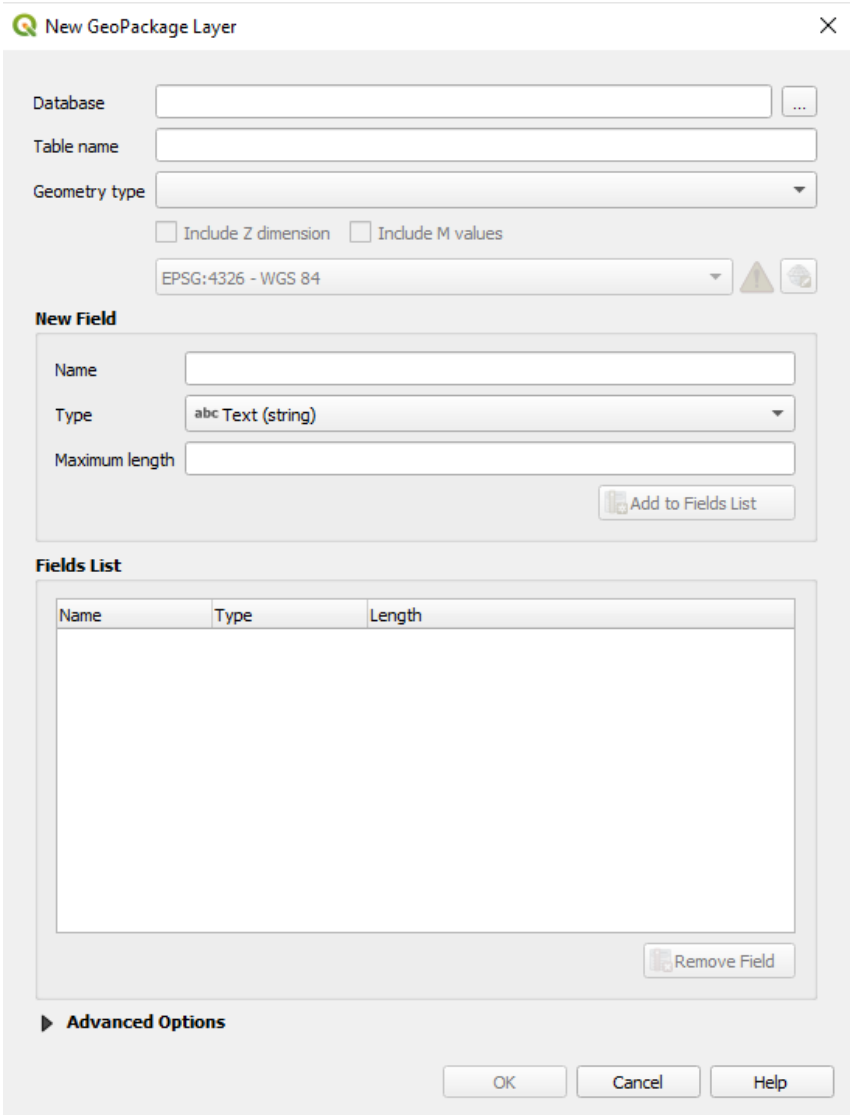
As mentioned above, the geopackage format is a database that can contain several layers in one package. It is therefore convenient to use together with QField. You will now create a geopackage with a vector layer. You will also prepare the attribute table with the set of columns (also called fields in GIS) that is needed for storing attributes for your fieldwork observations.

- For this training, **make a new folder** in your SNAC_workshop folder called *QField_training* and save all data there.
- Open a new project in QGIS and save it as ***fieldmapping.qgz* from *main menu* > *Save as***

To create your own GeoPackage navigate to **New GeoPackage Layer** in the Toolbar.



A new dialogue will open, where you have different setting options.



First, specify where you want to store your GeoPackage and choose a suitable name of the file. The file extension for geopackages is *.gpkg. A geopackage can contain many layers. The name of the layer is given under “table name”.

- Name your **database** *fieldmapping* and set **Table name to** *survey*. Store it in the folder *QField_training* that you just created

Under Geometry type you choose which type of geometry you want to map. This depends on how you have decided to represent your geographical features **at the scale you are working on**. For instance, is it points (e.g. trees), lines (e.g. roads) or polygons (larger areas of e.g. buildings or ponds). **See video *Planning field mapping* for more information about representations**.

In this case, choose points.

Now you can set the desired Coordinate Reference System (CRS) (See video FIELD MAPPING USING MOBILE APP). **In Sudan WGS84 zone 36N or 37N is appropriate; 37N fits best in the east!**. These systems are projected in meters. You can also use WGS84 that will give positions in latitude and longitude.

Under the New field section, you can specify **which fields you need in your attribute table and which data types they should contain.**

Assign a name, data type (Text, Integer, Decimal**,** Date **…**) and click on „Add to fields list“.

In the **table** below you are given an example of a simple attribute table for **a general field survey form.**

- What information is needed depends on the features you want to map!
- Also note that the space available for the name of the field is limited

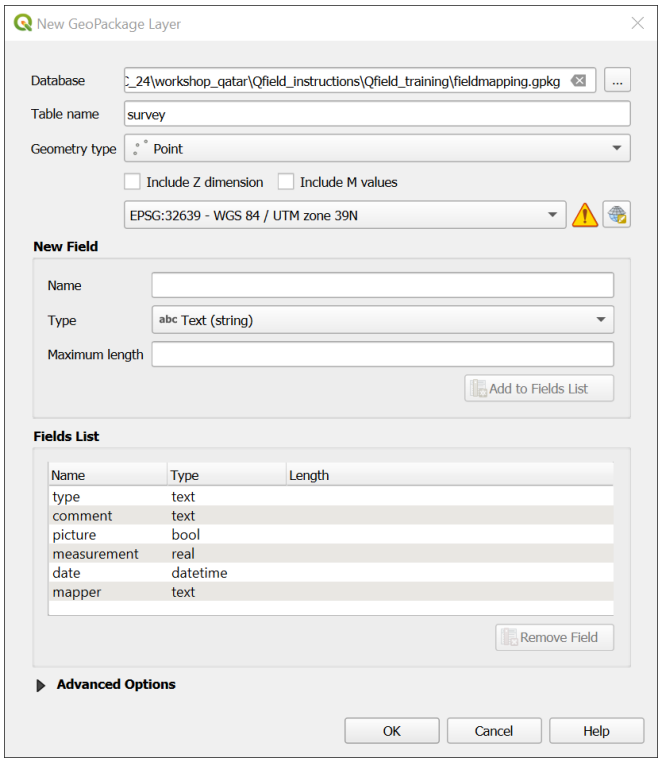
Name	**Data Type**	**purpose**
type	Text (string)	Define broad classes of observation
comment	Text (string)	Add additional information about your observation
picture	Boolean	Tick if you have taken a picture. This can be handy if you have an additional camera that is used. In that case another field with picture name could be recommended.
measurement	Decimal (double)	A field where a measurement can be added. It allows decimal numbers to be stored. The data type *Integer* also allows numbers to be stored, but without decimals.
date	Date & time	To record date and time. Should always be part of your form. It can also be used to link other information, like sound recordings or videos
mapper	Text (string)	Name of mapper / fieldworker

Here is an example of what it should look like for this training:

As soon as you are **done with the** fields you can confirm by clicking OK.

Remember to save your project every now and then.

Now the geopackage is ready to be **further formatted before use in** QField.



Customizing fields with appropriate datatypes

In this part you will learn how to add and edit fields in the attribute table and add useful settings that can help streamline your mapping in field. This includes functionality that you have seen in the Bee Farming project, like selecting predefined classes (species) from a list.

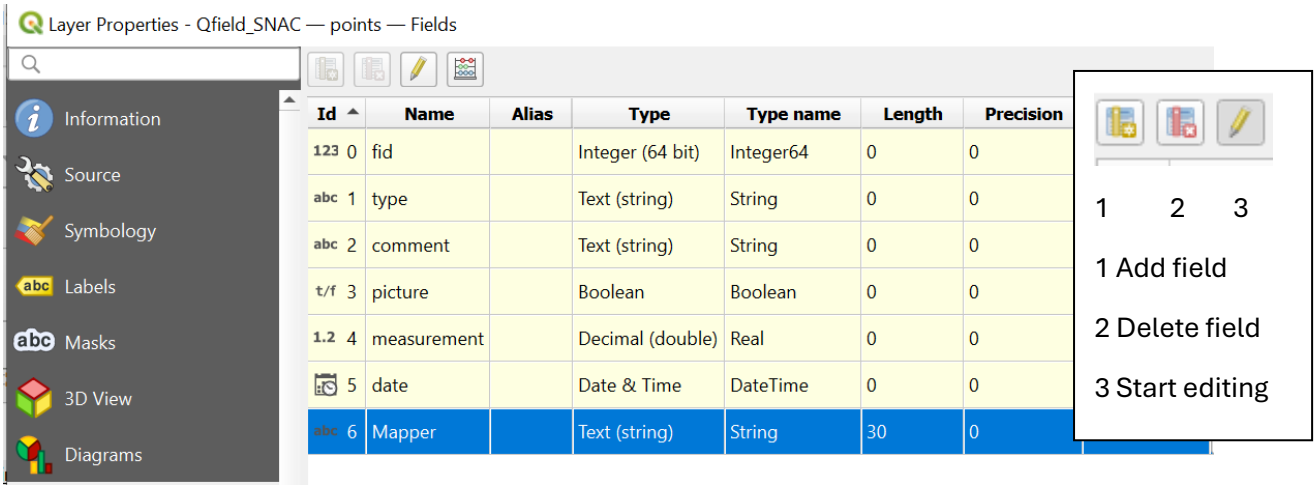
Edit existing fields and create new ones

Open the attribute table to inspect the fields it has now.

- Mark layer in layers panel > right click > open attribute table

In order to get an overview of the settings for each field, open Fields in Layer properties:

- Mark layer in layers panel > right click > layer properties > Fields



Type and *Type name* refers to the data type for each field.

In the fields view you can edit field names and add and delete fields from the toolbar:

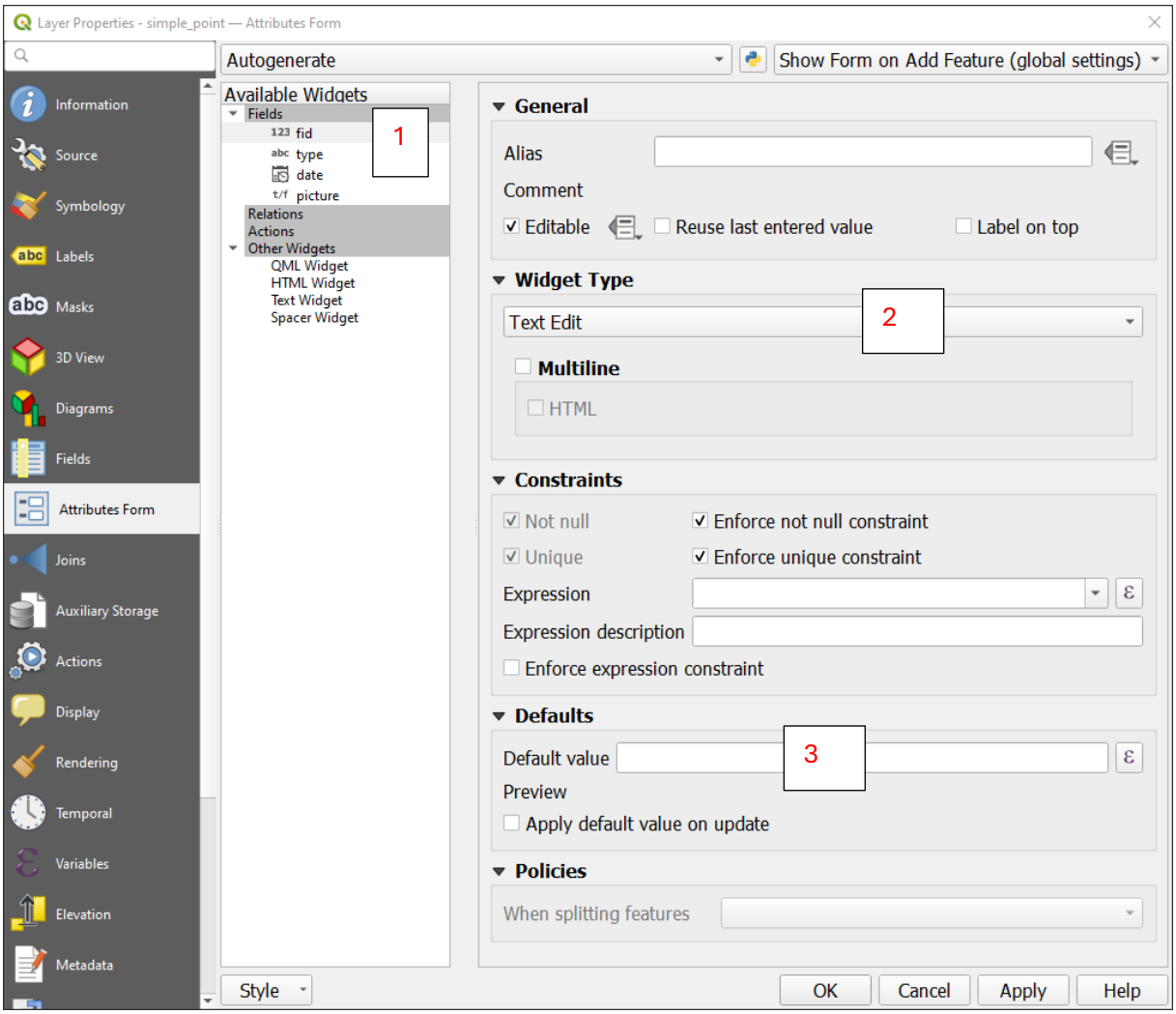
- Now, if necessary, edit your fields until you have the same fields and datatypes as in the above image.

Notice that in existing fields you can only change *Name*.

For an overview of what the intention with the different fields are, revisit the table in the section above.

When you have all the above fields, the next step is to define how the fields should be filled. This includes choices like automatic filling of values (useful for automatic date and time, or running numbers) and defining codes/allowed values from a dropdown menu (useful for avoiding typo-errors and unwanted values).

Such refinements are available from *Attributes Form* in the properties window. You will become familiar with the options here through the steps below.



Add running, unique IDs in a field

Choose *fid* from the list under Fields (1)

Under **Widget Type** (2), choose *Text Edit*, and under General tick *Editable,* as seen in figure above

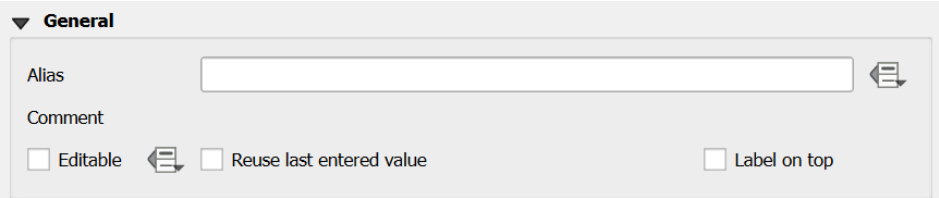
Widgets allow you to edit data in various different ways. You will be familiar with more of them below.

