

# An Introduction to GIS Fundamentals

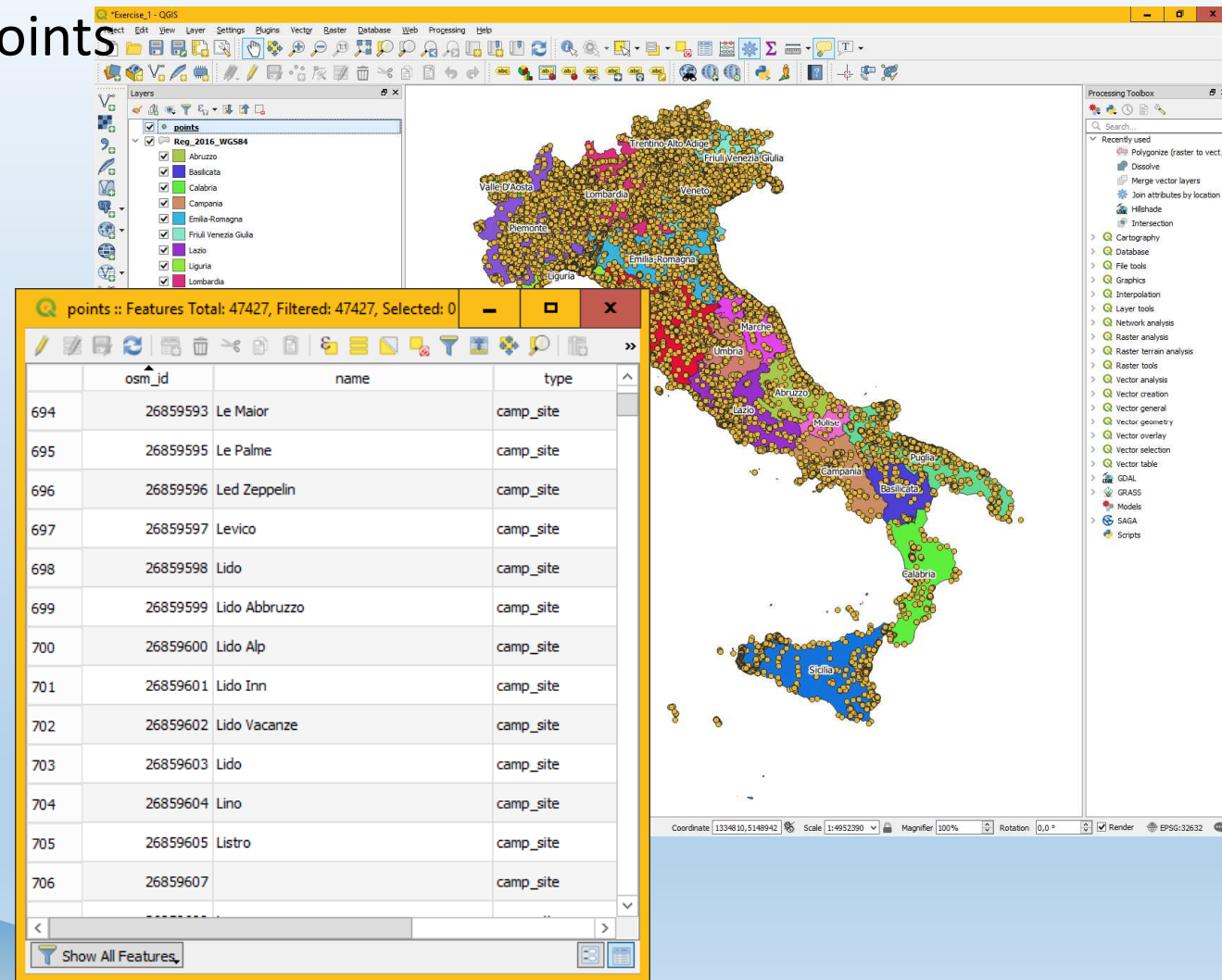
## PART 4. LAYER and DATA



Add the shape file «points.shp»  
Open the attribute table: 47427 points

## Layer Ordering

- ☐ Layers on top are drawn on top
- ☐ Just drag and drop within the Layers Panel to change order
- ☐ Try it now



The screenshot shows the QGIS interface with a map of Italy. The 'points' layer is selected in the Layers panel. The attribute table for 'points' is open, showing 47427 features. The table has columns: osm\_id, name, and type. The 'type' column shows 'camp\_site' for all entries.

	osm_id	name	type
694	26859593	Le Maior	camp_site
695	26859595	Le Palme	camp_site
696	26859596	Led Zeppelin	camp_site
697	26859597	Levico	camp_site
698	26859598	Lido	camp_site
699	26859599	Lido Abbruzzo	camp_site
700	26859600	Lido Alp	camp_site
701	26859601	Lido Inn	camp_site
702	26859602	Lido Vacanze	camp_site
703	26859603	Lido	camp_site
704	26859604	Lino	camp_site
705	26859605	Listro	camp_site
706	26859607		camp_site

