Topology

ISTANBUL**TECHNICAL**UNIVERSITY

Sp. Anly. and Alg. in GIS
Week 3

Res. Assist. Ömer AKIN

Introduction & Aim of the Study

Aim of the Study:

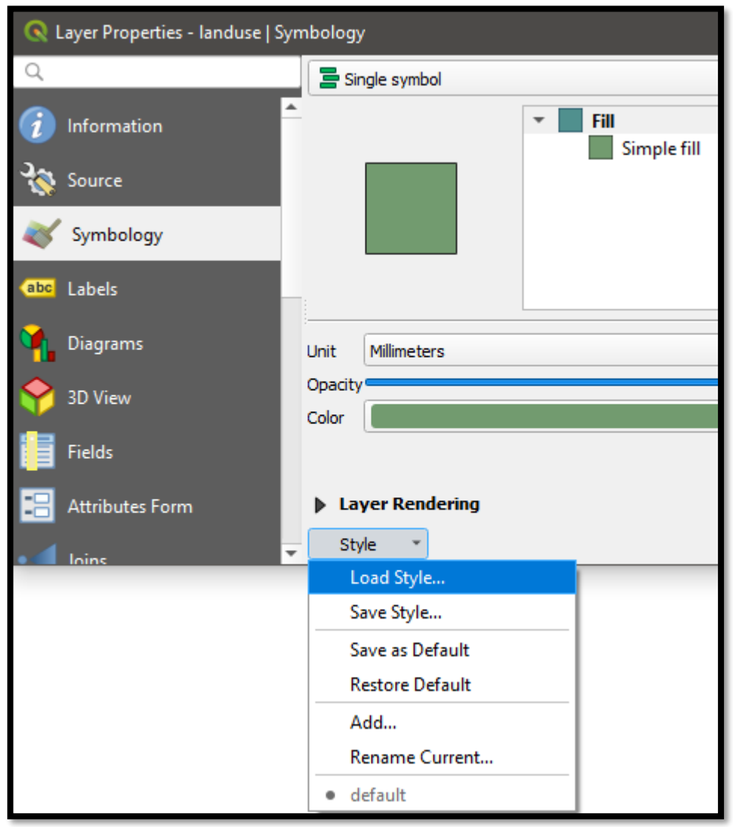
- *Check the errors of given vector data by following topology rules*

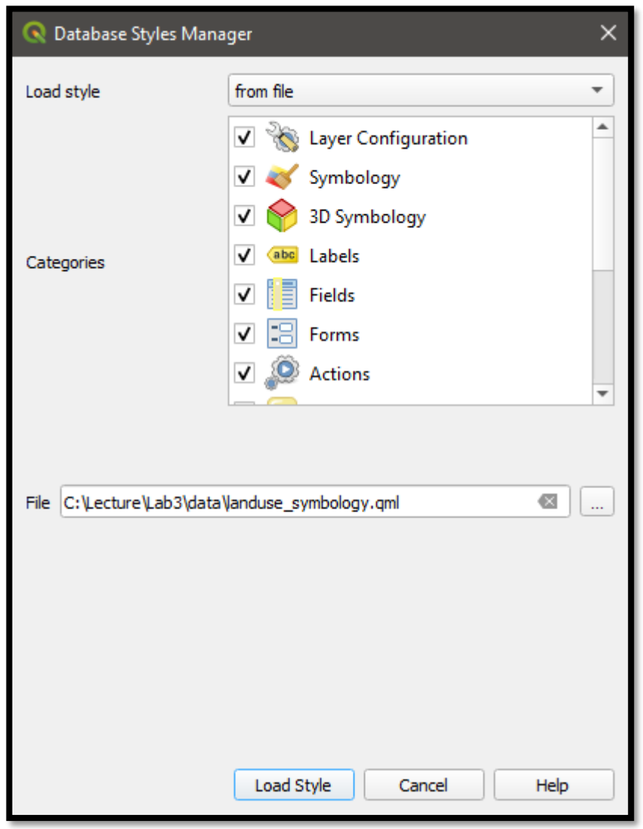
Input Data:

- *Topology Check (Geopackage)*
  - *POI (Vector-Point)*
  - *Nodes (Vector-Point)*
  - *Edges (Vector-Polyline)*
  - *Buildings (Vector-Polygon)*
  - *Landuse (Vector-Polygon)*

Exploring Data

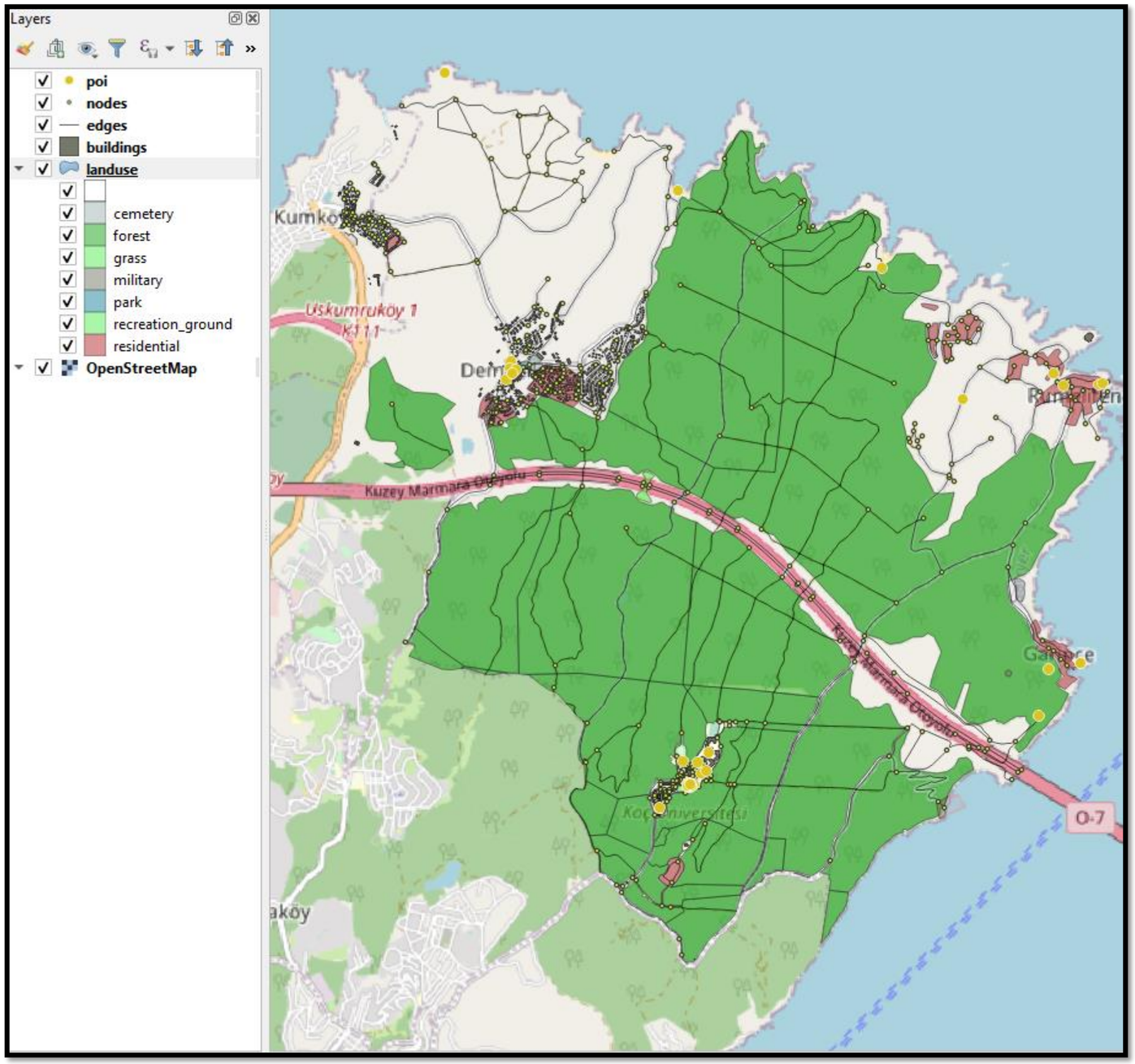
Open poi, roads, edges, landuse and buildings in QGIS and apply landuse sembology by using given styling file named “landuse_symbology.qml”