Under Defaults > default value (3), type `$id` This code ($id) automatically generates running ids.

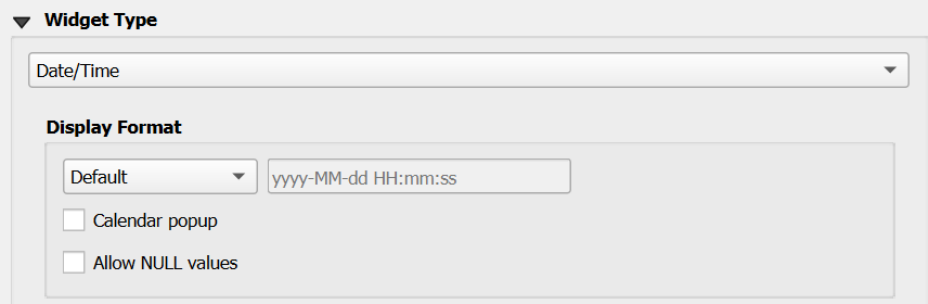
Add automatic date and time in a field

Choose *date* from the list under Fields (1)

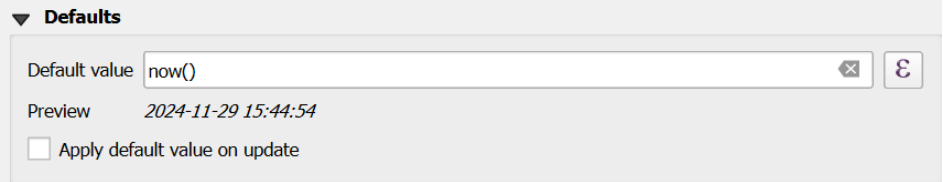
Under **General**, untick *Editable*. This will make it impossible for someone to change the date. In some cases, it can be good to know when an observation was first registered.



Choose the **widget type** Date/time and fill it like this:



Under **Defaults**, fill it like this



The code *now()* generates the date and time for this moment.

Add default values in a field

Choose *type* from the list under Fields

- Under **Widget Type**, choose Value Map

This tool allows you to define allowed values. You must give a Value and Description. *Value* is what will be stored in your attribute table, *Description* is the choice visible for the mapper.

Use this table to fill in the Value Map:

Value	**Description**
Other	Other observation
Cult_heritage	Cultural heritage
Botany	Botany and vegetation
Landscape	Landscape observation
Hydrology	Hydrology and wells

- Under constraints, tick not null (5). This reminds the field to be filled by the mapper.

Add checkbox

Choose *picture* from the list under Fields (1)

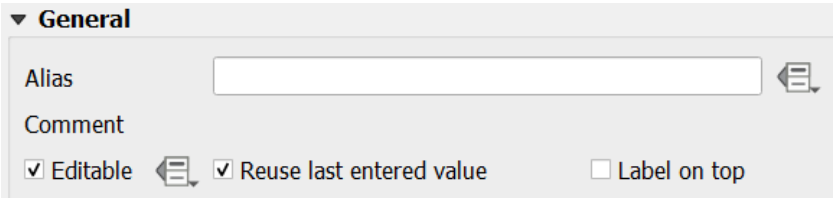
- Under **Widget Type**, choose Checkbox

Other useful settings

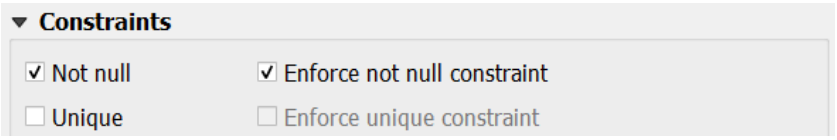
mapper field:

If several persons use the same layer for mapping, it is convenient to add the name of the mapper. In this example we use data type *text* and the name has to be typed in for each observation. Luckily it is possible to avoid repetitive typing of names:

- Under **General**, tick "reuse last entered value"



- Under **Constraints**, tick both "Not null" and "Enforce not null constraints" – this forces the mapper to fill this field. Notice the difference between "Not Null" and "Enforce not null constraints"

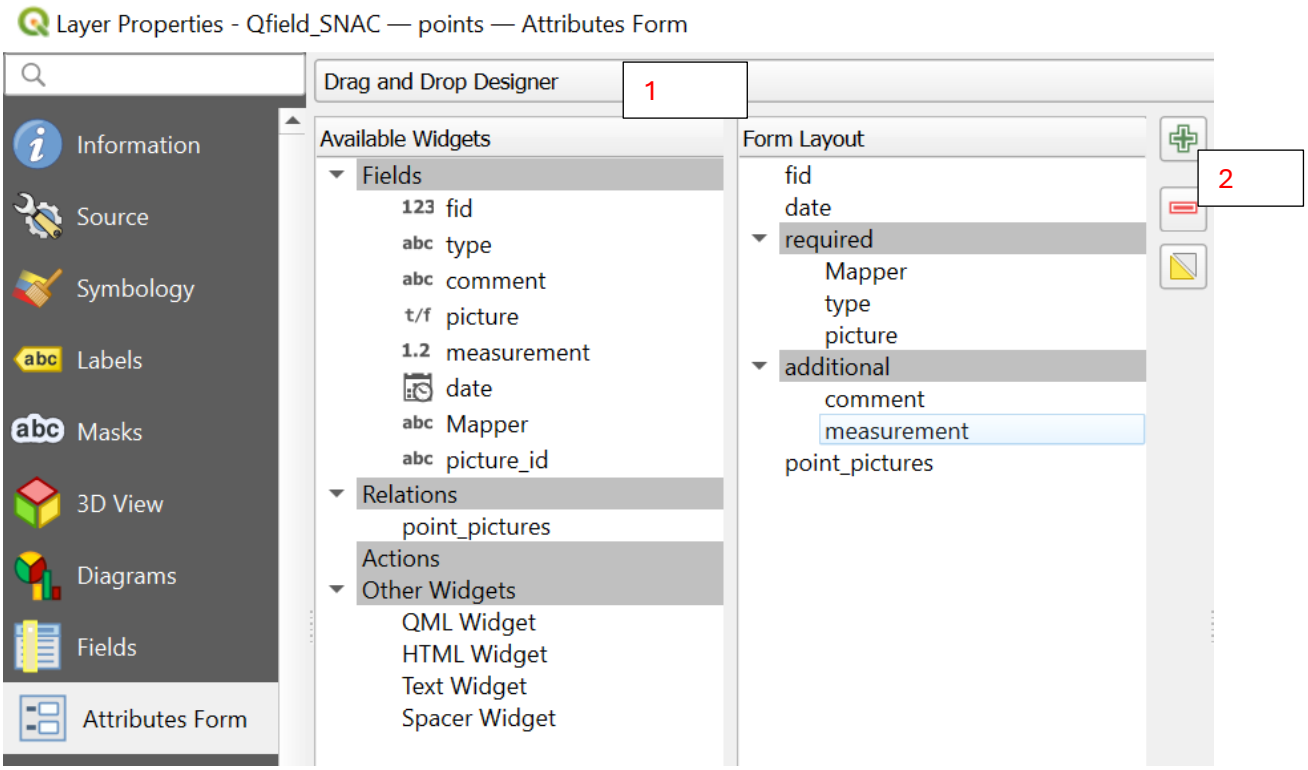


- Finally for the **field *measurement*,** choose **widget type** *text edit*. This allows the mapper to type in the measurement. You can also explore the range widget that is another possible widget for data type *decimal (double) (Real)*.

Designing attribute forms

In this section you will learn how you can organize the requested input information in a tidy and organized manner. The design you generate in QGIS will be what you get in QField.

In Attributes Form, change from *Autogenerate* to *Drag and Drop Designer* in the upper part of the window (1). A new panel appears called *Form Layout*. This helps create a structure with groups of data input under headings that you decide.



The plus and minus buttons (2) add and remove groups/levels in the layout. Fields can then be dragged and dropped under the group labels.

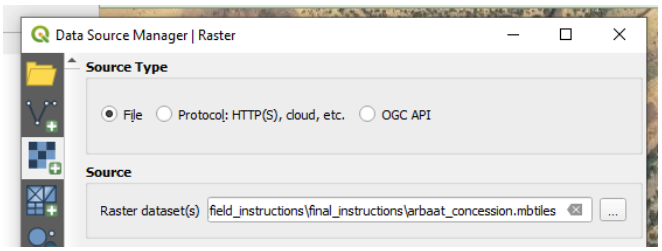
- Start by adding a group (plus sign) called *Required*
- Drag and drop the fields *mapper*, *type* and *picture* below it
- Add another group called *Additional*
- Drag and drop the fields *comment* and *measurement* below it

You don't have the relation called point_pictures in your dataset, so you can skip that. This will be added in Part 5 and is used to add pictures to your database.

Add basemap and layers to project

So far you have not added any basemap to your project.

- Add google satellite basemap in the same manner as you did in Part 1 Adding basemaps via plugins.
- In addition, we will add an offline version of google satellite of the field area in Arbaat
    - Go to Layer > add layer > add raster layer
    - Navigate to the folder Data/Part3/basemap/ and select the file *arbaat_concession.mbtiles*
    - Click ok
    - If you turn off the google satellite basemap you'll see the extent of the layer you just added. Zoom to layer if needed (*right click layer > zoom to layer*)



- If necessary, rearrange the layers.

Add test points and define symbology

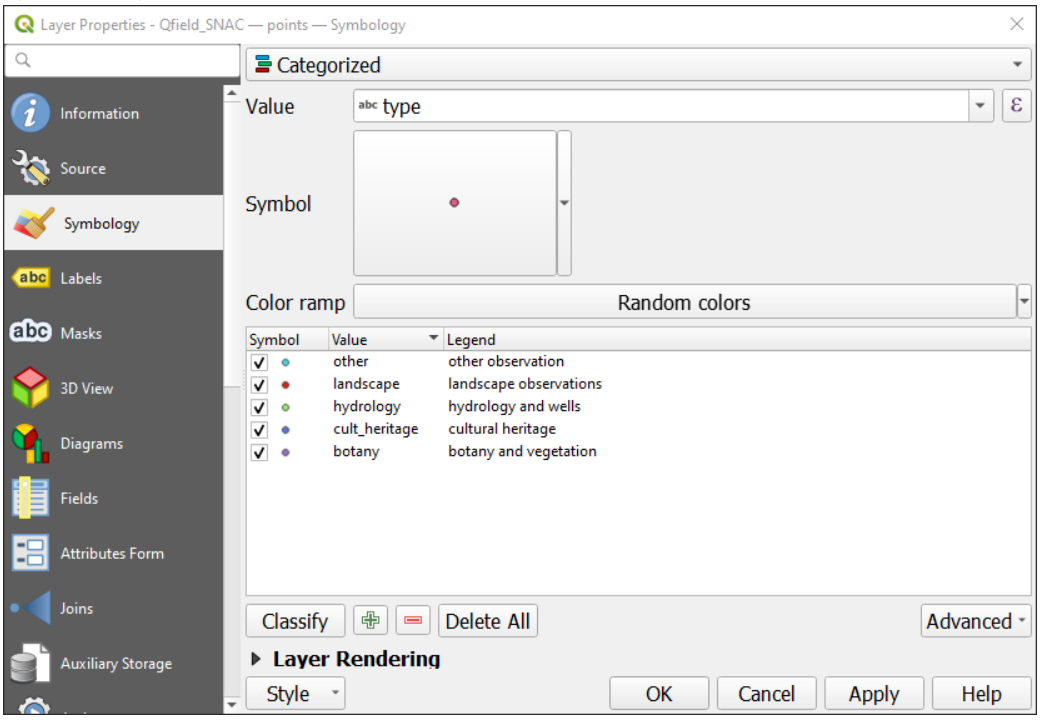
In QField the features you add will be displayed on the map with the same symbology as you have defined in QGIS. Now you will test your setup by adding one point for each of the *types* you have defined.

On the Digitzing toolbar, make the layer editable  and use the add points tool  to add points

Check that adding information works as expected compared to the widgets you have added above.

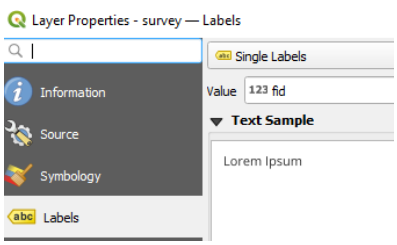
When done, save changes  and check in the attribute table that you have one feature for each type (i.e. 5 points)

Open the symbology window from the layer properties and use the *type* field as Value to symbolize your features. Click OK when done.



To make it easy to keep track of recorded observations, it can be good to activate labelling. This will label each point with, for instance, a unique code as stored in the column *fid*.

- Go to layers panel, select survey layer and right click > select *Show labels*
- Open *layer properties* > *Labels* and fill like this to label observations with *fid*



Tracking

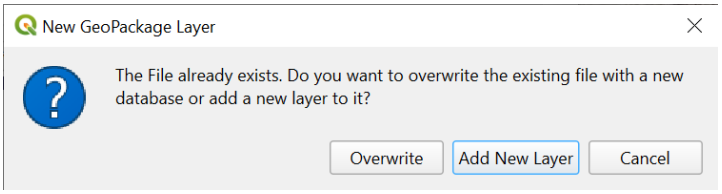
Tracking your movement is very convenient when you are working in field. You can track your movement either in a point feature layer or in a line feature layer. When you start tracking in QField, you can decide how often you want your position to be stored. The frequency depends on how much detail you need, and how fast you are moving.

If you save your track to a point layer, each point can store date and time[1]. This is very useful, for instance if you take pictures or record videos or sound that do not have a geotag. In such cases you can connect such recordings to your track via the date and time information.

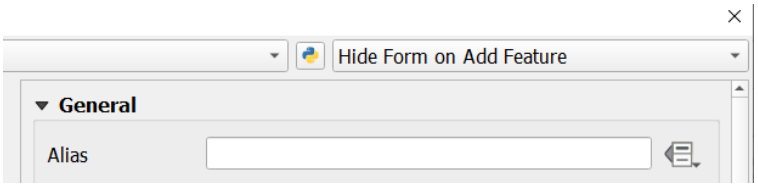
In this example, you will prepare a point layer for tracking.

Create a new point layer in your geodatabase as you did earlier in the exercise (Making a GeoPackage database). Call it *tracking*.

- Add a new field that can store *date and time*. When you click OK to create the layer, choose "Add new layer".