# Filter and Query

Right-click on the layer and select "Filter" to open the **Query Builder**

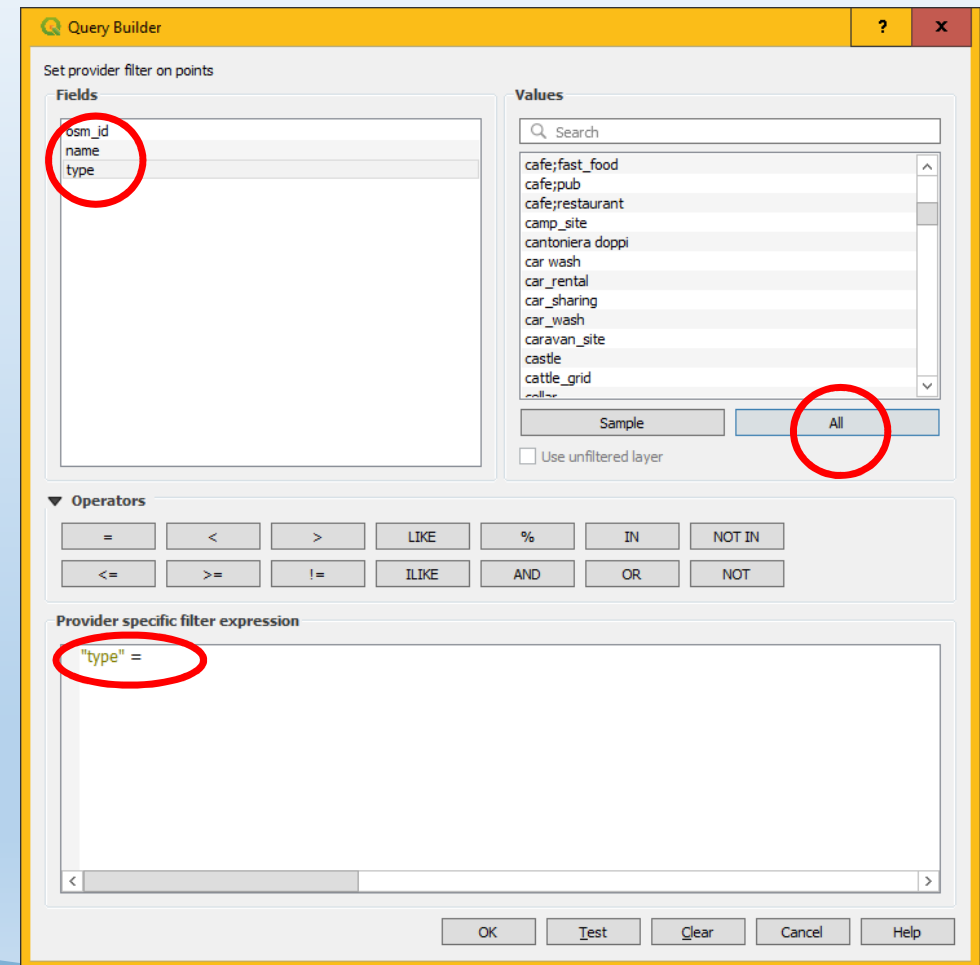
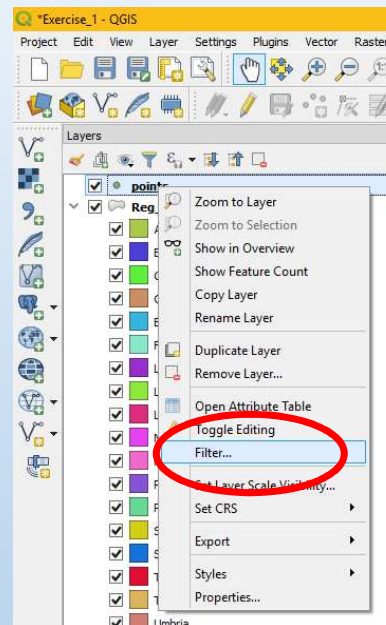
The available operators are:

= > < <= >=

LIKE AND OR NOT ...etc

Multiple filter/query can be used on the same command string

"type" = camp\_site



# Filter and Query

Exercise\_1 - QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Help

Layers

- points
- Reg\_2016\_WGS84
  - Abruzzo
  - Basilicata
  - Calabria
  - Campania
  - Emilia-Romagna
  - Friuli Venezia Giulia
  - Lazio
  - Liguria
  - Lombardia
  - Marche

points :: Features Total: 671, Filtered: 671, ...

	osm_id	name	type
1	270673818	al lago	camp_site
2	270673820	camping Bavaria	camp_site
3	293192720	Maremma Sans Souci	camp_site
4	353920090	Le Marze	camp_site
5	248758304		camp_site
6	374380343	San Michele	camp_site
7	272788768	Camping Tivolara	camp_site
8	417859210	Europa	camp_site
9	278363702		camp_site
10	278364848		camp_site
11	355850889	Due Laghi	camp_site
12	387038557	Schermo interoC...	camp_site
13	334769681	Camping Villagio Victoria	camp_site
14	26859619	Mantineria	camp_site

Show All Features

Zoom to Layer  
Zoom to Selection  
Show in Overview  
Show Feature Count  
Copy Layer  
Rename Layer  
Duplicate Layer  
Remove Layer...  
Open Attribute Table  
Filter...  
Set Layer Scale Visibility...  
Set CRS  
Export  
Styles  
Properties...

Table and map show only the filtered elements (n = 671)  
These can be saved, exported, ...


Processing Toolbox

Search...