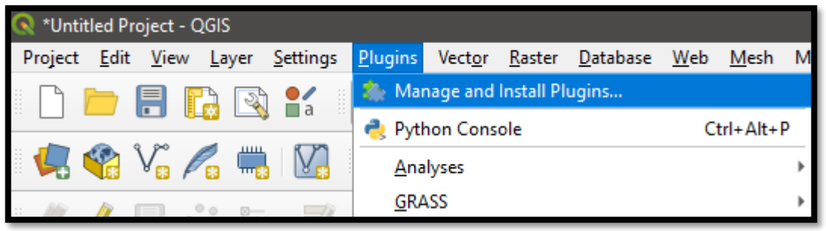


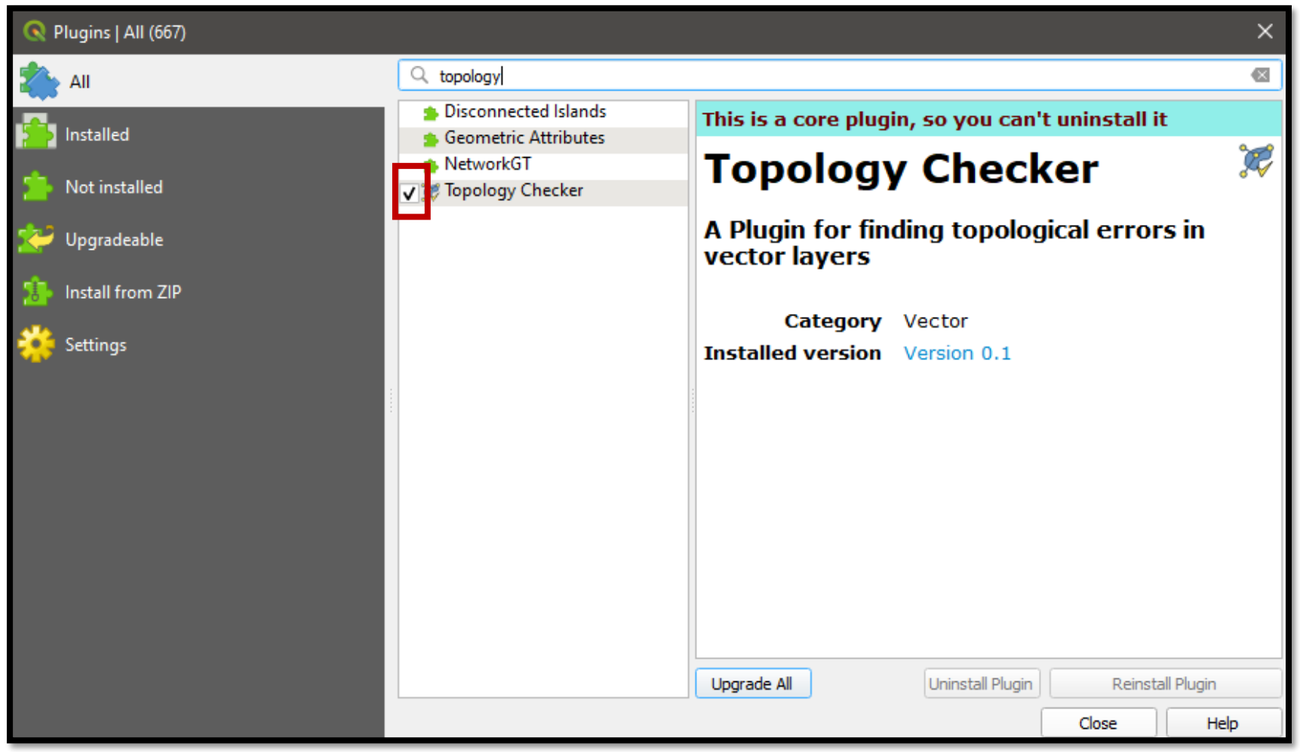
Exploring Data

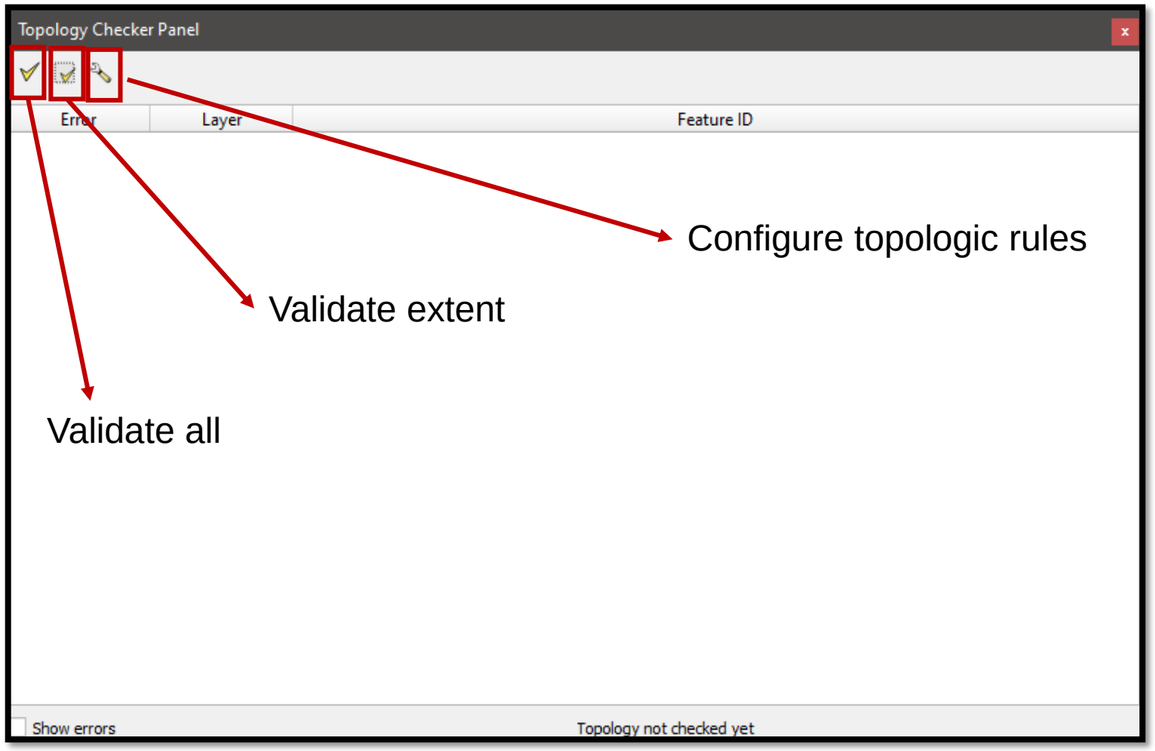
Explore with OpenStreetMap Basemap

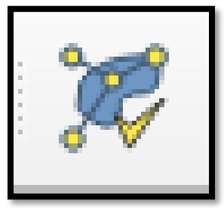


Topology Checker





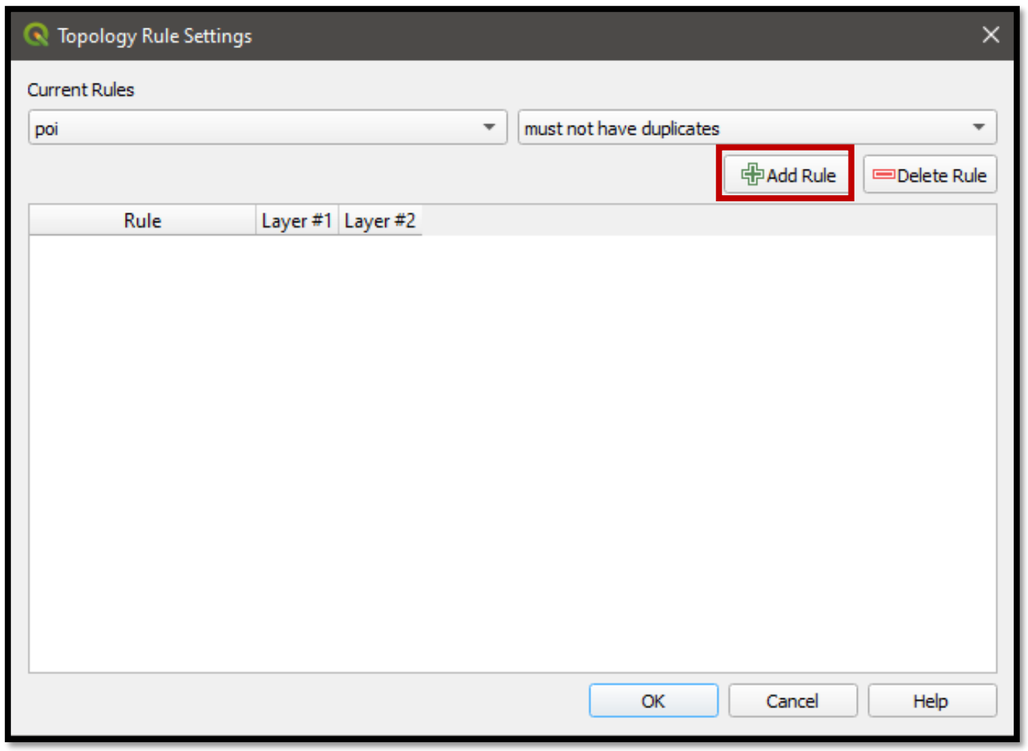




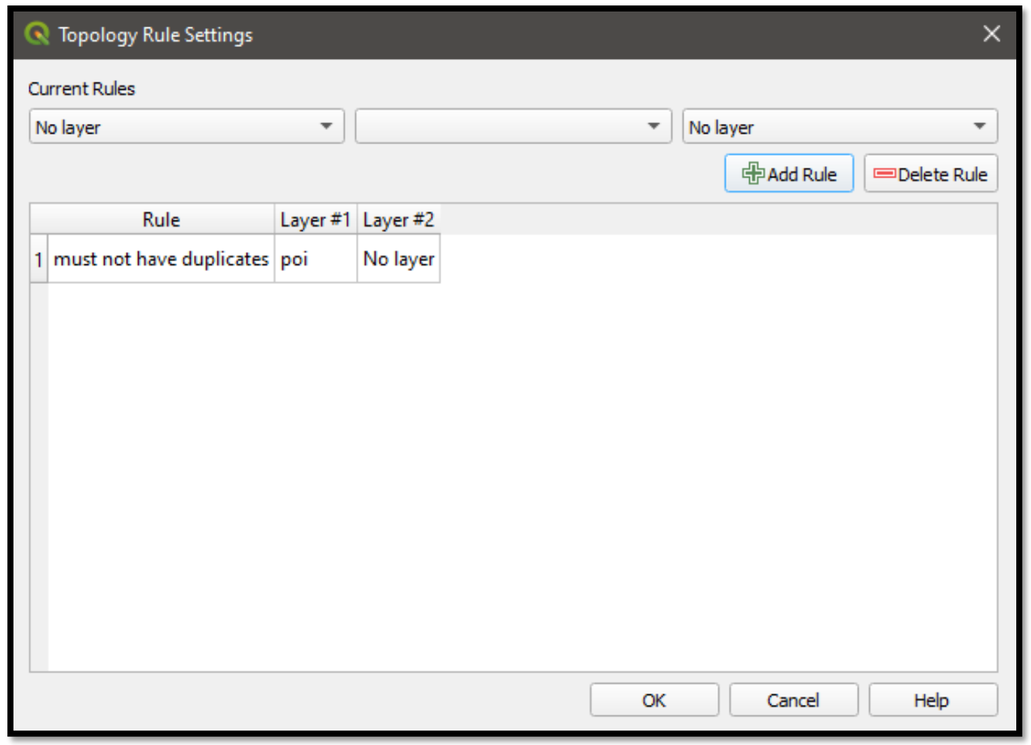
Point Topology Rules in QGIS

- **Must be covered by:** Here you can choose a vector layer from your project. Points that aren't covered by the given vector layer occur in the 'Error' field.
- **Must be covered by endpoints of:** Here you can choose a line layer from your project.