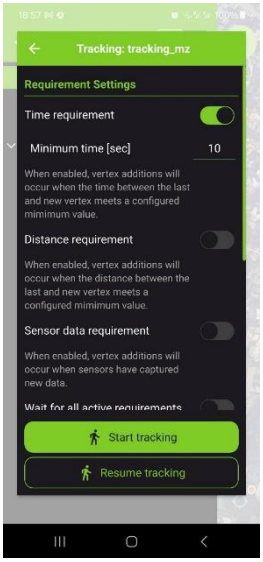


- In the *attributes form*, define the **date widget** as we did above (Add automatic date and time in a field).
- To avoid the form popping up each time a new point is added, choose "Hide form on add feature" in upper right corner.



- Click apply when you are done. If needed save your edits.

In QField you start tracking by long-pressing on the tracking layer. This window will appear where you can choose to track by time or distance:



You can read more about tracking here: https://docs.QField.org/how-to/tracking/ or in the supplied pdf-file: Data/Documents/Tracking - QField Ecosystem Documentation.pdf

Practical Task:

If you have time, design a new layer (polygon, point or line) with customized fields and a form that can be useful in your field of studies. PS ! This can also be done later when you have more time 😊

[1] If you track as a line, the line will receive date and time information when you start tracking. Each vertex (point on the line) can store M-values (has to be chosen when you create the layer), which means seconds since tracking started.

From QGIS to QField

We are nearly there!

Before exporting your project to QField, make sure you save the latest version. If you have any layers in the project that you don't want in QField, remove them from the project.

The following layers should be in your project:

- Survey (from fieldmapping.gpkg)
- Tracking (from fieldmapping.gpkg)
- Arbaat_concession.mbtiles (raster layer)

Save again if necessary.

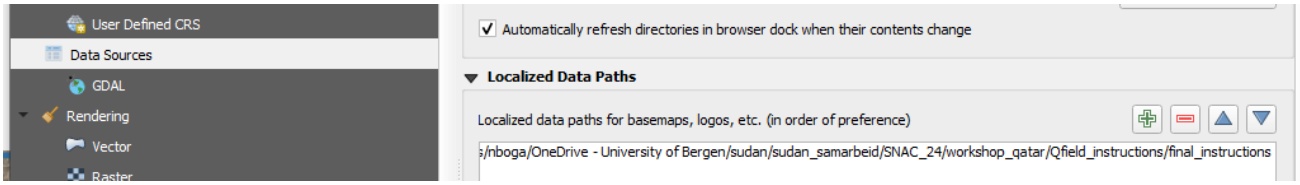
Configuring offline basemap

The raster layer Arbaat_concession.mbtiles makes it possible for us to have a high resolution basemap offline during fieldwork.

PS! You can create this file on your own for any area of interest, as explained in Part 5: Generate basemap for offline mapping.

Since this raster layer is a large file (for instance too large for QFieldCloud, see Part5), we need to set one setting in QGIS and manually copy the file to our mobilephone.

- Go to Settings > Options > In the window, locate Data Sources > Localized Data Paths
- Use the + - sign and navigate to the folder where the mbtiles-file is stored (folder Part3/basemap) in order to add the path. It should look something like this (the exact path will vary from computer to computer)



- Click OK

In this way we tell QField to look for a copy of this file on the mobile telephone in an internal folder called basemaps under QField

PS! You must copy the raster file to your mobile phone. Follow these steps

- Connect your mobile to the computer
- Navigate to this folder on the mobile
  - /Android/data/ch.opengis.qfield/files/QField/basemaps
- Copy Arbaat_concession.mbtiles to this folder

Transfer of project via folder import / export

There are different ways to transfer your project to your mobile device.

1. Transfer a folder with all project content to the device using e.g. a cable

2. Transfer the project using QFieldSync Plugin, either with a cable or via a cloud solution (QField Cloud).

What we recommend in this course is option 1. Option 2 is explained in detail in Part 5.

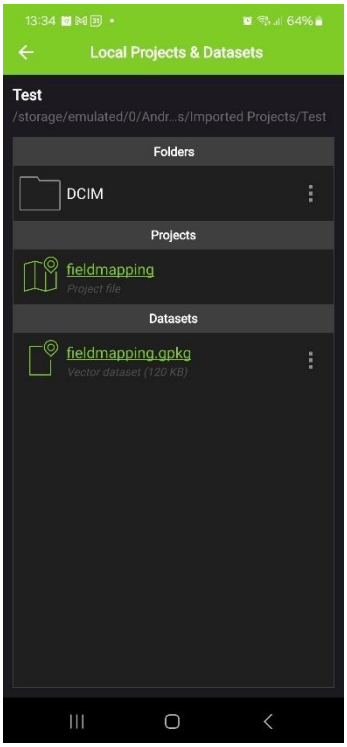
Before you transfer your working folder (should be *Qfield_training* in your case) make sure that all your layers are stored in that folder.

Use file explorer to see the content of the folder. It should contain:

- Fieldmapping.gpkg and
- Fieldmapping.qgz

Save and close your QGIS project.

Now transfer the project by following these steps:



- Copy the Qfield_training folder to your mobile device, e.g. by using a cable. Note where on the device you save the folder.
- Open Qfield and choose > Open from local file
- Press + symbol > import project from folder > navigate to the location where you saved your folder and press “use this folder”, and if needed accept Qfield to access files in the folder by pressing *Allow*
- You will see an overview of the imported content and can open the project by pressing the name of the project; *fieldmapping*
- The project opens and you are ready to start collecting data.

PS! Before going to field check that everything works as expected by adding some test observations.

Getting data from device to computer

If you don't have any attachments (pictures etc; see below if you do) stored in the geopackage, the easiest way to export the data is to open the project in QGIS, choose *Settings* > *Project folder* > *press the 3 dots behind the geopackage* name and choose one of the options there:

- Send to – this will send the file using any of the apps on your device, e.g. whatsApp
- Export to folder
    - Navigate to the folder where you want to save your geopackage. If needed, create a new folder.
    - Connect your phone to the computer and transfer the file.

Getting data from device to computer when you have attachments:

If you have added attachments to any layer, they are stored in a separate folder called DCIM. To get all the data, pictures and geodata in one go it is recommended to export all the data belonging in the project to a folder.

Connect the phone to your computer. On the phone's storage, create a folder called Qfield_export.

If Qfield is open, close and reopen it. On the front page, choose *open local file* > *Imported projects* > *press the three dots behind your project name* (same name as your original folder name) > *Export to folder* > Navigate to the Qfield_export folder you just created > select "use this folder" and accept any questions about permissions.

Now copy that folder to your computer and open the qgis-project file inside it.

Some tips about working with field data after fieldwork

When you are back from fieldwork you typically want to analyse and visualize your data, and how you can make a map is explained in more detail in the next section. But it is important work after fieldwork to go over and control the quality of your data and correct any obvious errors. Unfortunately, there is not time in this workshop to cover this, but here are some tips with links to more information:

- inspect all the collected geographical data to make sure there are no obvious errors, like points/features outside the field area. If possible, reposition them by editing the layer. You can read more editing/digizing here: https://docs.qgis.org/3.34/en/docs/user_manual/working_with_vector/editing_geometry_attributes.html#digitizing-an-existing-layer
- inspect your attribute table for errors, like obviously wrong measurements or spelling mistakes etc. You can symbolize the data using any of the columns and this can give a clue about possible mistakes. You can also sort the columns in increasing/decreasing order to see if values are in expected range. If you need to edit data in the table, start editing by choosing the pencil symbol.
    - PS! If you edit your table, always remember to keep a copy of the original version!
- You might have notes in a notebook that you want to include in your attribute table. You can create a new field (as you did when you made the survey layer) and add info manually by punching your notes into the attribute table. An alternative way is to write up all your notes in e.g. Excel and save it as a delimited text file, and *import the table* to QGIS and use the *join-tool* to connect this table with the attribute table. In either cases, you will have to use an identifier to connect the two. In most cases, this will be the column *fid; that's why you should also note the fid down if you make handwritten notes for an observation*
    - Importing delimted text file: https://docs.qgis.org/3.34/en/docs/user_manual/managing_data_source/opening_data.html#index-9
    - Joining table to attribute table: https://docs.qgis.org/3.34/en/docs/training_manual/database_concepts/queries.html#joins
- If you have geotagged photos from field work, they can also be imported in your GIS-project. Here's an explanation of how: https://mapscaping.com/adding-geotagged-photos-to-qgis/

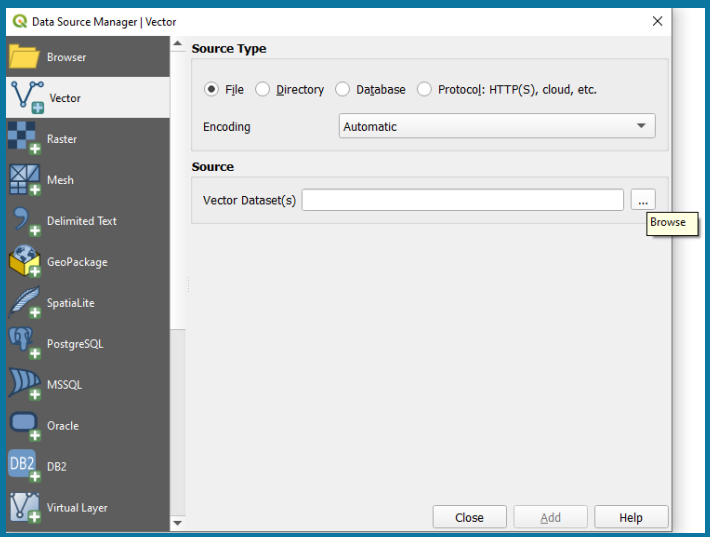
4. Making a final Map Layout of the field area

In this section you will learn how to make a final map representation of your field data. It builds on what you learnt in part 1: Create a Layout

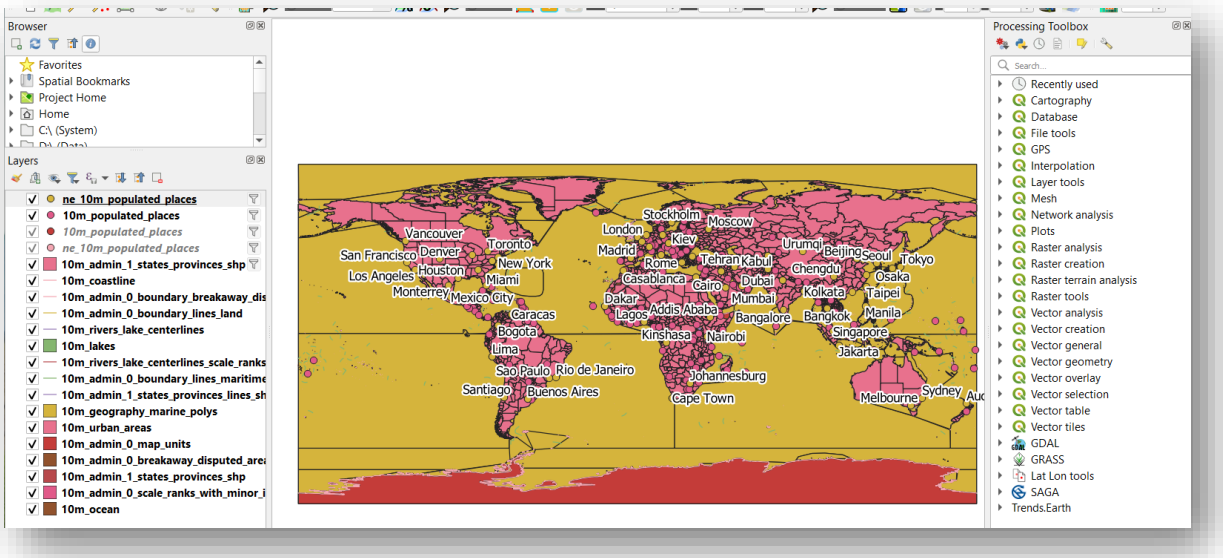
Creating an overview map of Sudan

In the Data folder navigate to Part4/Natural_Earth_quick_start/ and locate the QGIS project file (*Natural_Earth_quick_start_for_QGIS.qgs*) and double-click to open it.

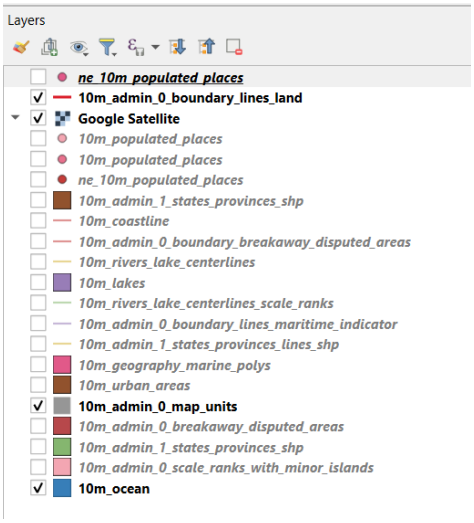
For future projects: You can add any wanted vector data via the Data source manager.



When opened, the project will look something like this (note that the colours may be different):



Zoom the East coast of Sudan.



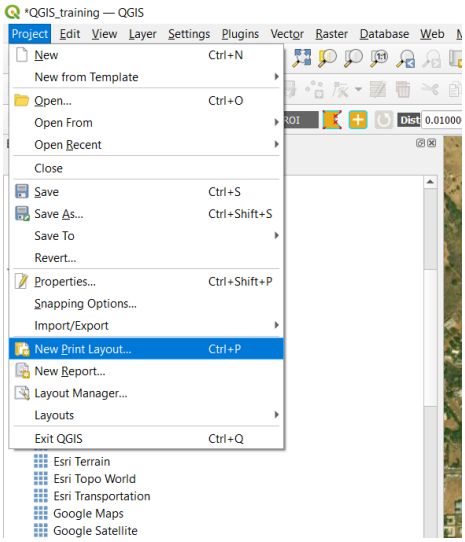
It can be a bit distracting if every layer is activated. Go ahead and try turning some off until you think the amount of information is right and the visibility is good.

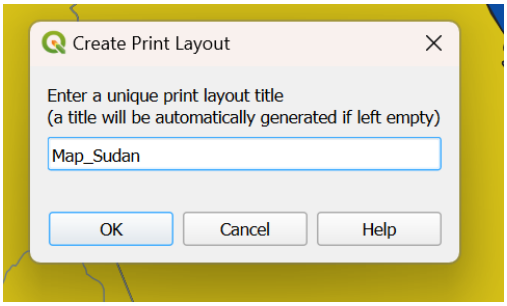
You can also re-arrange the order of the layers by dragging the ones to the top of the list, that you want to display on the top.

Identify the layers you want to include in your overview map and symbolize them as explained in Part 1: Changing Layer Symbology.