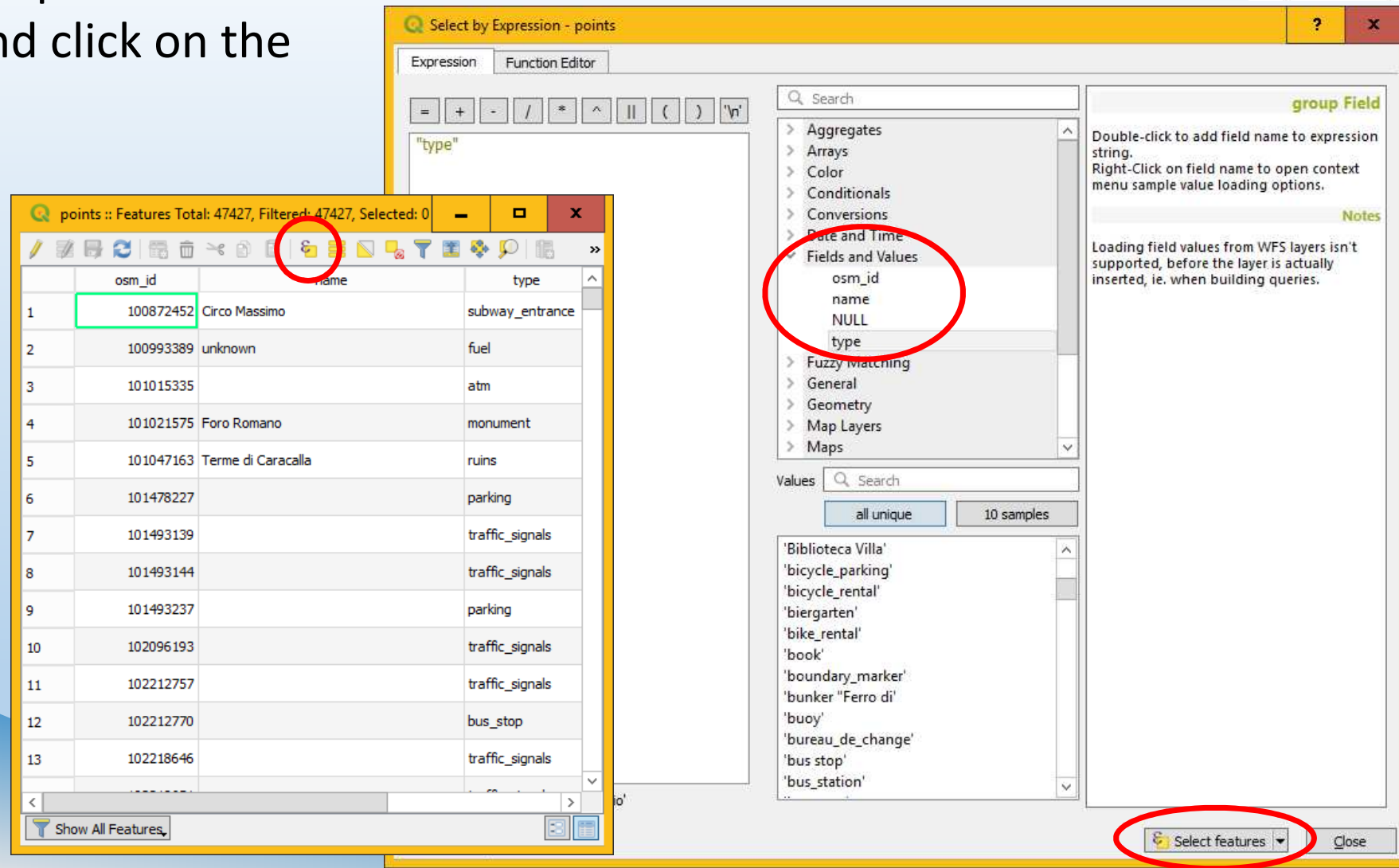
Recently used

- Polygonize (raster to vector)
- Dissolve
- Merge vector layers
- Join attributes by location
- Hillshade
- Intersection

Cartography  
Database  
File tools  
Graphics  
Interpolation  
Layer tools  
Network analysis  
Raster analysis  
Raster terrain analysis  
Vector analysis  
Vector creation  
Vector general  
Vector geometry  
Vector overlay  
Vector selection  
Vector table  
GDAL  
GRASS  
Models  
SAGA  
Scripts

As an alternative open the attribute table and click on the icon 

In «Select by Expression» click on «Fields and Values» and double click on *type* Click on «all unique» to have the full list of class Click on '=' and then select «camp\_site» and click «select feature»



The screenshot shows the QGIS interface with the 'Select by Expression' dialog open. The 'Expression' field contains '"type"'. The 'Function Editor' tab is active, showing a list of functions. The 'Fields and Values' category is selected, and the 'type' field is highlighted. The 'Values' list shows 'all unique' selected. The attribute table for 'points' is visible, showing columns 'osm\_id', 'name', and 'type'. The 'type' column has values like 'subway\_entrance', 'fuel', 'atm', 'monument', 'ruins', 'parking', 'traffic\_signals', 'bus\_stop', and 'camp\_site'.

	osm_id	name	type
1	100872452	Circo Massimo	subway_entrance
2	100993389	unknown	fuel
3	101015335		atm
4	101021575	Foro Romano	monument
5	101047163	Terme di Caracalla	ruins
6	101478227		parking
7	101493139		traffic_signals
8	101493144		traffic_signals
9	101493237		parking
10	102096193		traffic_signals
11	102212757		traffic_signals
12	102212770		bus_stop
13	102218646		traffic_signals



points :: Features Total: 47427, Filtered: 47427, Selected: 671

	osm_id	name	type
1	26859342	Adamello	camp_site
2	26859344	Adria	camp_site
3	26859345	Adriati	camp_site
4	26859346	Adriatico	camp_site
5	26859347	Adriatico	camp_site
6	26859348	Ai Pioppi	camp_site
7	26859349	Ai Salici	camp_site
8	26859352	Al Lago	camp_site
9	26859353	Al Po	camp_site
10	26859354	Al Porto	camp_site
11	26859355	Al Sole	camp_site
12	26859356	Alba	camp_site
13	26859357	Albatros	camp_site
14	26859358	Albatroso	camp_site