- **Must be inside:** Here you can choose a polygon layer from your project. The points must be inside a polygon. Otherwise, QGIS writes an 'Error' for the point.
- **Must not have duplicates:** Whenever a point is represented twice or more, it will occur in the 'Error' field.
- **Must not have invalid geometries:** Checks whether the geometries are valid.
- **Must not have multi-part-geometries:** All multi-part points are written into the 'Error' field.

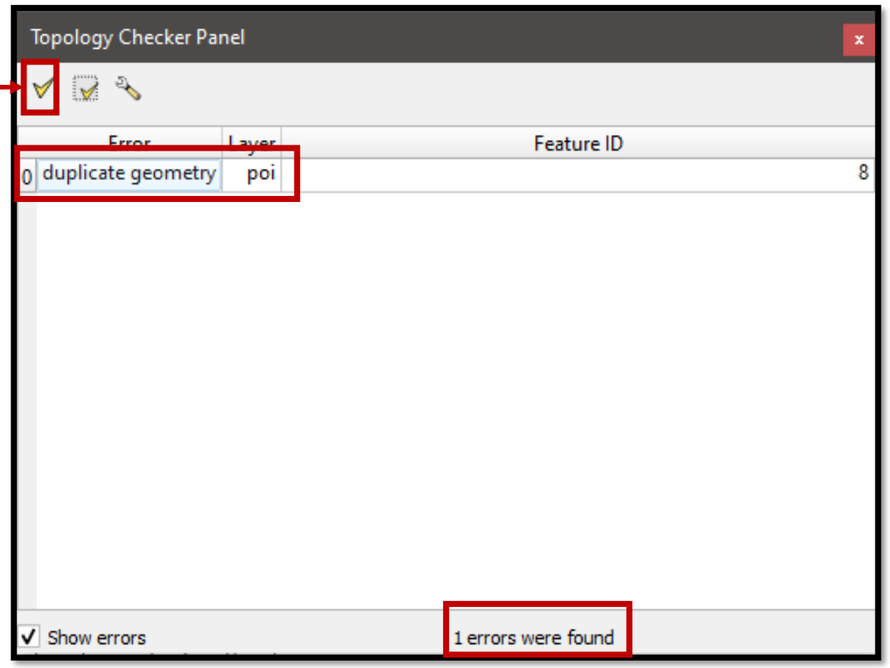
Point Topology Rules
Must not have duplicates