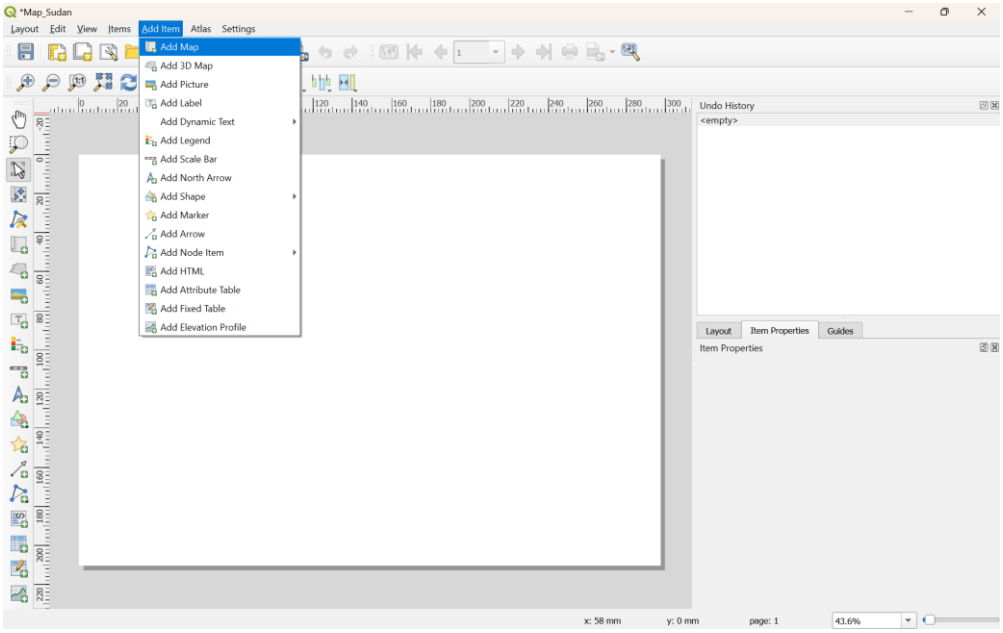
- Change the layers you want to use into sensible styles and colours.

Open a new print Layout by going to **Project → New Print Layout** and give it a title, for example, Sudan_Layout. A new window will open.

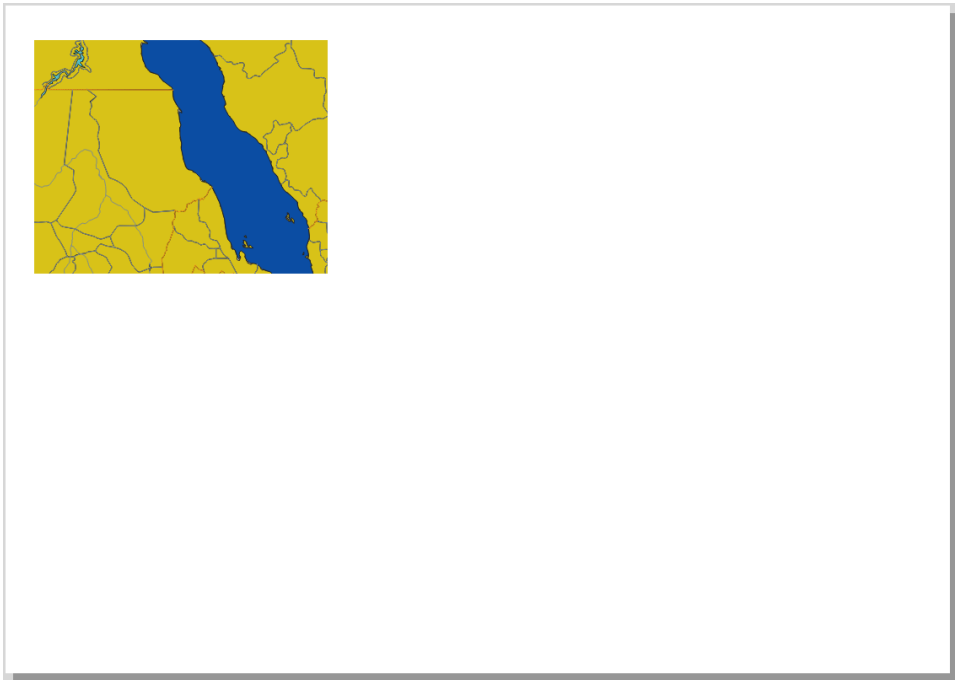




When clicking **Add item → Add Map** you can choose the area of the canvas which should be covered by the map by drawing a rectangle. You will need space outside the map for text or other elements.

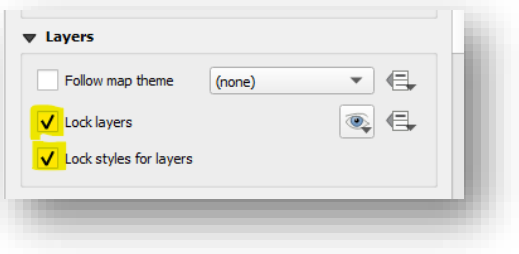


Since this map is not going to be the man focus, you can leave it rather small. We will add another map and other elements in the next steps.



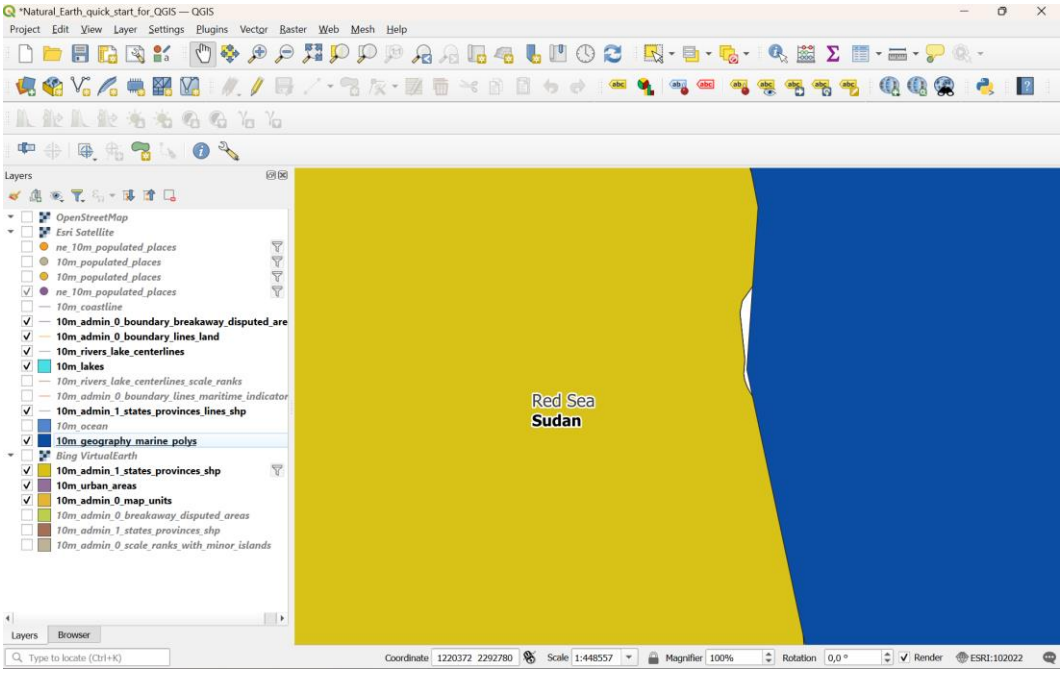
Click on the map once and you will see that a pane called **Item Properties** opens on the right side. Here you can adjust certain properties such as **scale** or CRS.

Now we want to insert another map. Before doing so, make sure that the layers and their styling are locked so that we can insert a second map on top the first map without affecting the first one.

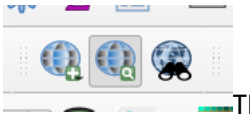


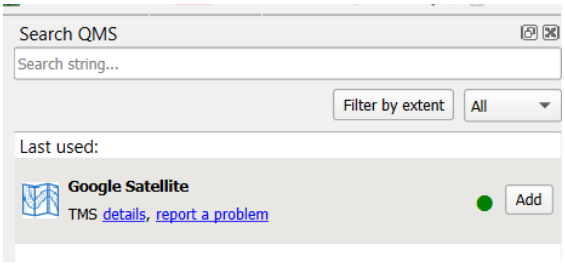
Adding a map of your field area

We often wish to have multiple maps displayed on a graphic or page, for example, with an inset map that shows the general location for an area displayed in greater detail. We'll create such a map in learning the rudiments of layout styling. Go back to the QGIS main window and zoom in to the area you want to highlight. **In this example we have used Port Sudan, but you should zoom into the field area you have visited.**



Now add another basemap from QuickMapServices tool. Open the tool and select Google satellite.

PS! You can also use the Search QMS tool.  The panel will be activated on the right side of QGIS main window. Here Search for Google Satellite and click add.

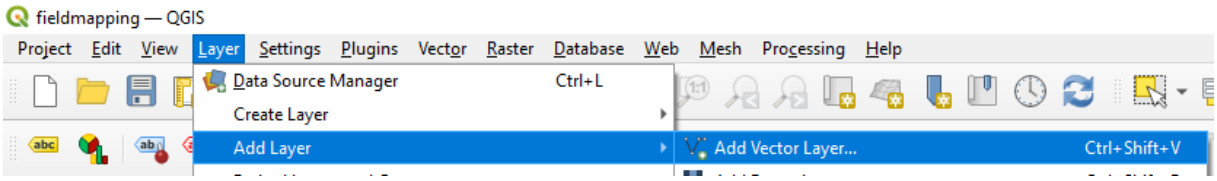


Make sure that Google Satellite basemap is visible, either by putting it on the top of the layer list or by adjusting the ordering and visibility of other layers.

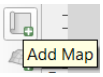
PS! If you don't have wifi, add the Arbaat_concession.mbtiles layer and use it as a basemap.

Now add your field data to the project:

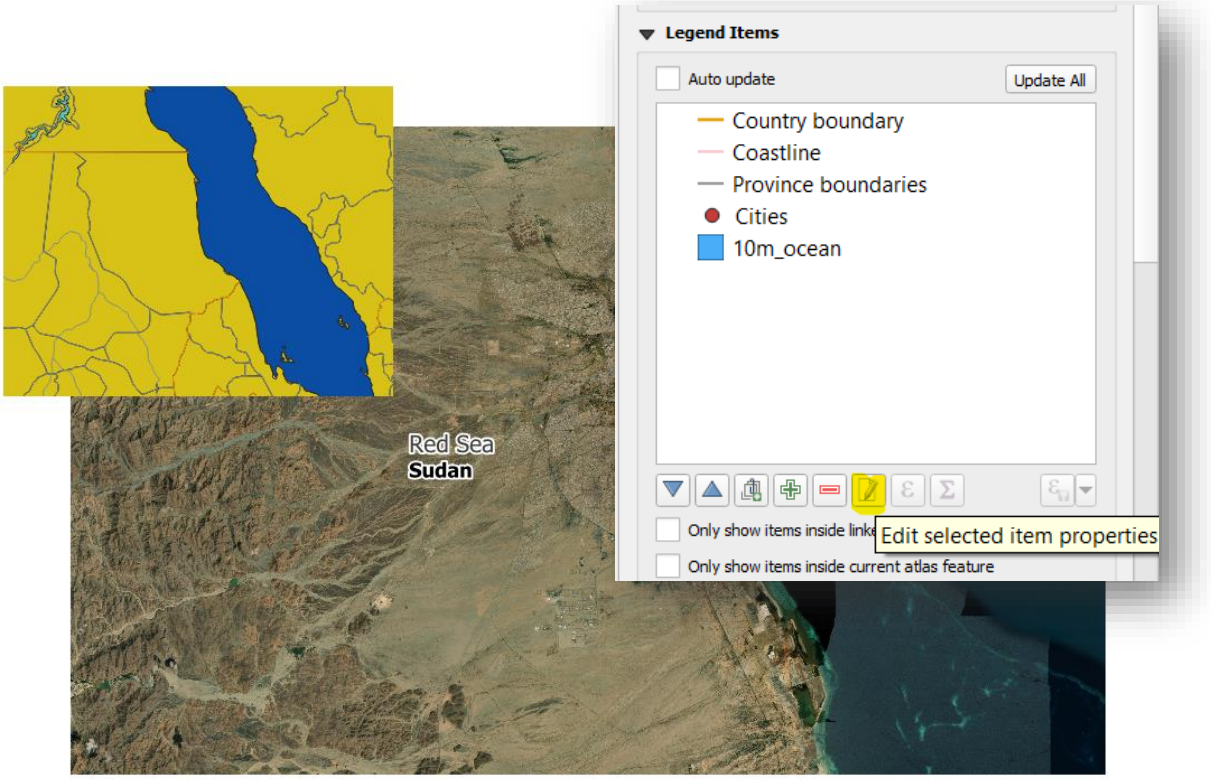
- It is explained how to add data from OSMAnd in the section: Downloading data and importing to QGIS.
- Data from QField is added by locating your updated geopackage (see section: Synchronize cloud projects after fieldwork and/or Exporting back to the QGIS) and use the add vector layer tool to add them into the project.



- Symbolize the added vector layers appropriately and zoom to the extent of your choice.

Now, go back to the **Print Layout** Window and add a new map the same way you did with the first one (**Add Item → Add Map** or you can use the Add Map tool 

from the toolbar).



Tips:

Use this tool from the toolbar to move your map in the map frame. When you are satisfied, click on the white hand that is used to navigate the elements of the layout.

We will now add other map elements to complete the map layout: legend, scale bar, title, north arrow and source (CRS).

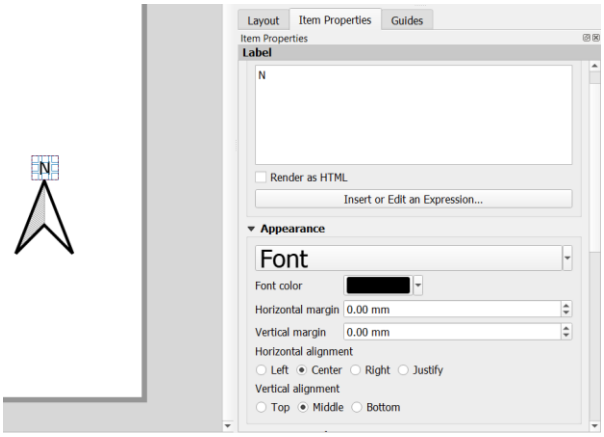
- If you don't remember how to do this, revisit Part 1: Create a Layout where this is explained.

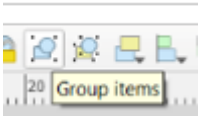
Add legend: When adding a legend, note that you can rename your layers in the main window, so they appear nicer in the legend by clicking on Edit selected item properties:

Add scale bar 

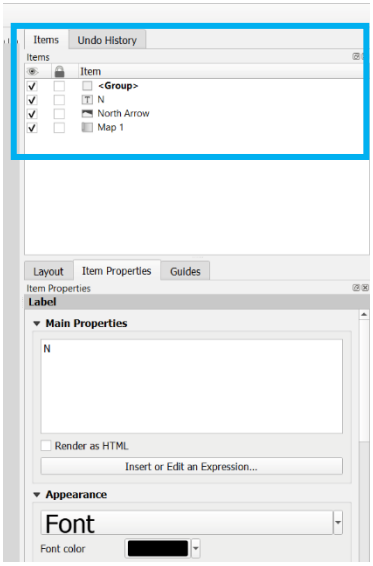
Add Label /Title  and adjust font and font size

Add North arrow  . Most north arrows do not contain an "N", in order to consider languages that do not use "North" / "N". Accordingly, we manually add "N" to the arrow. Click on *Add Label* to create a text element. Just write an "N" into the text field on the right and set a proper format, e.g. allign the letter in the middle and choose a suitable font (see picture to the right). Hint: you need to click on the font field to be able to change it.