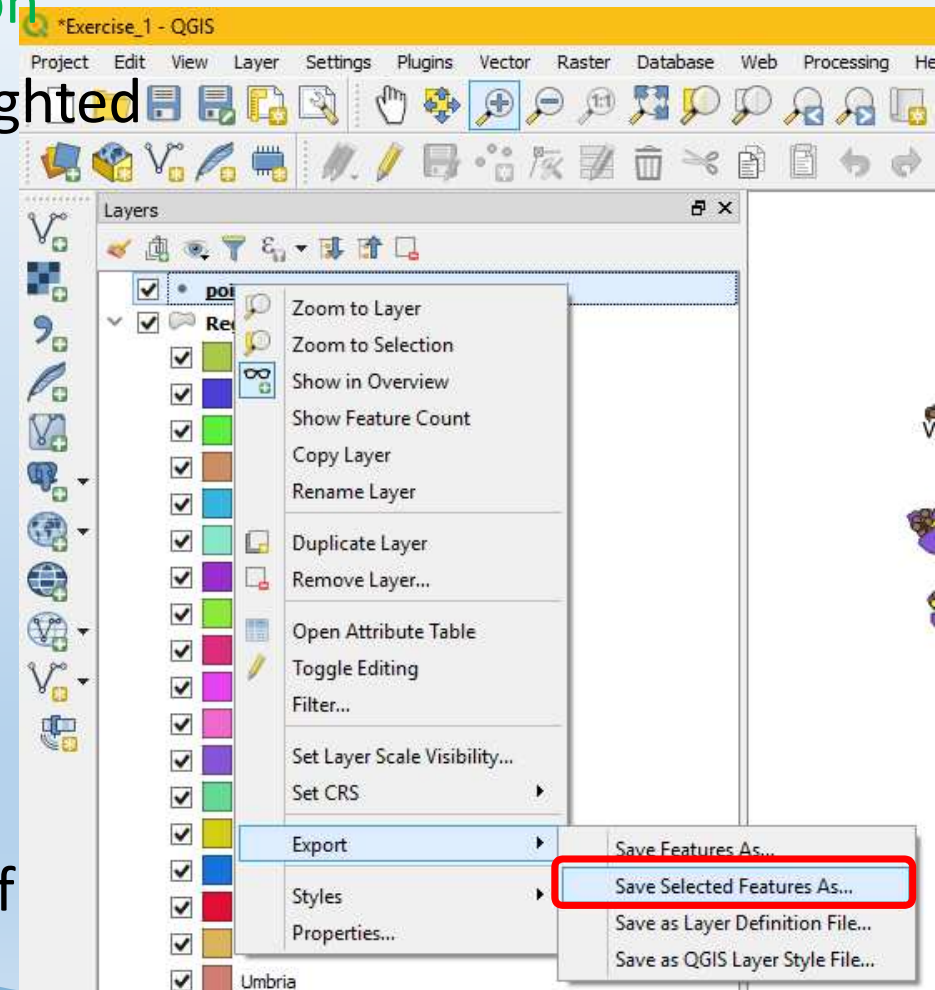
Show All Features

Move selection on top

Invert selection

Clear selection

Selected points are highlighted in yellow on the map



Selected features can be saved and exported (and reprojected if necessary)!

Training event (C1) of Daylighting rivers Florence Oct. 1<sup>st</sup> – 5<sup>th</sup> 2018

# Exporting Data : Export > Save Feature as

**Coordinate Reference System Selector**

Select the coordinate reference system for the vector file. The data points will be transformed from the layer coordinate reference system.

Filter

Recently used coordinate reference systems

Coordinate Reference System	Authority ID
* Generated CRS (+proj=aea +lat_1=29.5 +lat_2=45.5 +lat_0=23 +lon_0=0 +srs=EPSG:31466)	USER:100031
* Generated CRS (+proj=lcc +lat_1=40.66666666666666 +lat_2=41.66666666666666 +lon_0=0 +srs=EPSG:31466)	USER:100030
Monte Mario / Italy zone 1	EPSG:3003
WGS 84	EPSG:4326
* SR generato (+proj=tmerc +lat_0=0 +lon_0=9.000000000000002 +srs=EPSG:31466)	USER:100001
* SR generato (+proj=tmerc +lat_0=0 +lon_0=9 +k=0.9996 +x_0=500000 +y_0=0 +srs=EPSG:31466)	USER:100000
ED50 / UTM zone 32N	EPSG:23032

Coordinate reference systems of the world

☐ Hide deprecated CRSs

Coordinate Reference System	Authority ID
WGS 66	EPSG:4760
WGS 72	EPSG:4322
WGS 72BE	EPSG:4324
WGS 84	EPSG:4326

Selected CRS: WGS 84

Extent: -180.00, -90.00, 180.00, 90.00  
Proj4: +proj=longlat +datum=WGS84 +no\_defs

OK Cancel Help

**Save Vector Layer as...**

**Format** ESRI Shapefile

**File name** GeoPackage

**Layer name** ESRI Shapefile

**CRS** INTERLIS 2

**Encoding** Keyhole Markup Language [KML]

☐ Save only selected features

☒ Add saved file to map

**Select fields to export and their export options**

**Geometry**

Geometry type Automatic

☐ Force multi-type

☐ Include z-dimension

☐ Extent (current: layer)

**Layer Options**

RESIZE NO

OK Cancel Help

**Save Vector Layer as...**

**Format** ESRI Shapefile

**File name**

**Layer name**

**CRS** EPSG:4326 - WGS 84

**Encoding** Project CRS: EPSG:32632 - WGS 84 / UTM zone 32N  
Default CRS: EPSG:4326 - WGS 84  
Layer CRS: EPSG:4326 - WGS 84  
EPSG:102091 - Monte Mario Italy\_1  
EPSG:5659 - Monte Mario / TM Emilia-Romagna  
EPSG:23032 - ED50 / UTM zone 32N

☐ Save only selected features

☒ Add saved file to map

OK Cancel Help

## Zoom Selection

Select the zoom on the toolbar

Draw a box around the area you want to zoom into

Click the icon to return to the previous map extent



## Pan Map

Select the hand tool to pan around the map





## Your Turn

- ✓ Filter for different types in the attribute table of “points.shp”
- ✓ Try and find something interesting
- ✓ Change the style of the point, either to a different shape, color, or icon
- ✓ Export your selection as a new shapefile