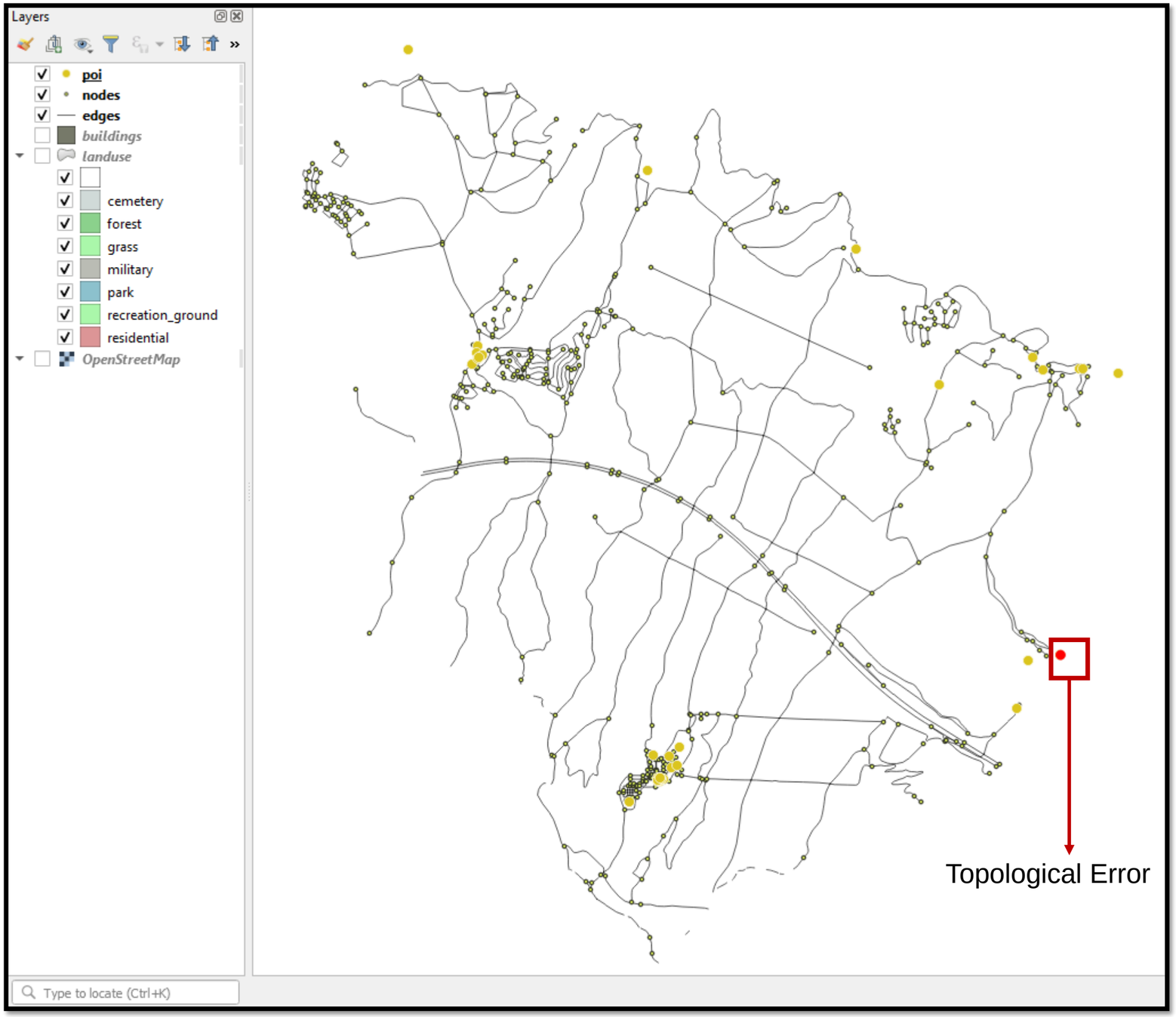
Configure Topology Rules



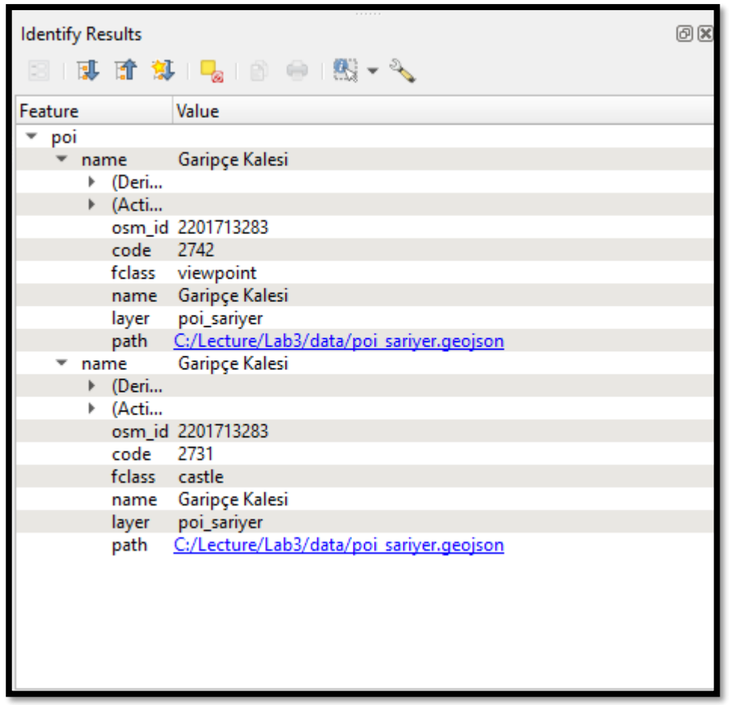
Validate all



Point Topology Rules
Must not have duplicates



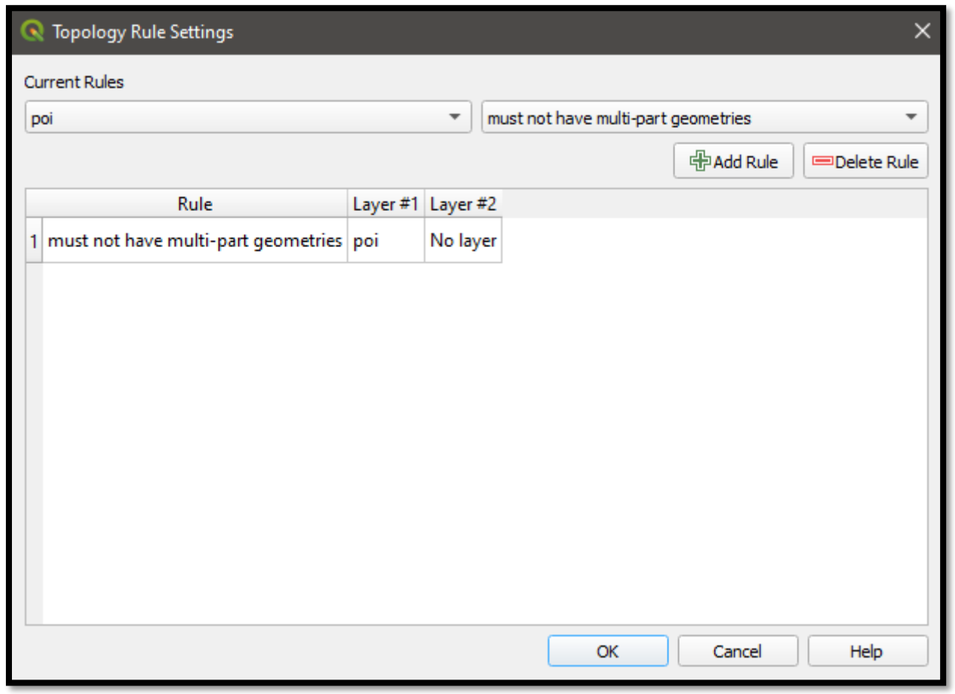
Zoom to topologic error and identify features