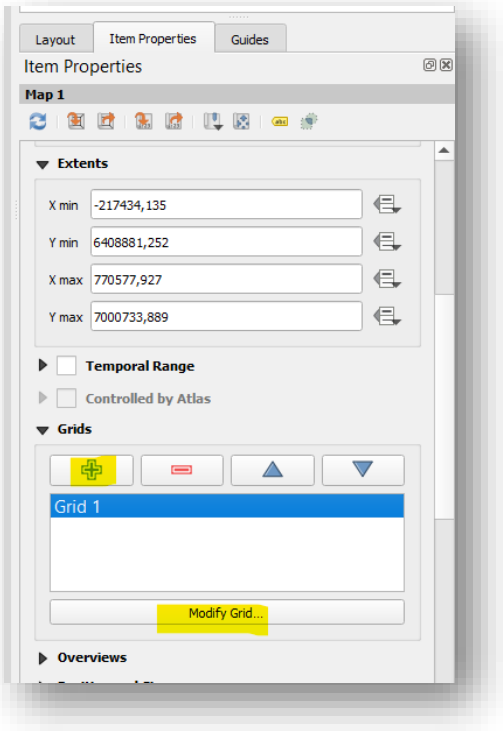


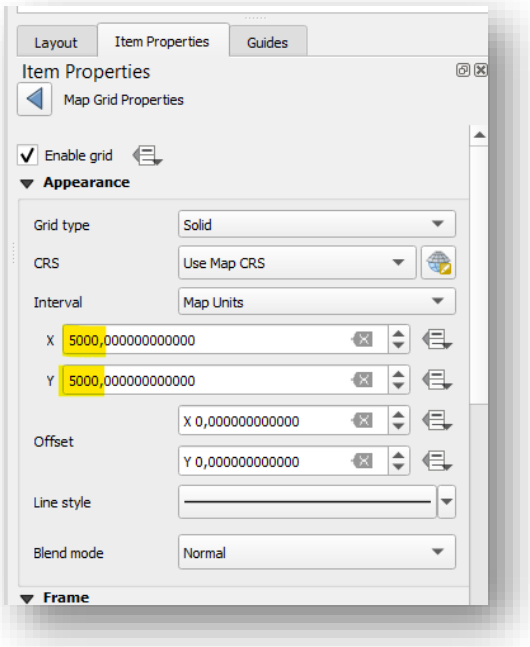
It is convenient to group the north arrow and the "N" together, so that they will be treated as one element. Mark both by typing *Crtl* and left clicking on each element. Go to *Group items* in the main icon bar at the top. 

The group will appear in the Items window (blue box) .

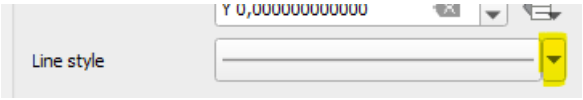


Add map grids showing the coordinates. You can do it by selecting one of your maps by clicking on it → **Item properties window** → **Grids**. Add grid by clicking the **Plus** sign and then **Modify Grid.** Play around with **interval** till you find an interval that fit the extent of your map layout.





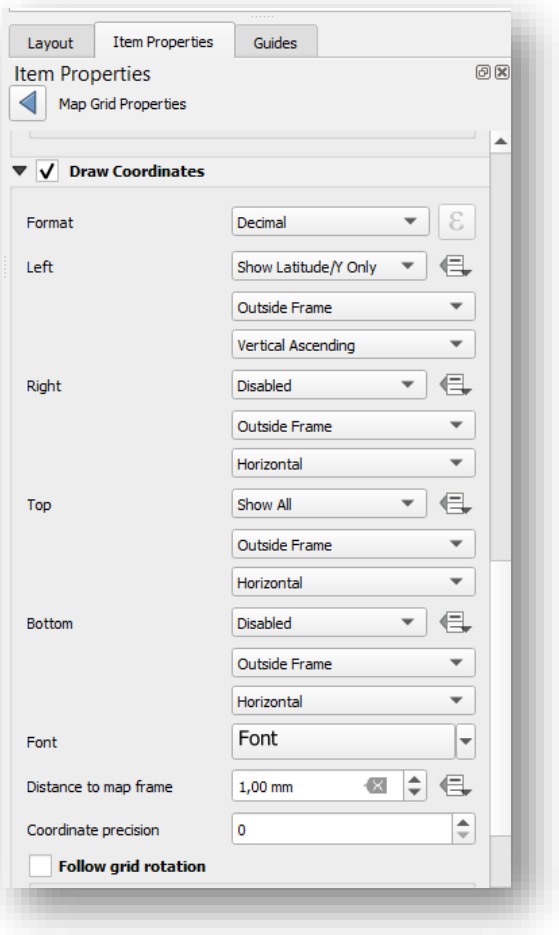
Change the line color to gray to make the grid less dominant in the layout, but so that it is still visible.



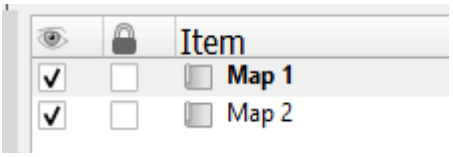
Note:

The map grid is used for locating places on the map accurately. It consists of vertical and horizontal lines that create a grid, with each section labelled with a unique reference. This enables users to pinpoint exact locations using coordinates, facilitating navigation, planning, and geographic analysis. It should not hinder to read the map.

Further down the list in the **Item Properties**, **tick Draw Coordinates** box. This will add coordinate labels. Adjust the parameters so that the labels look good.



Add a label with text about data source, CRS and projection used for the map as well as the author.



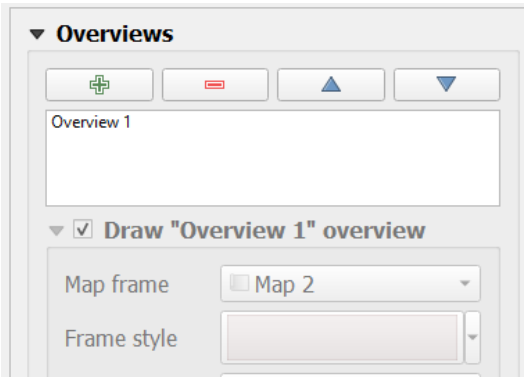
Lastly, we want to **indicate the location of the detailed map in the overview map**. In the Items window, mark the item Map1.

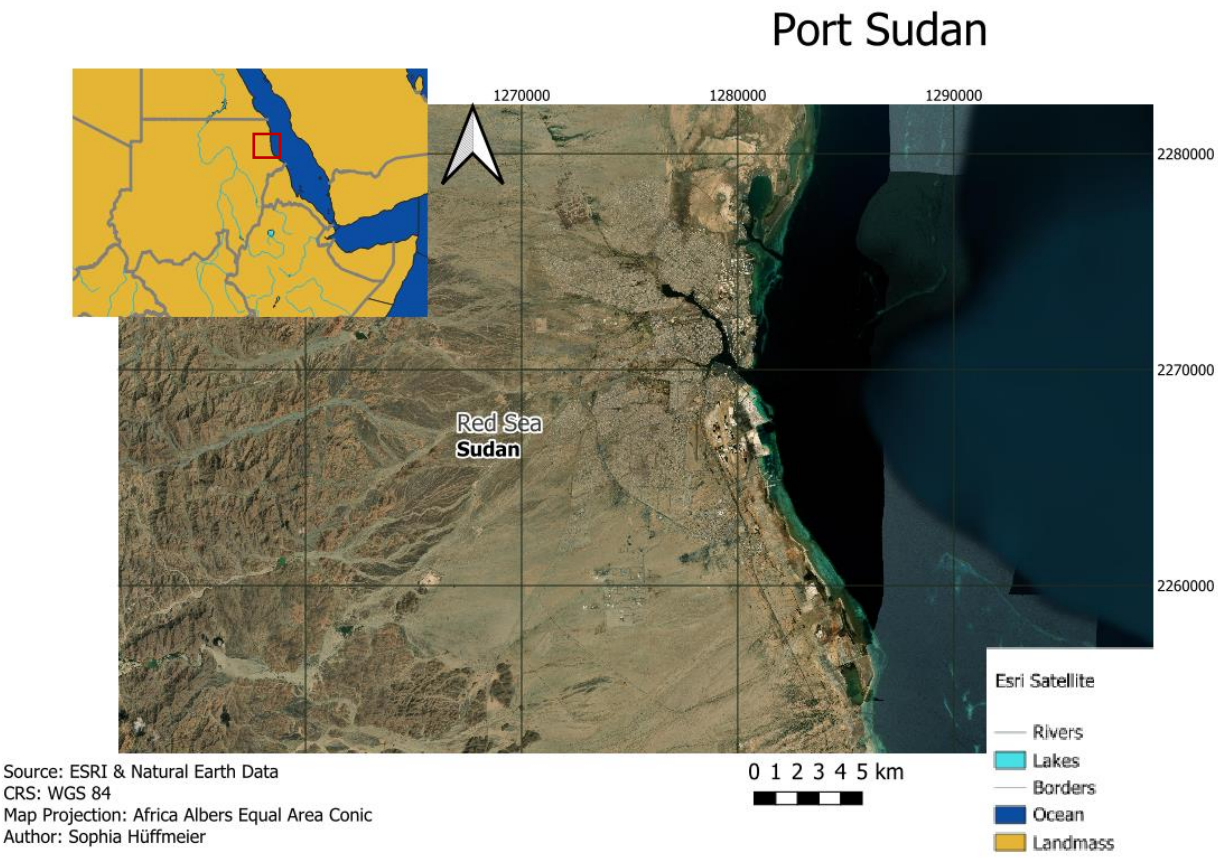
Go to the Item properties tab and scroll down to **Overviews**.

- Click the + sign, and tick the box “Draw “Overview 1” Overview. In the Map frame dropdown, select Map 2.

If your zoom level is appropriate, it is marked out where your detailed map is located in Map1 map frame. If you change the zoom level in the detailed map layout, the overview indicator will change accordingly.

- In the Frame style, you can edit the style of the frame to for instance a red outline as seen below.





You are now ready to export your map as a pdf or another format of your choice

Click on the *Export as PDF...* icon in the toolbar on top. Recall the instructions from Part 1.

5. QField – More to know

Adding attachments like pictures, videos and sound recordings

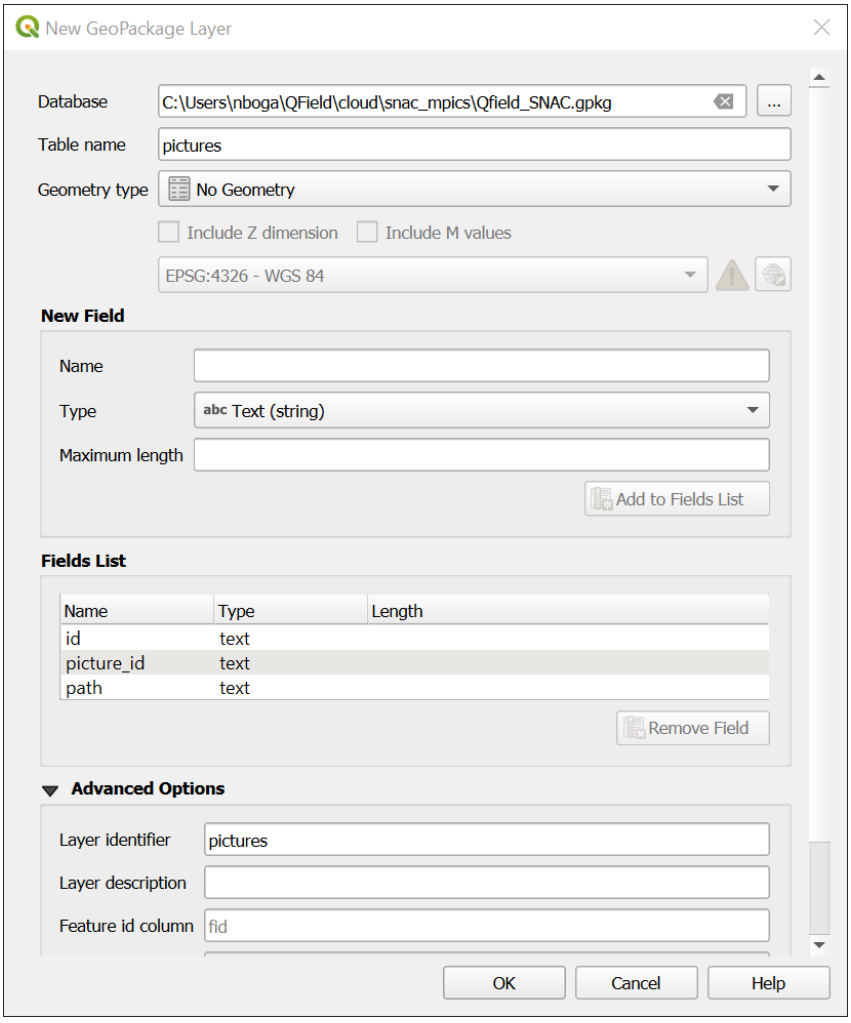
We can use the **widget type** *attachments* to add pictures to our field recording. For this we need to have a table where the path to all our pictures is stored. We also need to add a relation between this table and the main layer for the mapping, in this case our point layer.