# Importing a CSV file

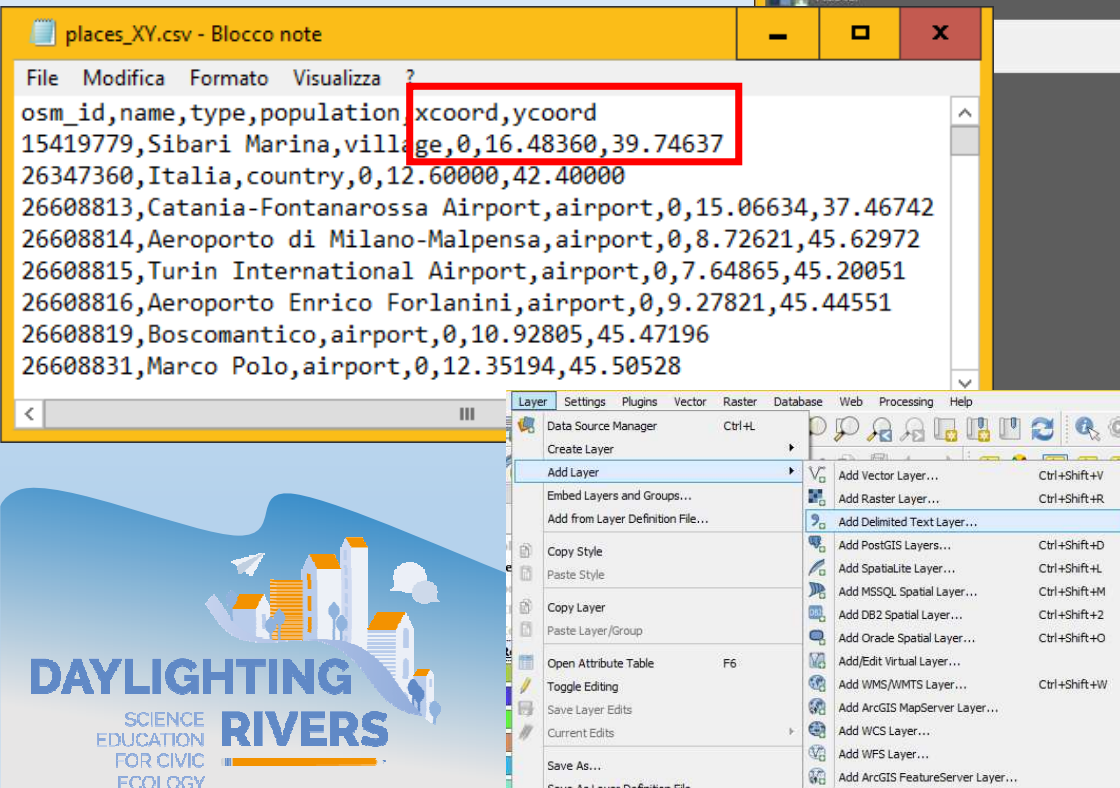
Click on the comma icon on the left toolbar (*Manage Layers Toolbar*)