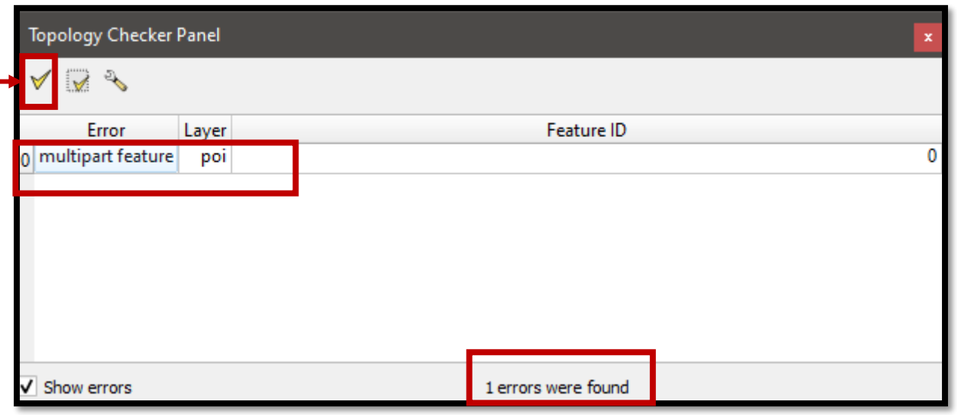
There are two point data in same coordinates

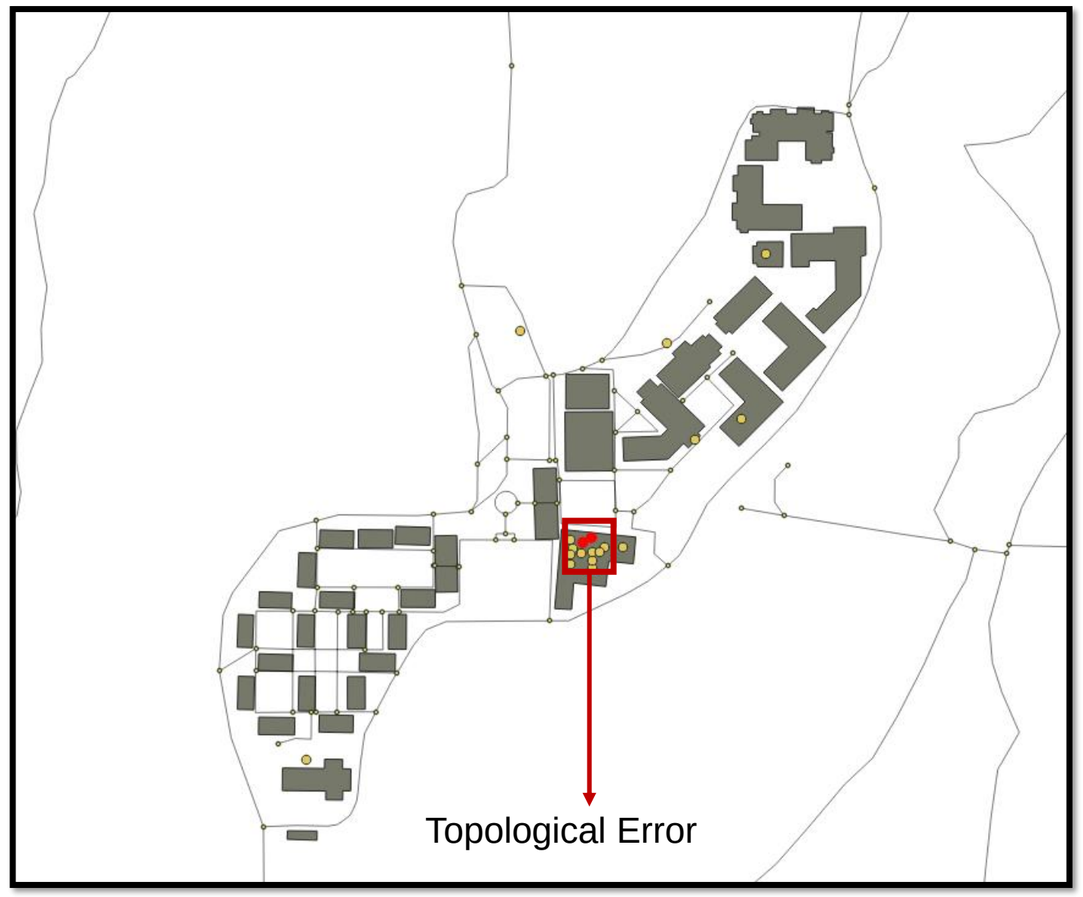
Point Topology Rules
Must not have multi-part geometries

Configure



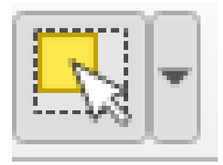
Validate all

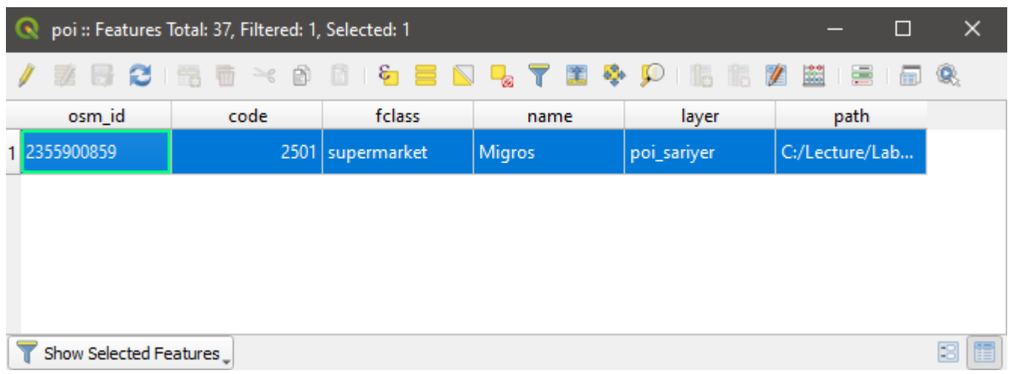




Point Topology Rules
Must not have multi-part geometries

Select these points to further explore in attribute table





Two distinct points are represented as one multipart geometry

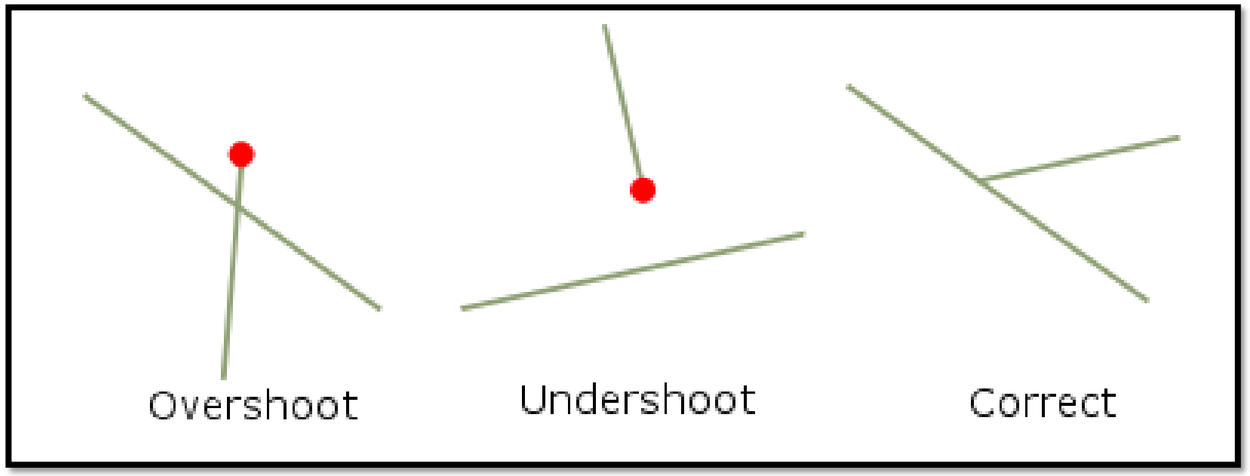
After detecting Multipart geometries, they could easily be handled by “Multipart to Singlepart” tool