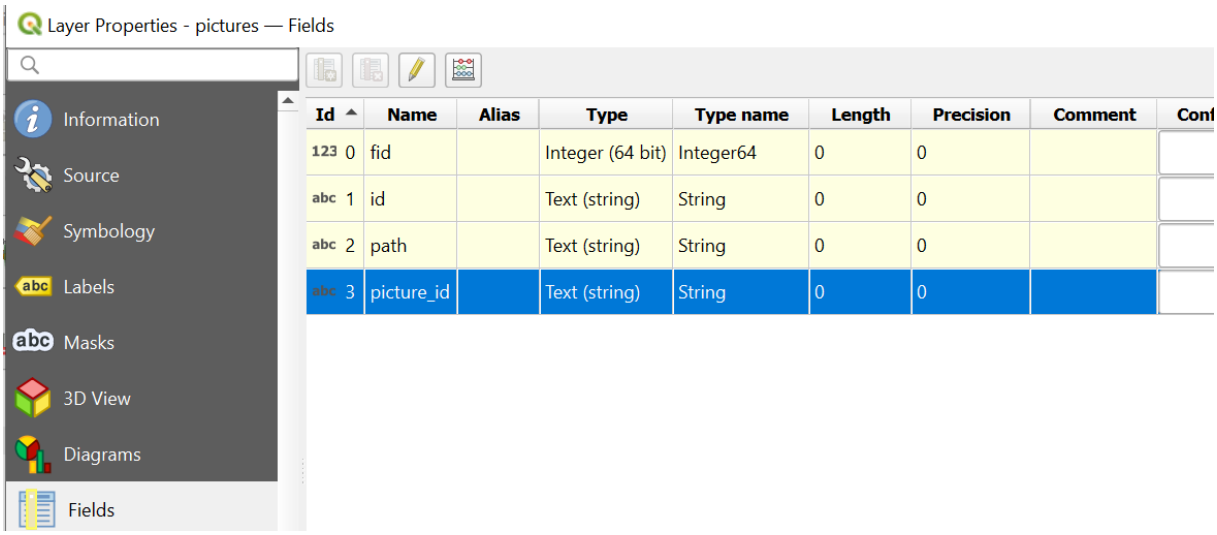
Add and format fields of the table layer

Add a new table layer to geopackage

- Main meny > layer > create layer > new geopackage layer

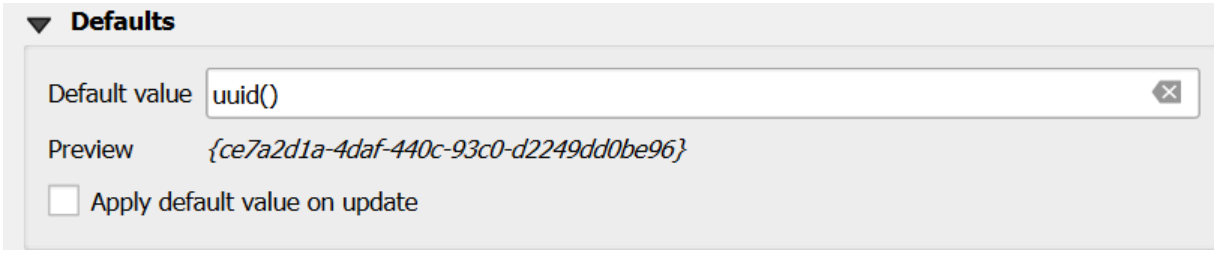
Fill it as described in the picture below





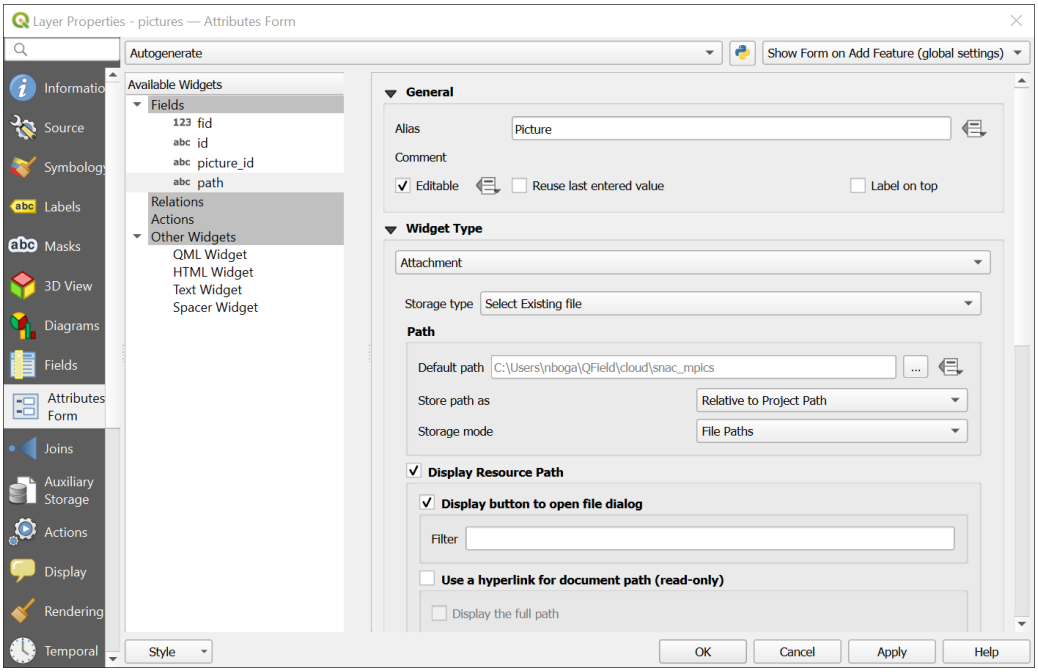
Now open Properties > Attributes Form of the Table layer

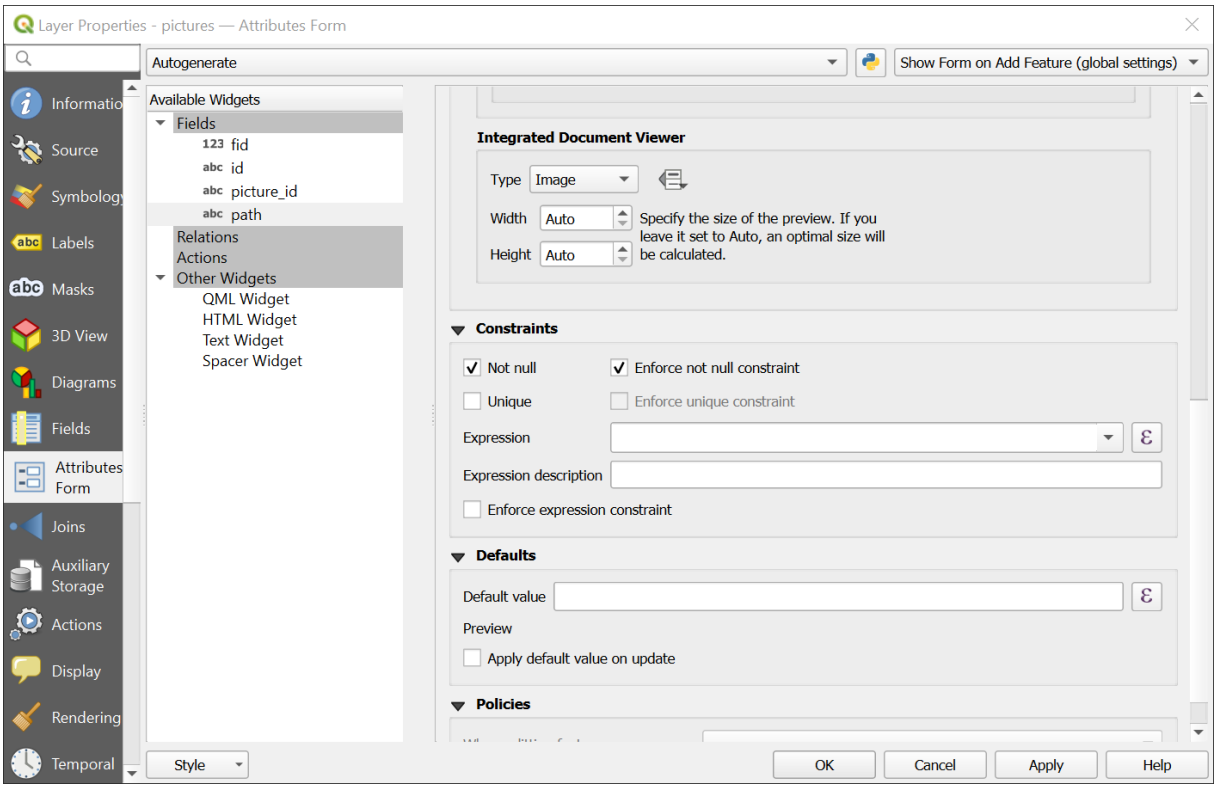
For field *id*, type uuid() in the **defaults** field



Do the same for the *picture_id* field.

For *path* set **widget type** to *attachment*, and fill as shown below. Notice in the next image that the **integrated document viewer** is set to type *image*. This allows the image to be displayed in QGIS/QField when you use click on a point of interest.





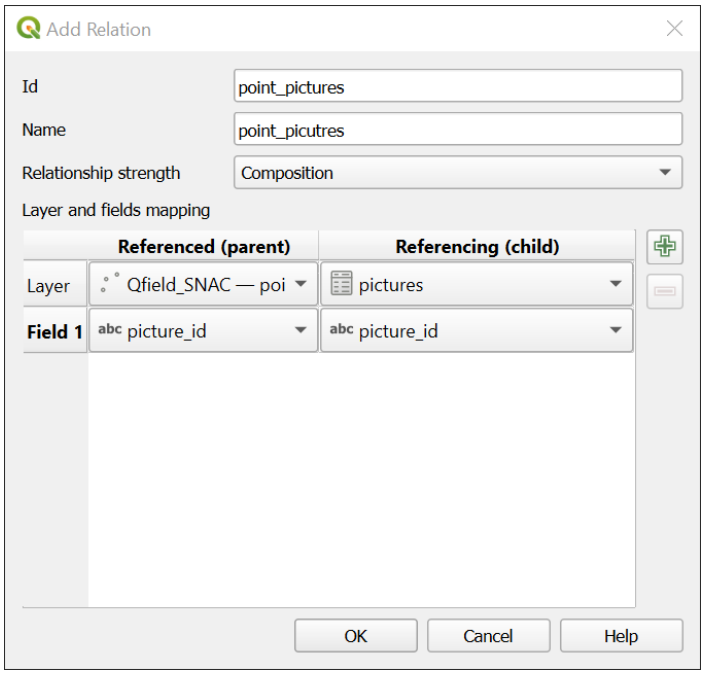
Add relation

For keeping track of which pictures (stored in the table) belongs to which feature, we need to make a relationship between the table and our feature layer. A relation is created using a unique ID that is shared between the two datasets. In our case the unique ID are created above with the uuid() expression.

Relations are set up in the project properties.

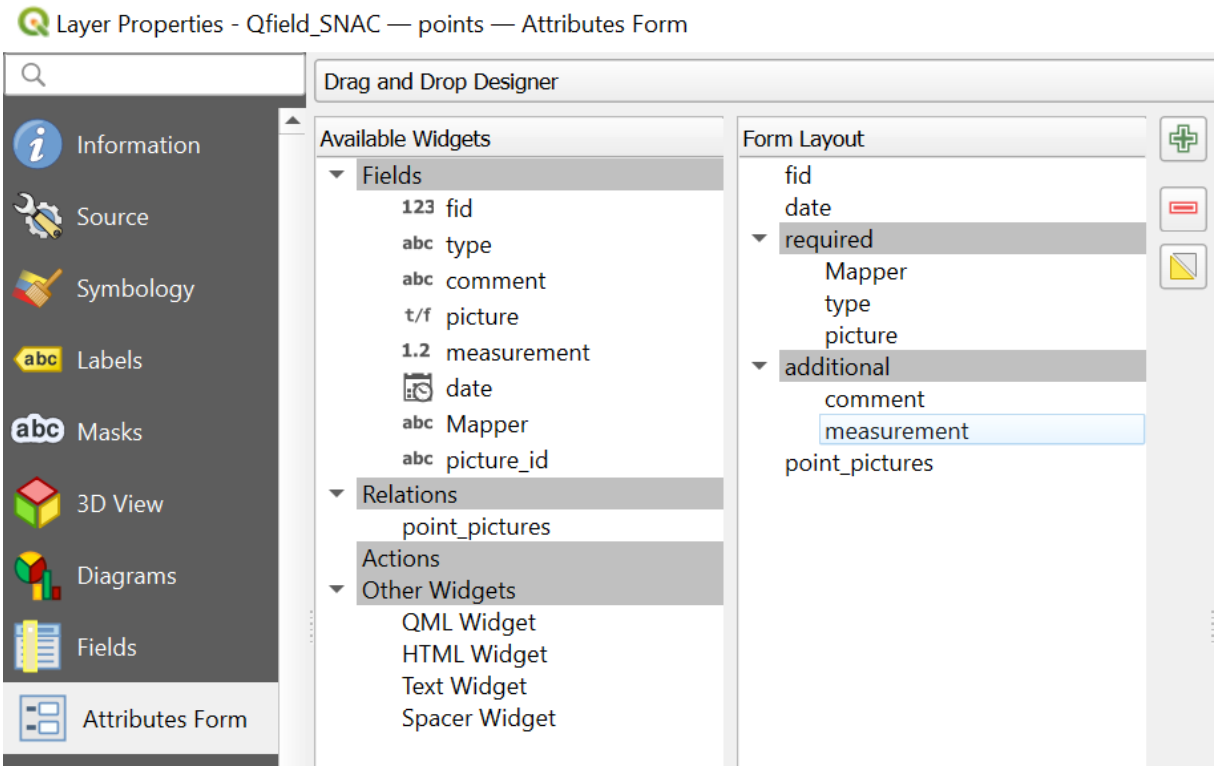
Main menu > Project > properties > relations > add relation

Fill the window like shown to the right.



The next step is to add this relationship to the feature layer.

Open the properties dialog and the **attribute form** of the point layer. The relation you just created is visible under **relations**. Drag and drop the relation point_pictures into your Form Layout.



TIP: When using the default options in QField, pictures will be taken with a minimalist internal camera. The advantage is that this allows geotagging of images. If you want more camera options you can choose to use the native camera of your mobile phone. However, this does not allow geotagging within QField. If you need geotagged images and want more camera options, you need to install the *Open camera app*. You can default settings in QField under settings > general > Advanced. The *open camera app* will have to be installed on the smart phone.

Generate basemap for offline mapping

In this section you will learn how to generate maptiles that can be exported to QField for use in offline mode.

When you work in areas without coverage it is very useful to have a background map, i.e. basemap, available offline. By offline we mean that the basemap is stored as a local copy on your device (smart phone). The basemap will be stored as so-called *tiles*. It means that the map of your area of interest is divided into several small maps, i.e. tiles, and the same is done at multiple scale levels. *Tiling* makes zooming in and out in the map fast. Each tile generated is an image, typically in jpeg og png-format. Maptiles retain geolocation from the original map source.