Open the file places\_XY.csv

...Data\Italy\Italy-places-shape\  
Places\_XY.csv

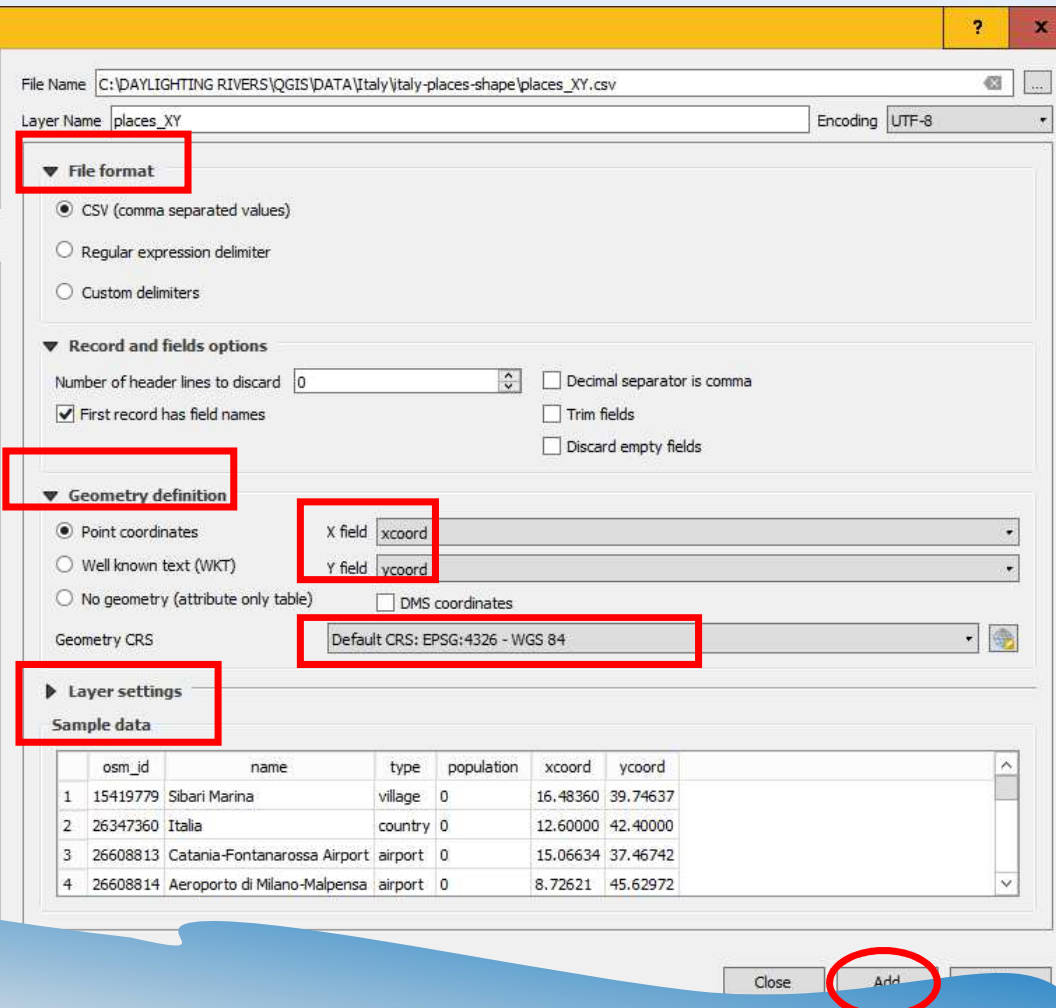
**X Y Coordinates !**



The screenshot shows the QGIS interface with the Data Source Manager (Delimited Text) dialog box open. The file path is C:\DAYLIGHTING RIVERS\QGIS\DATA\Italy\Italy-places-shape\places\_XY.csv. The Layer Name is places\_XY and the Encoding is UTF-8. The File format is set to CSV (comma separated values). The Record and fields options are: Number of header lines to discard 0, First record has field names checked, Decimal separator is comma unchecked, Trim fields unchecked, and Discard empty fields unchecked. The Geometry definition is set to Point coordinates, with X field xcoord and Y field ycoord. The Geometry CRS is set to Default CRS: EPSG:4326 - WGS 84. The Layer settings section shows sample data.

The Notepad window shows the content of the CSV file:

```
osm_id,name,type,population,xcoord,ycoord
15419779,Sibari Marina,village,0,16.48360,39.74637
26347360,Italia,country,0,12.60000,42.40000
26608813,Catania-Fontanarossa Airport,airport,0,15.06634,37.46742
26608814,Aeroporto di Milano-Malpensa,airport,0,8.72621,45.62972
26608815,Turin International Airport,airport,0,7.64865,45.20051
26608816,Aeroporto Enrico Forlanini,airport,0,9.27821,45.44551
26608819,Boscomantico,airport,0,10.92805,45.47196
26608831,Marco Polo,airport,0,12.35194,45.50528
```

The screenshot shows the QGIS Data Source Manager dialog box with the following settings highlighted by red boxes:

- File format:** CSV (comma separated values)
- Record and fields options:** First record has field names (checked)
- Geometry definition:** Point coordinates (selected), X field xcoord, Y field ycoord
- Geometry CRS:** Default CRS: EPSG:4326 - WGS 84
- Layer settings:** Sample data table

	osm_id	name	type	population	xcoord	ycoord
1	15419779	Sibari Marina	village	0	16.48360	39.74637
2	26347360	Italia	country	0	12.60000	42.40000
3	26608813	Catania-Fontanarossa Airport	airport	0	15.06634	37.46742
4	26608814	Aeroporto di Milano-Malpensa	airport	0	8.72621	45.62972

The 'Add' button at the bottom right is highlighted with a red circle.

# Importing a CSV file

Click on the comma icon on the left toolbar (*Manage Layers Toolbar*)



Open the file places\_XY.csv

...Data\Italy\Italy-administrative-shape\

Town\_Reg\_2016.csv

**NO GEOMETRY (NO X,Y )!**

Town\_Reg\_2016.txt - Blocco note

COD_REG	REGIONE	TOWN
1	Piemonte	Torino
2	Valle D'Aosta	Aosta
3	Lombardia	Milano
4	Trentino-Alto Adige	Trento
5	Veneto	Venezia
6	Friuli Venezia Giulia	Trieste
7	Liguria	Genova
8	Emilia-Romagna	Bologna
9	Toscana	Firenze
10	Umbria	Perugia
11	Marche	Ancona
12	Lazio	Roma
13	Abruzzo	L'Aquila
14	Molise	Campobasso
15	Campania	Napoli
16	Puglia	Bari
17	Basilicata	Potenza
18	Calabria	Catanzaro
20	Sardegna	Cagliari
19	Sicilia	Palermo

Data Source Manager | Delimited Text

File Name: C:\DAYLIGHTING RIVERS\QGIS\DATA\Italy\Italy-administrative-shape\Town\_Reg\_2016.txt

Layer Name: Town\_Reg\_2016 Encoding: UTF-8

**File format**

☐ CSV (comma separated values) ☒ Tab ☐ Colon ☐ Space

☐ Regular expression delimiter ☐ Semicolon ☐ Comma Others:

☒ Custom delimiters Quote:  Escape:

**Record and fields options**

Number of header lines to discard: 0 ☐ Decimal separator is comma

☒ First record has field names ☐ Trim fields

☐ Discard empty fields

**Geometry definition**

☐ Point coordinates

☐ Well known text (WKT)

☒ No geometry (attribute only table)

Geometry CRS: EPSG:5659 - Monte Mario / TM Emilia-Romagna

**Layer settings**

Sample data

	COD_REG	REGIONE	TOWN
1	1	Piemonte	Torino
2	2	Valle D'Aosta	Aosta
3	3	Lombardia	Milano
4	4	Trentino-Alto Adige	Trento