Polyline Topology Rules in QGIS

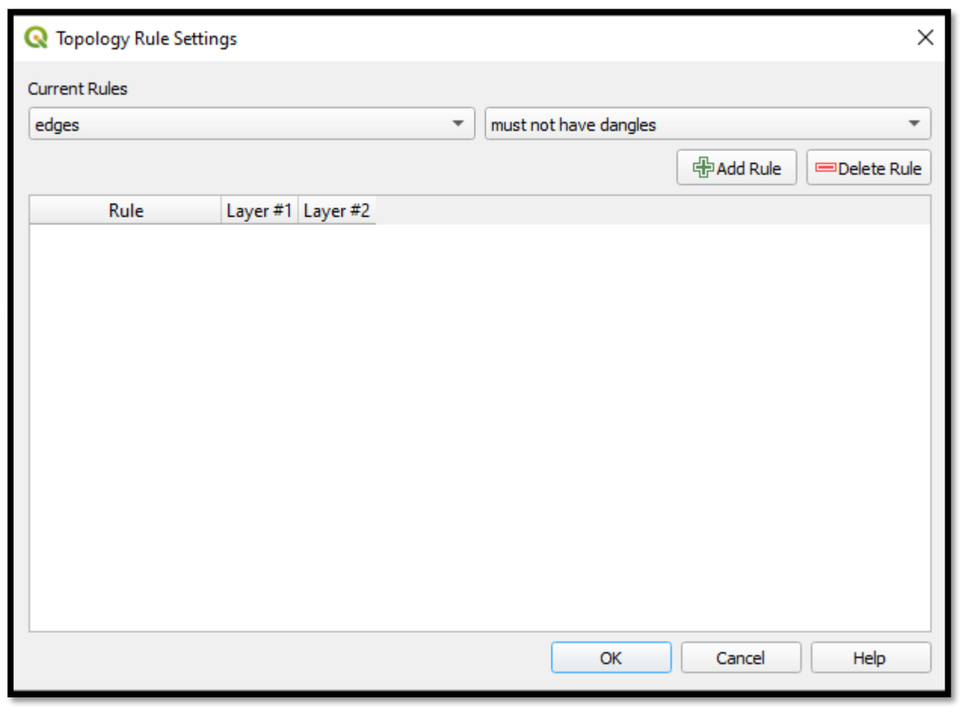
- **End points must be covered by:** Here you can select a point layer from your project.
- **Must not have dangles:** This will show the overshoots in the line layer.
- **Must not have duplicates:** Whenever a line feature is represented twice or more, it will occur in the ‘Error’ field.
- **Must not have invalid geometries:** Checks whether the geometries are valid.
- **Must not have multi-part geometries:** Sometimes, a geometry is actually a collection of simple (single-part) geometries. Such a geometry is called multi-part geometry. If it contains just one type of simple geometry, we call it multi-point, multi-linestring or multi-polygon. All multi-part lines are written into the ‘Error’ field.
- **Must not have pseudos:** A line geometry’s endpoint should be connected to the endpoints of two other geometries. If the endpoint is connected to only one other geometry’s endpoint, the endpoint is called a pseudo node.

Polyline Topology Rules
Must not have dangles

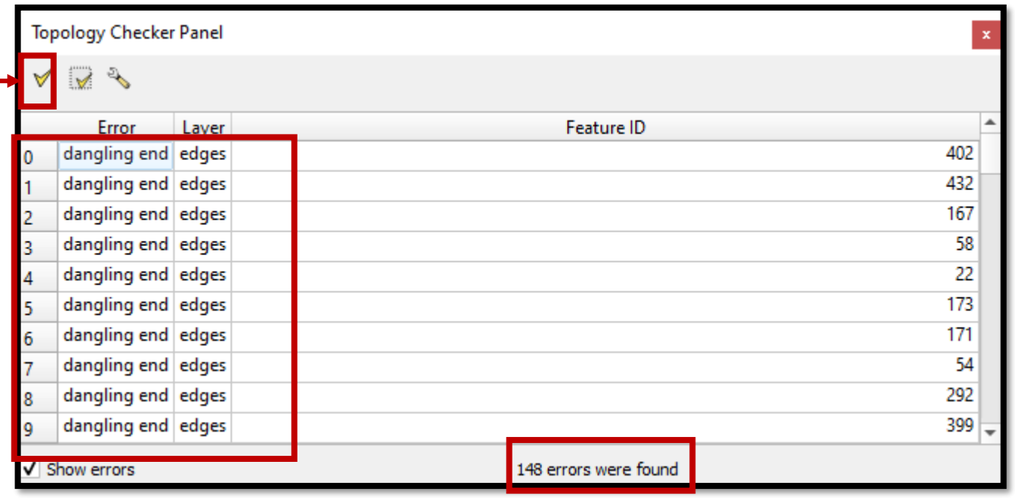
Polylines must not have dangles to create network topology.
It is an important consideration before initializing any network analysis