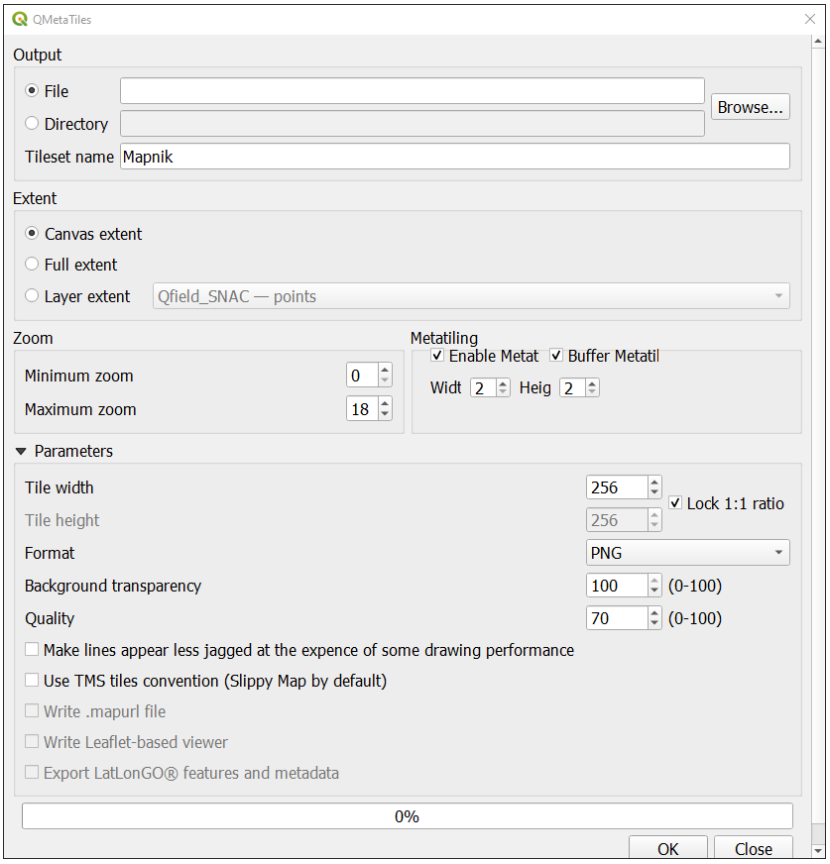
There are different plugins in QGIS that can convert background maps into tiles. In this exercise we will use QMetaTiles that you have already installed.

Generate tiles from a basemap.

The basemap you want to use in QField has to be displayed in your map. In this example you will use Google Satellite as basemap.

Locate the QMetaTiles tool on the toolbar and press to open: 

This window will appear:



Here follows an explanation of the settings and what to select:

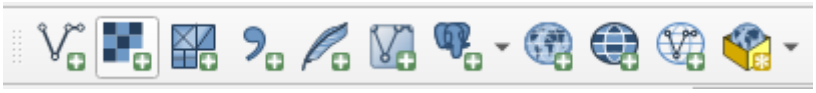
- Tileset name: change to the same as your background map, e.g. Google maps.
- File – click browse. In the new window
    - Navigate to your working folder
    - File name: Specify an appropriate name, e.g. Googlesat_background
    - Save as type: Choose *MBTiles databases*
    - When done, click save
- Extent – different options to delimit extent of the tiles.
    - Zoom to your area of interest and choose canvas extent
    - Canvas extent is recommended when your canvas is fitted to your area of interest in the map window,.
    - Layer extent is recommended when you have a layer outlining your area of interest
    - Full extent is not recommended when the background map has a global coverage
- Other settings can be kept with default values. Here's a short explanation of what the most important ones mean
    - Minimum zoom – this is the coarsest scale that tiles will be generated at.
    - Maximum zoom – this is the finest scale that tiles will generated at. This is the one you like to have as high as possible. But higher number also means more tiles and bigger files. Filesize is often a limitation, especially if your area of

interest is large. A good balance between between map details and filesize is needed.

- Tile width and height – sets how many pixels each tile is in x and y direction
- Quality – compression of files, lower value less quality

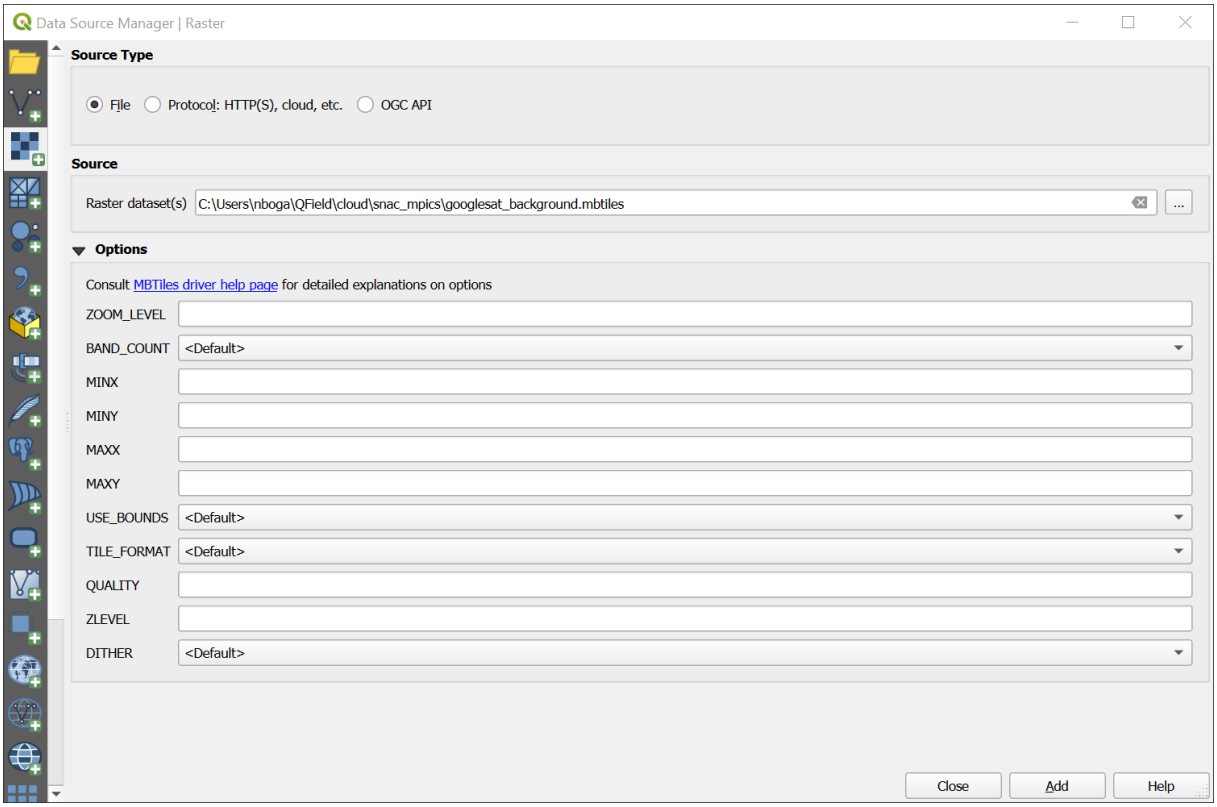
Add basemap to your project

The tiles you just generated are in raster format. Add tiles to your project by choosing *Add raster layer* from the *Manage layer toolbar*



This can also be done from the main menu > Layer > Add layer > Add raster layer

In Source > navigate to your working folder and select the Googlesat_background.mbtiles file > click Add



The file can also be imported to your project in QField

Adding tiles to QField

Tiles can be added to Qfield in different ways.

The easiest way is to include it in the QGIS project and synchronize it to the cloud with the rest of the files in the project. However, if the tile is large, you might get problems with storage space in the cloud. If that is the case, the approach describe in section From QGIS to QField recommended.

From QGIS to QField with QField Sync

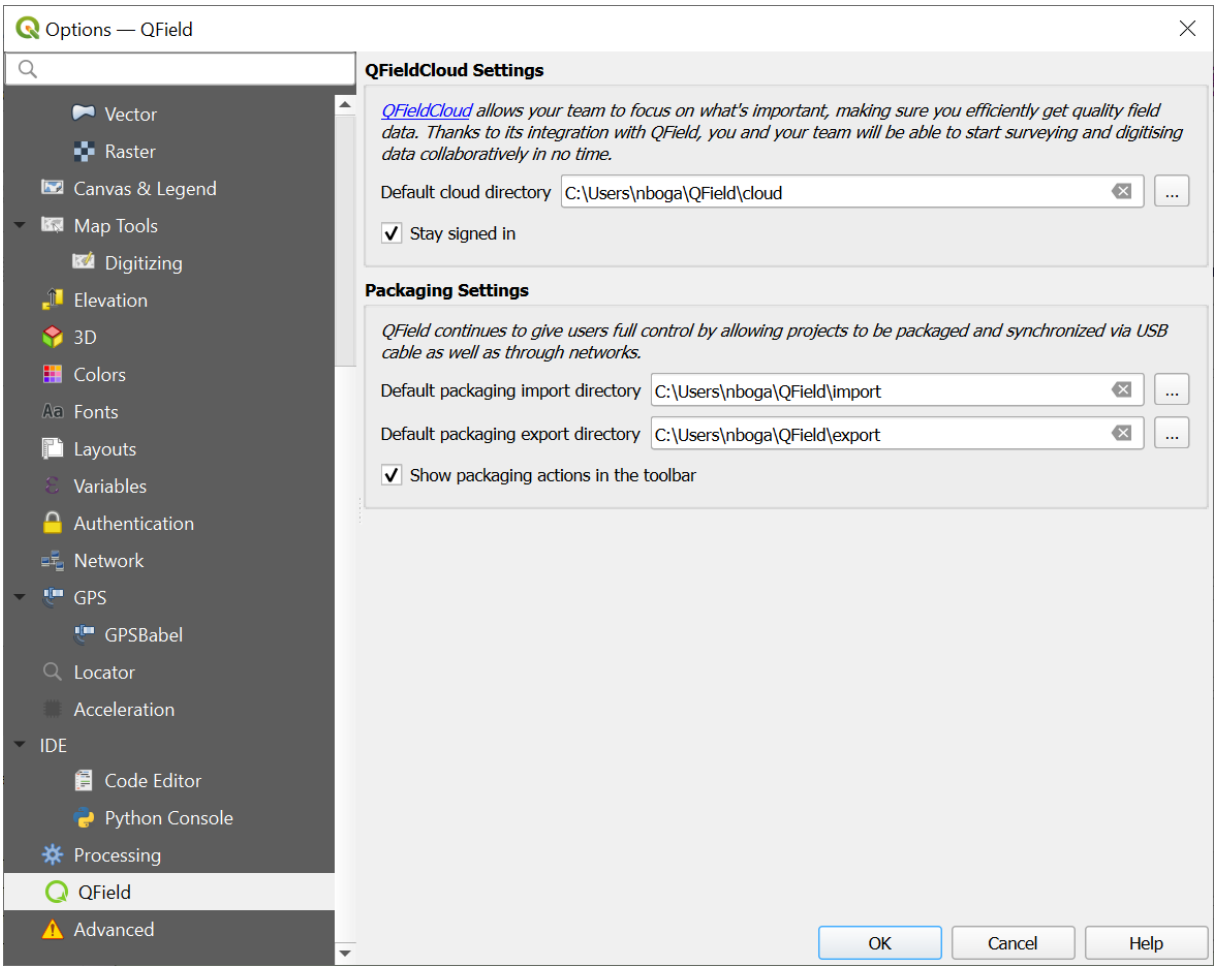
We will use the **QField Sync plugin** to export our project to our smartphone. Installation of the plugin is explained in section: Installation of Plugins needed for the Workshop

The first step is to **set preferences** for QField

main menu > Plugins > QField Sync> Preferences.

Notice what are the default directories for storing projects. There are two different settings, one for cloud projects (QFieldCloud settings) and one for projects that you will manually copy to your mobile phone (Packaging settings). Write down the paths so you remember them!

PS! It is an advantage that the path is not too long, and it should not include any spaces or special characters.



Configure for cloud synchronization

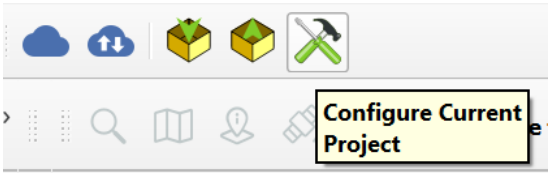
Using QField cloud is a very convenient way to export projects to QField. It requires that you have wifi connection. It will store a copy of the project in the cloud and synchronize from there to QField, and after fieldwork it will update your project in QGIS via the cloud version.

To use cloud synchronization an account is needed. It can be created from within QField, as explained in section: Installation of QFieldInstallation of , or by clicking on the blue cloud symbol

and register from there. In either cases, **remember to confirm your email address before you try to login!**

When you have an account, press the blue cloud symbol and login.

Now press **Configure Current Project**

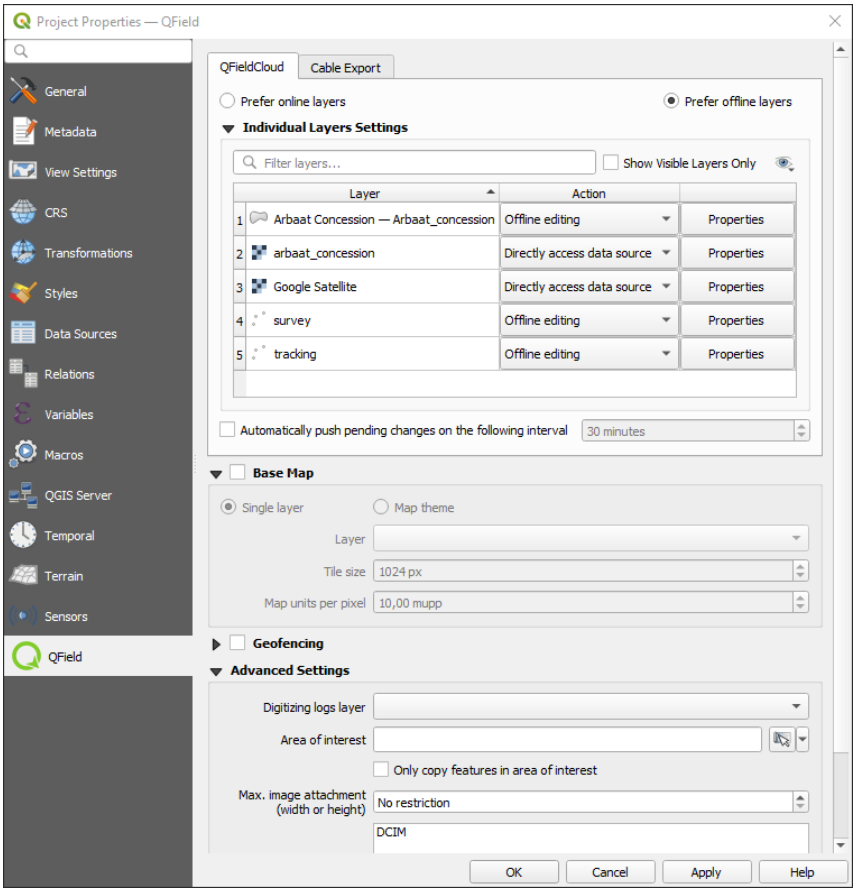


Here you define how the project will be exported:

Prefer offline layers means you can work with your project in field without wifi connection. Notice that the vector files survey and tracking now have the Action *Offline editing*.