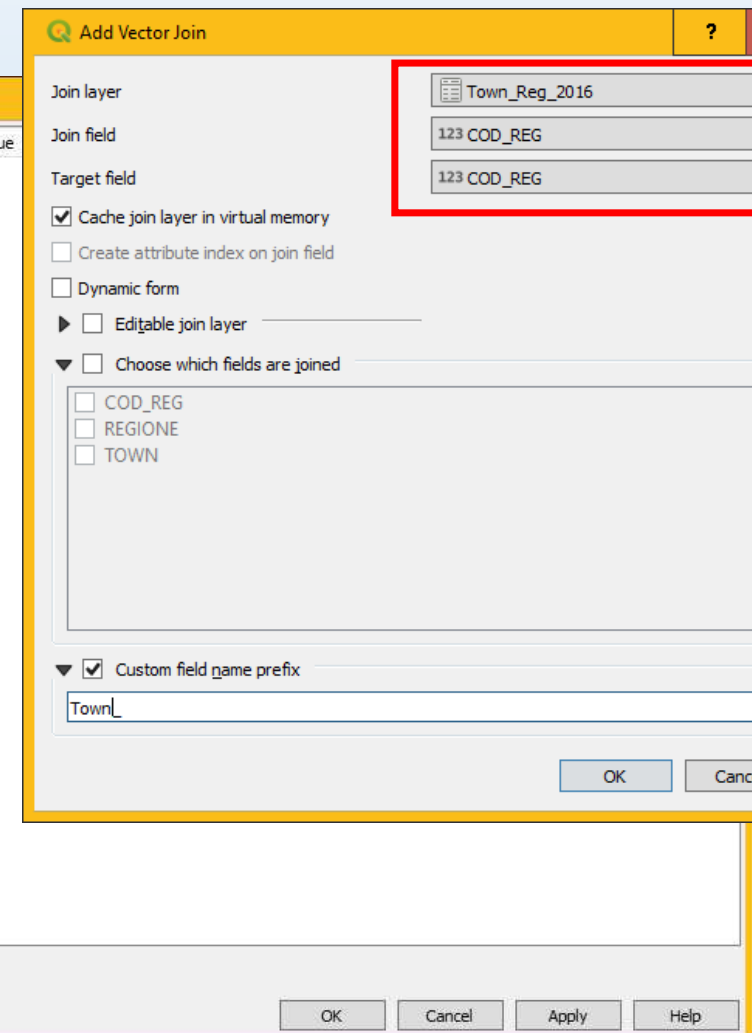
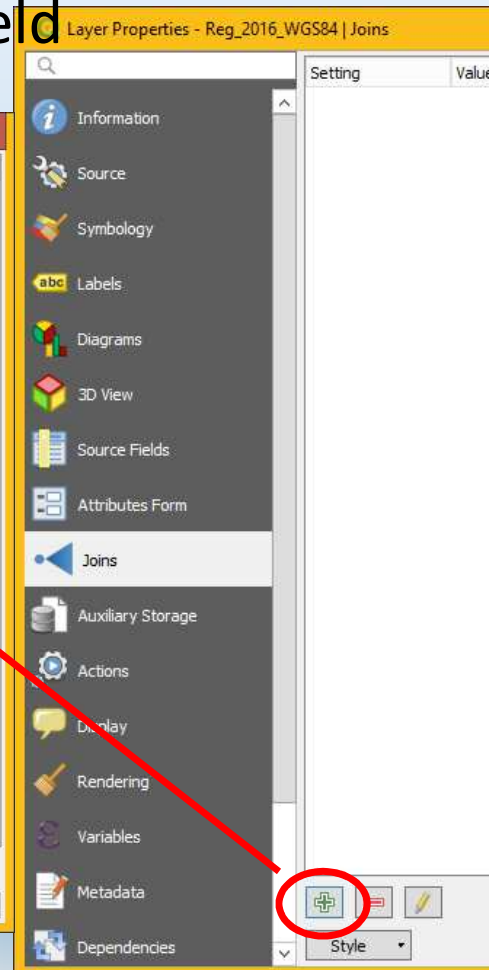
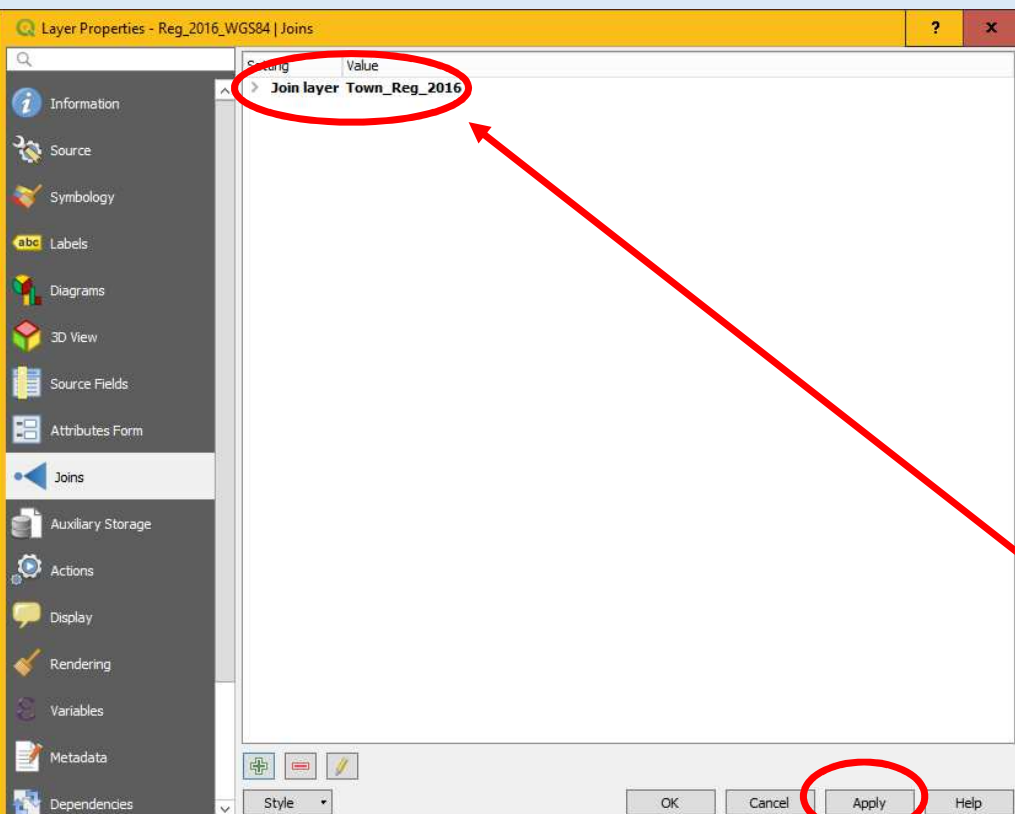
Close Add

# Joining a text table to the attribute table

Right double click on the layer, select > Properties > Join

Click on the green plus

Specify: Join layer, Join field, Target field



# Joining a text table to the attribute table

Table joins are TEMPORARY/VIRTUAL >  
save the layer with a new name to  
make them permanent!