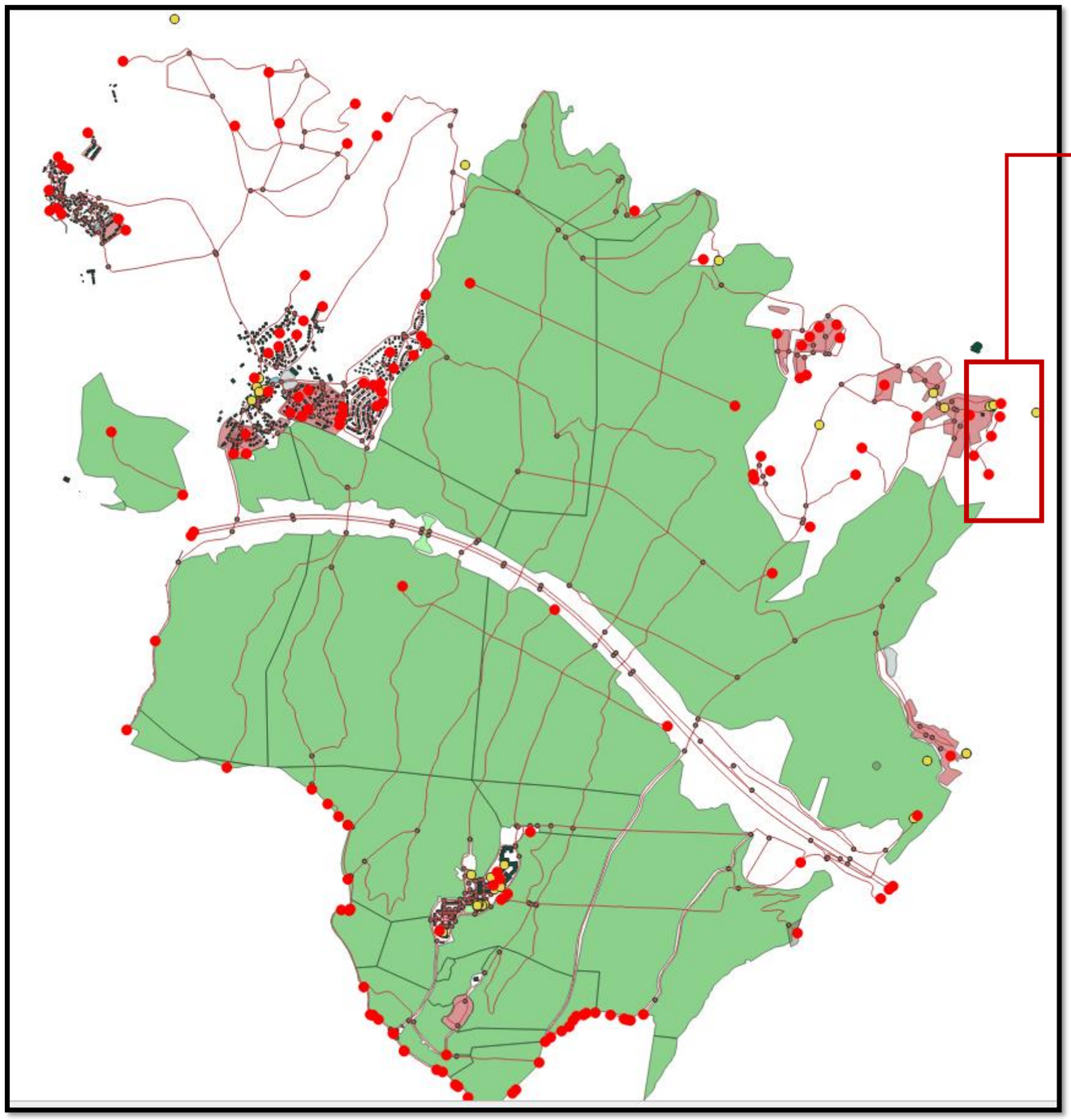
Configure



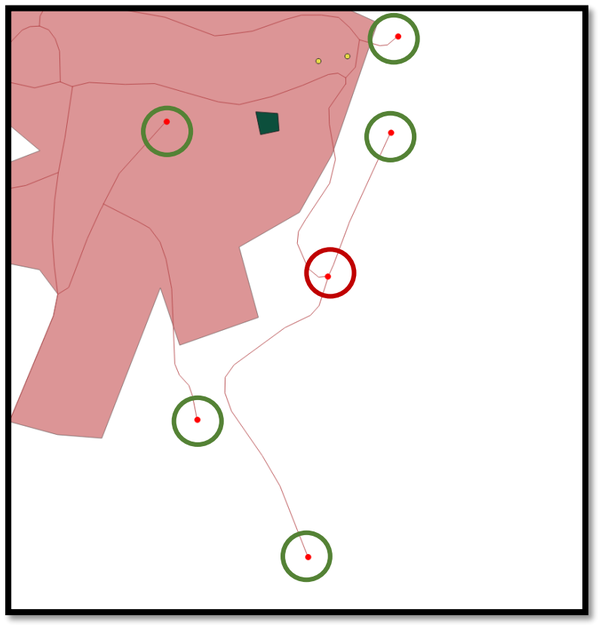
Validate all



Polyline Topology Rules
Must not have dangles



Zoom here to inspect errors in detail

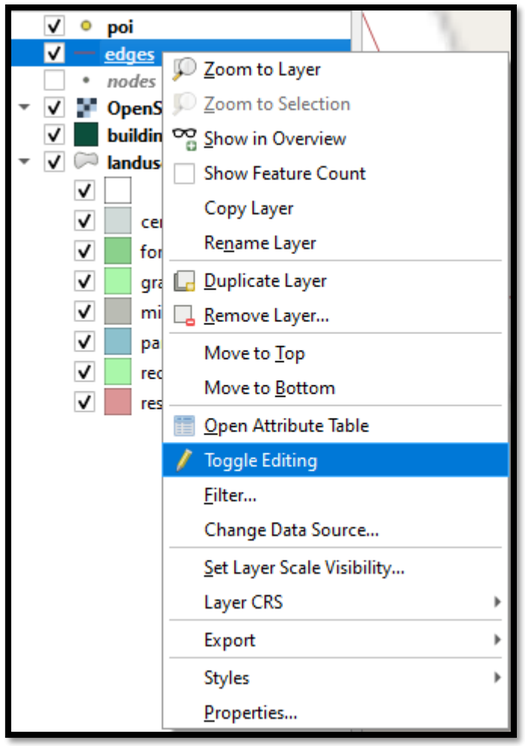


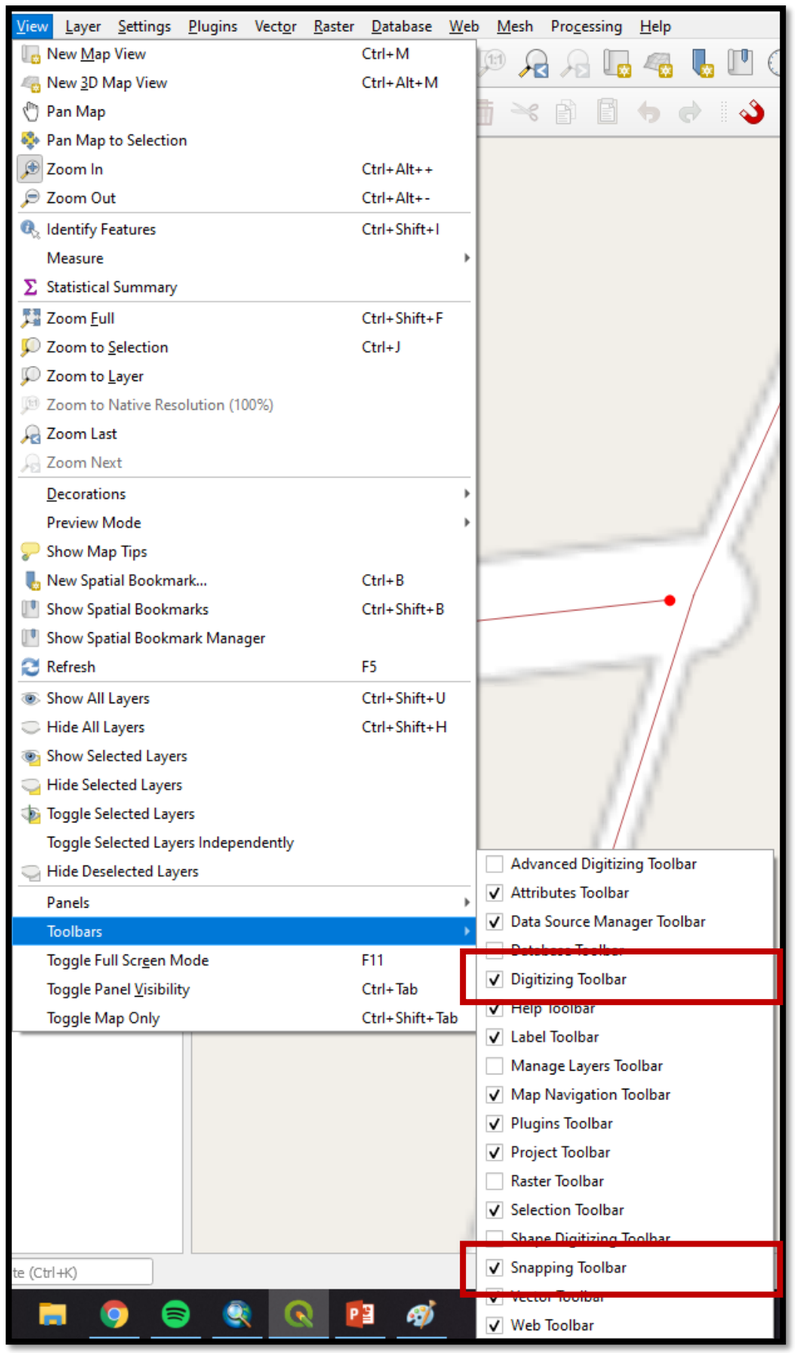
- Green circles are the endpoints of a road segment. So the topological errors need to be neglected.
- Red circle seems to be a vertex point so it should be further investigated.

Polyline Topology Rules
Must not have dangles

This is a vertex point as we can see with the help of OpenStreet basemap. Before starting any network analysis, this should be edited.