Under **Base Map** you can choose to export a chosen background map so it can be accessible without wifi connection. However, when using cloud synchronization, storage is limited in the cloud. That is why we use the alternative approach with setting localized path and copying our basemap manually, as explained above.

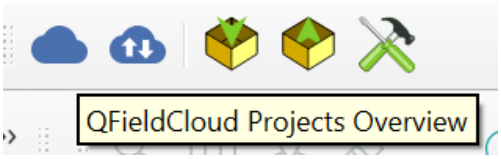
Under **Advanced settings** you can choose to only export what you see in your map extent. It is very important to limit map extent if you also choose to create a Base map.

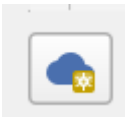


- When settings are fine, click OK

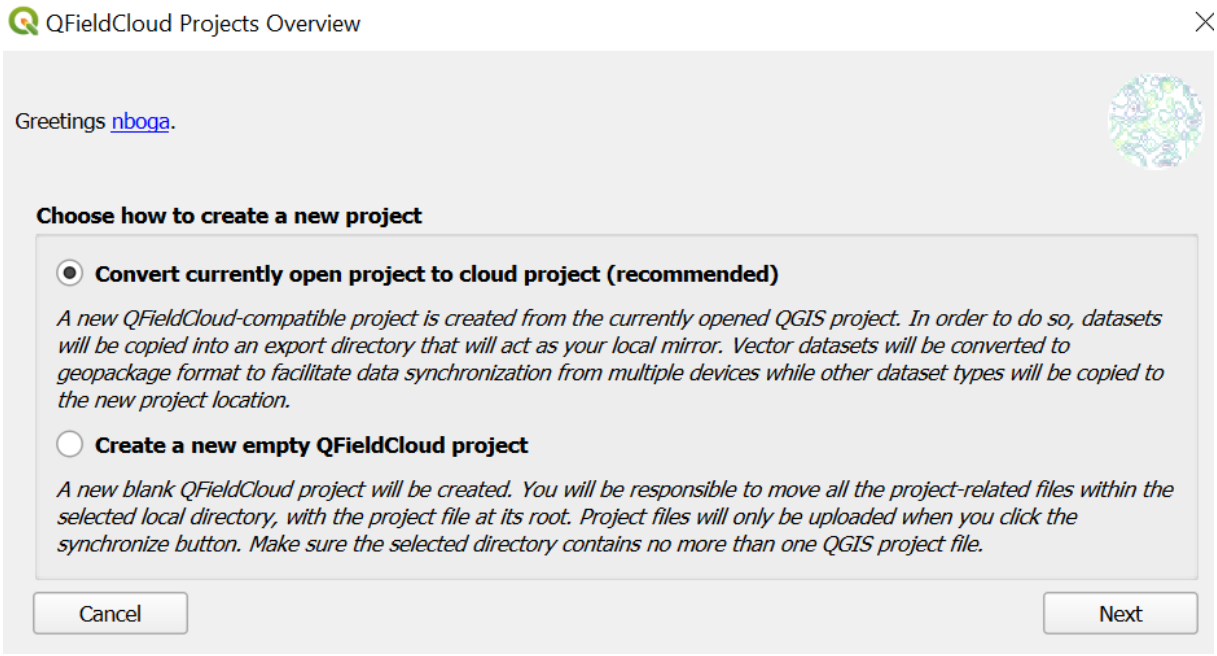
- **Save your project!**

Now, Press the **blue cloud** to generate a new cloud project.



In the window appearing, press the **create new project** button  in the lower left corner.

In the next window select the recommended setup:



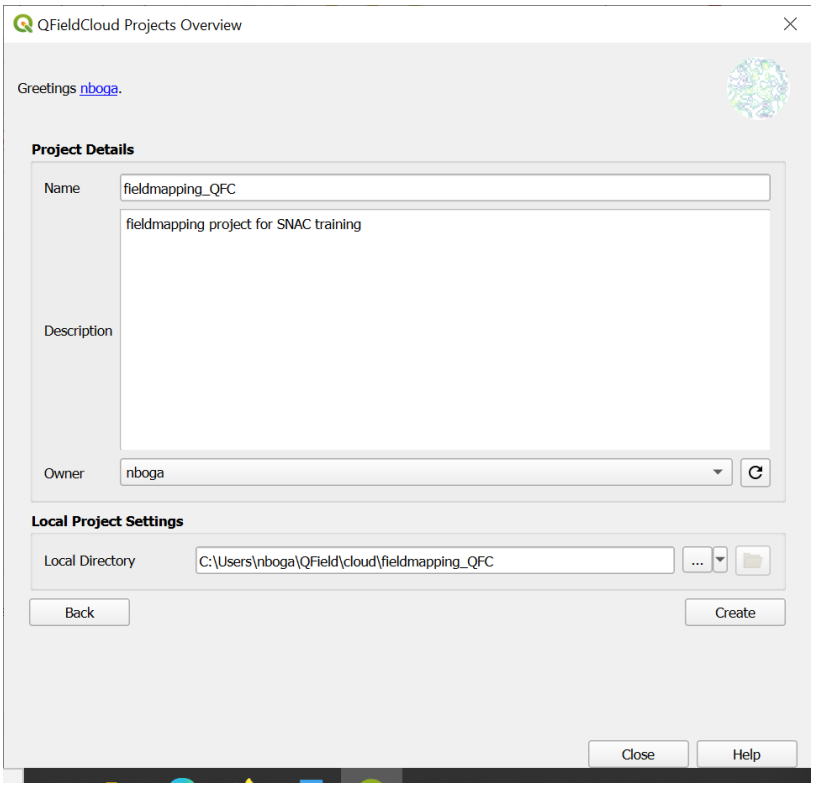
Notice that you are now going to create a copy of your project that will be saved in the folder specified above as **default cloud directory.**

This means that you now have two copies of your project

- The original version in your SNAC_workshop/QField_training folder
- The cloud version in your default cloud directory

PS! When you synchronize after field work, changes should be synchronized back to the project in the **default cloud directory**! After synchronization you can copy the geopackage file with all your added field observations to a new location. Use this file to make a new project to display, analyse and make a final map layout. **In this way you will keep the original project intact for further edits and adjustments for new field work.**

Press next and make an appropriate project and folder names, and press **create.**



After the project is created you will see it in the project overview list.

Save your project and close QGIS.

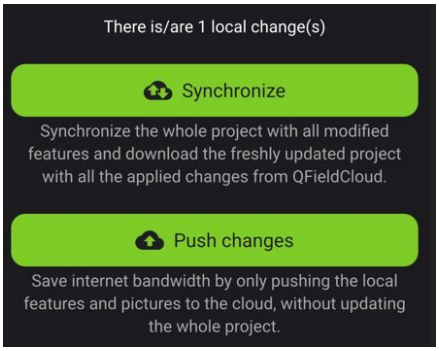
You are now ready to open the project in the QField App.

- On the first screen, choose “QField cloud projects”.
- Log in if needed and choose the project from the list under “My projects”.

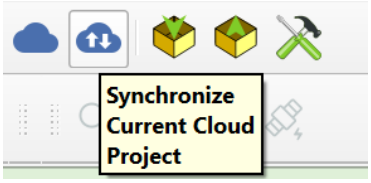
Congratulations – you are ready for fieldmapping using QField!

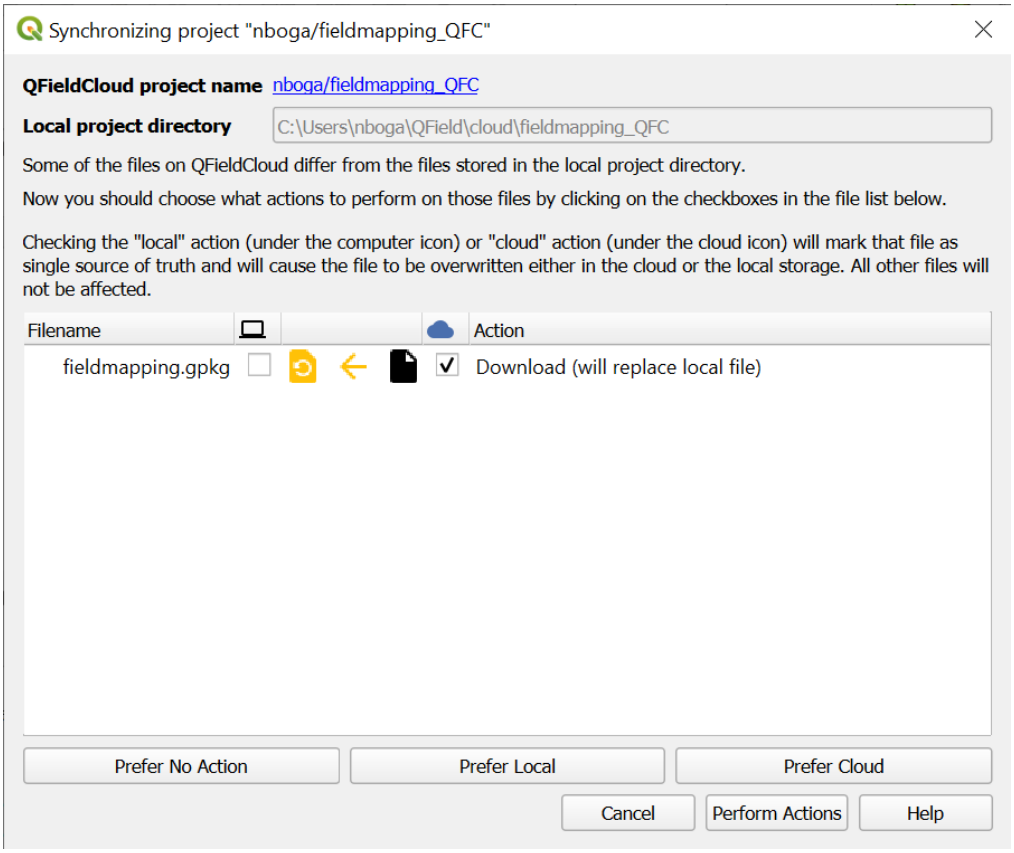
Synchronize cloud projects after fieldwork

When you are done with your fieldwork, the project in QField will show a blue cloud with updates. Press it and choose either **synchronize** or **push changes. Push changes** will push updates done in the app to the cloud. This should be sufficient after field work.



When you are back in your computer environment, open QGIS and locate your cloud project. PS! You 'll find it in your **default cloud directory!** When open, press the **blue cloud with arrows** to synchronize the changes:





Here you can decide how to handle the changes. In this case, we want to **download** the changes we have made in the layers (survey and tracking, and possible others you have made on your own) in the fieldmapping.gpkg. Click **Perform Actions**.

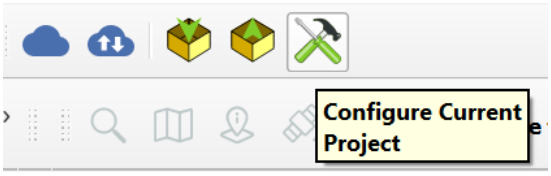
Now you should see the new data in your QField project! And you are ready for further editing, analysis or layout creation.

Configure for cable export

Skip this section if you have wifi and can use cloud synchronization.

This section describes the alternative way to export your project from QGIS to QField if you don't have WiFi connection. In this case you will use a cable to transfer the project from the computer to the smart phone.

From the toolbar, choose **configure project**, and the tab **Cable Export** in the window that appears.



On your geopackage layers, choose **offline editing**. According to the documentation this means that:

"A working copy of the layer is copied into the package folder. Every change which is done in the packaged project during work is recorded in a changelog. When synchronizing the changes back later on, this log will be replayed and all changes also be applied to the main data base. There is no conflict handling in place."

If you want to delimit your project to an area of interest, there are different possibilities under Advanced settings.

For more information about configuration, see here: https://docs.QField.org/get-started/tutorials/get-started-qfs/ or in the supplied pdf: Data/Documents/QFieldSync - QField Ecosystem Documentation.pdf

Click Ok when you are done.

Now you are ready to export.

From the toolbar, choose **Package for QField**.

Choose an export folder where your project will be saved. The default folder is ..\QField\export\ and name of the folder will be the same as your project name.

Import project into QField

Connect your phone to the laptop. **Make a folde**r named *QField*, and a subfolder called *export*. Make another subfolder called *import*. You will use the latter when you are done mapping.

- Copy the *fieldmapping* folder from your laptop to the *export* folder on your phone.
- Open QField, and choose **Open local file.**
- Press the + sign in the lower right corner, and choose **import project from folder**
- Navigate to the *fieldmapping* folder, and **press use this folder**

When import is done you can open the imported project and start mapping!

Exporting back to the QGIS

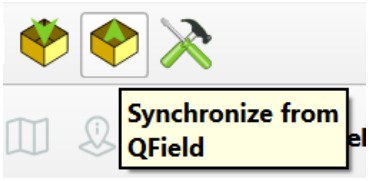
When you are done mapping you need to do the reverse process.

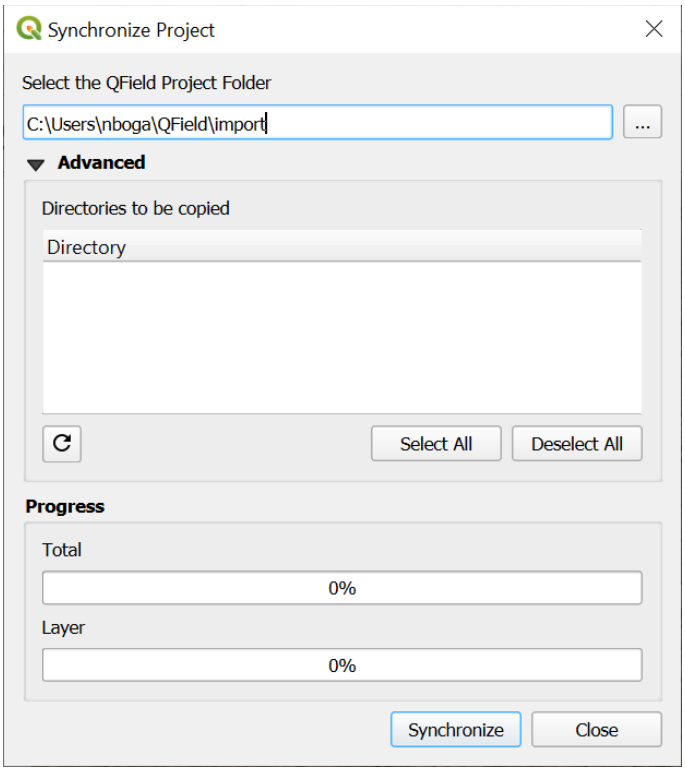
Notice that in the **imported projects** view in QField, there are three dots behind each project folder name.

Press these and choose **export to folder**.

Save to the *import* folder that you made above.

Copy the folder back to your PC and use the Synchronize from QField button on the QField sync plugin in QGIS. Navigate to the import folder and press synchronize.





You are now ready to edit or analyse your data further in QGIS or to make a nice layout for disseminating your findings.