If you don't, when you exit QGIS  
the table will be emptied by  
the program.

Reg\_2016\_WGS84 :: Features Total: 20, Filtered: 20, Selected: 0

	COD_REG	REGIONE	SHAPE_Leng	SHAPE_Area	Town_REGIONE	Town_TOWN
1	13	Abruzzo	664538,0091580...	10831496160,50...	Abruzzo	L'Aquila
2	17	Basilicata	675750,7063110...	10073110438,20...	Basilicata	Potenza
3	18	Calabria	934657,5450179...	15221614078,70...	Calabria	Catanzaro
4	15	Campania	1090752,836720...	13670597003,79...	Campania	Napoli
5	8	Emilia-Romagna	1260948,843270...	22452207785,79...	Emilia-Romagna	Bologna
6	6	Friuli Venezia Giulia	770142,8388320...	7862153894,409...	Friuli Venezia Giulia	Trieste
7	12	Lazio	1201764,764320...	17231723450,40...	Lazio	Roma
8	7	Liguria	1080307,228580...	5416134435,220...	Liguria	Genova
9	3	Lombardia	1511131,903930...	23863097447,00...	Lombardia	Milano
10	11	Marche	711091,4950849...	9401183273,590...	Marche	Ancona
11	14	Molise	471197,6267489...	4460436575,640...	Molise	Campobasso
12	1	Piemonte	1333428,214470...	25386696893,79...	Piemonte	Torino
13	16	Puglia	1507342,394910...	19540517739,79...	Puglia	Bari
14	20	Sardegna	2128723,504490...	24099792551,40...	Sardegna	Cagliari
15	19	Sicilia	1731333,013809...	25832016241,79...	Sicilia	Palermo
16	9	Toscana	1545205,801179...	22986579578,09...	Toscana	Firenze

Show All Features



# Edit the attribute table

The contents of the attribute table can be modified by activating the “edit mode”

Reg\_2016\_WGS84 :: Features Total: 20, Filtered: 20, Selected: 0

Toggle editing mode (Ctrl+E) Update All Update Selected

	COD_REG	REGIONE	SHAPE_Leng	SHAPE_Area	Town_REGIONE	Town_TOWN
11	14	Molise	471197.6267489...	4460436575.640...	Molise	Campobasso
12	1	Piemonte	1333428.214470...	25386696893.79...	Piemonte	Torino
13	16	Puglia	1507342.394910...	19540517739.79...	Puglia	Bari
14	20	Sardegna	2128723.504490...	24099792551.40...	Sardegna	Cagliari
15	19	Sicilia	1731333.013809...	25832016241.79...	Sicilia	Palermo
16	9	Toscana	1545205.801179...	22986579578.09...	Toscana	Firenze
17	4	Trentino-Alto Adige	859873.1379769...	13604721582.50...	Trentino-Alto Adige	Trento
18	10	Umbria	671416.0412500...	8464223125.920...	Umbria	Perugia
			325836.3681009...	3260854220.039...	Valle D'Aosta	Aosta

Delete field

Add field

Field calculator

Conditional formatting

Save edits!

# Edit the attribute table

Add field

Delete field

Field calculator

Conditional formatting

Add Field
?
X

Name
  
Comment
  
Type
Whole number (integer)
  
Provider type
integer
  
Length
0

OK
Cancel

Add Field
?
X

Name
  
Comment
  
Type
Whole number (integer)
  
Provider type
Whole number (integer)
Whole number (integer 64 bit)
Decimal number (real)
Text (string)
Date
  
Length

OK
Cancel

Delete Fields
?
X

COD\_REG
REGIONE
SHAPE\_Leng
SHAPE\_Area
Town\_REGIONE
Town\_TOWN

OK
Cancel

Join

Field Calculator
?
X

☒ Create a new field
☐ Update existing field

☐ Create virtual field

Output field name
  
Output field type
Whole number (integer)
Whole number (integer 64 bit)
Decimal number (real)
Text (string)
Date
  
Output field length
  
Expression
Full

row\_number
Aggregates
Arrays
Color
Conditionals
Conversions
Date and Time
Fields and Values
COD\_REG
NULL
REGIONE
SHAPE\_Leng
SHAPE\_Area
Town\_REGI...
Town\_TOWN
Fuzzy Matching
General
Geometry
Map Layers
Maps
Math
Operators
Record and Attri...

group Aggregates
Contains functions which aggregate values over layers and fields.

Output preview:

OK
Cancel
Help

Reg\_2016\_WGS84 :: Features Total: 20, Filtered: 2...
-
X

123 COD\_REG = 123 COD\_REG
Update All
Update Selected

REGIO
1 Piemonte
2 Valle D'Aost
3 Lombardia
4 Trentino-Alt
5 Veneto
6 Friuli Venezi
7 Liguria
8 Emilia-Roma
9 Toscana
10 Umbria
11 Marche
12 Lazio
13 Abruzzo
14 Molise

Conditional Format Rules
Name
Condition
@value
Preset
abc - 123
Background
Text
Icon
MS Shell Dlg 2
Done
Cancel

Show All Features

# Edit the attribute table

- ☐ Add the .txt file «Population by region»
- ☐ Join it to the .shp file Reg\_2016\_WGS84 via the field «COD\_REG»
- ☐ Save the layer as Reg\_Pop\_2016\_WGS84
- ☐ Edit the attribute table to calculate population density for each region and display it on the map with labels