Editing Vector Data



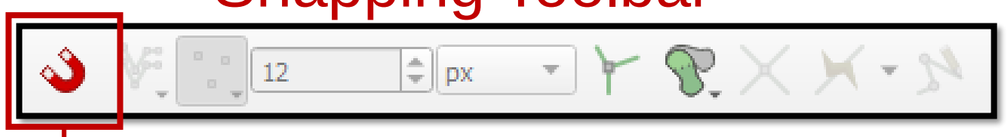


Digitazing Toolbar

Save Edits

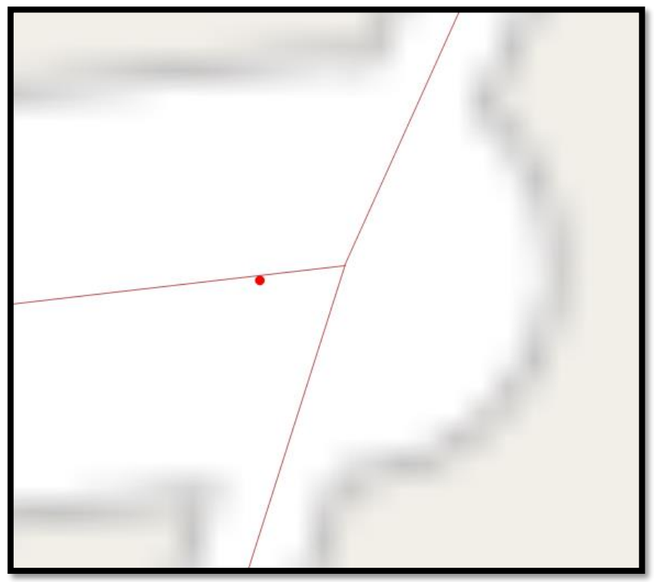
Select/Edit Vertex Tool

Snapping Toolbar



Snapping

Dangle error is eliminated. Do another topology check to see.

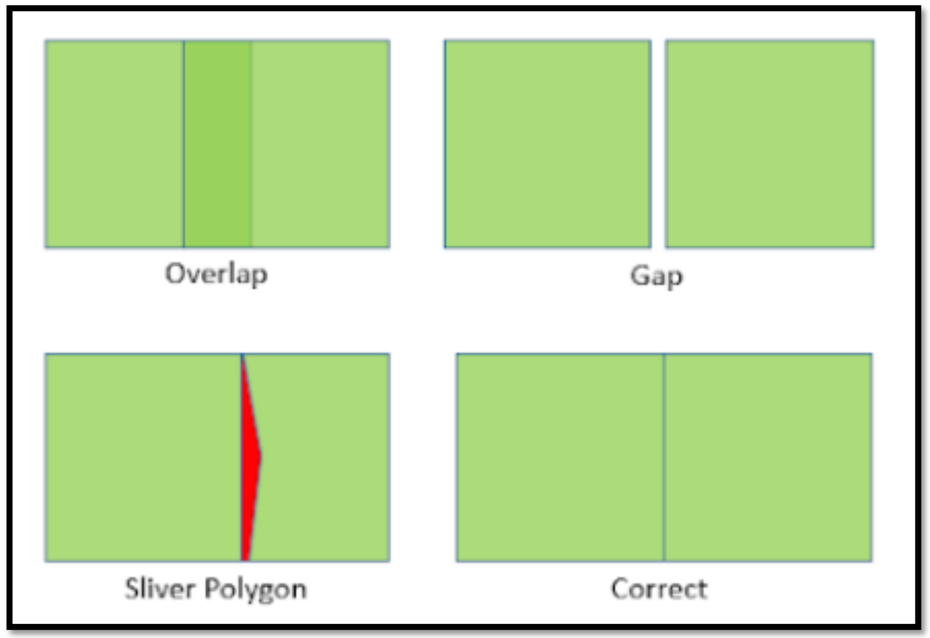


Polygon Topology Rules in QGIS

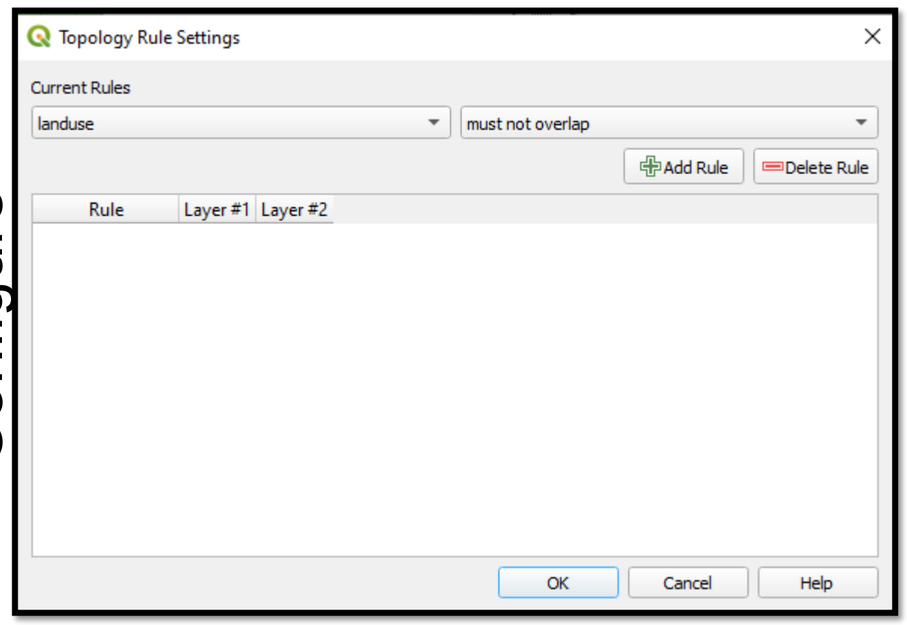
- **Must contain:** Polygon layer must contain at least one point geometry from the second layer.
- **Must not have duplicates:** Polygons from the same layer must not have identical geometries. Whenever a polygon feature is represented twice or more it will occur in the ‘Error’ field.
- **Must not have gaps:** Adjacent polygons should not form gaps between them. Administrative boundaries could be mentioned as an example (US state polygons do not have any gaps between them…).
- **Must not have invalid geometries:** Checks whether the geometries are valid. Some of the rules that define a valid geometry are:
  - Polygon rings must close.
  - Rings that define holes should be inside rings that define exterior boundaries.
  - Rings may not self-intersect (they may neither touch nor cross one another).
  - Rings may not touch other rings, except at a point.
- **Must not have multi-part geometries:** Sometimes, a geometry is actually a collection of simple (single-part) geometries. Such a geometry is called multi-part geometry. If it contains just one type of simple geometry, we call it multi-point, multi-linestring or multi-polygon. For example, a country consisting of multiple islands can be represented as a multi-polygon.
- **Must not overlap:** Adjacent polygons should not share common area.
- **Must not overlap with:** Adjacent polygons from one layer should not share common area with polygons from another layer.

Polygon Topology Rules
Must not overlap

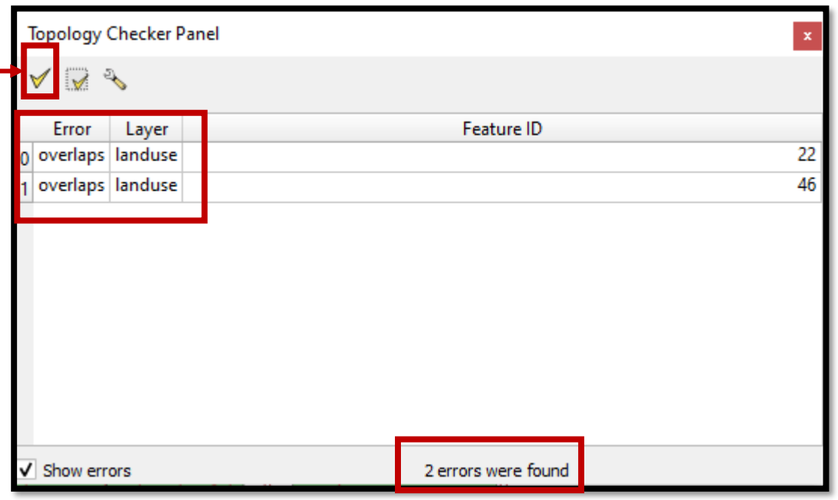
Overlap occurs where a part or whole part of a feature occupies the same position with another feature. It is impossible for a feature (such as parcels) to have same position with another feature.



Configure

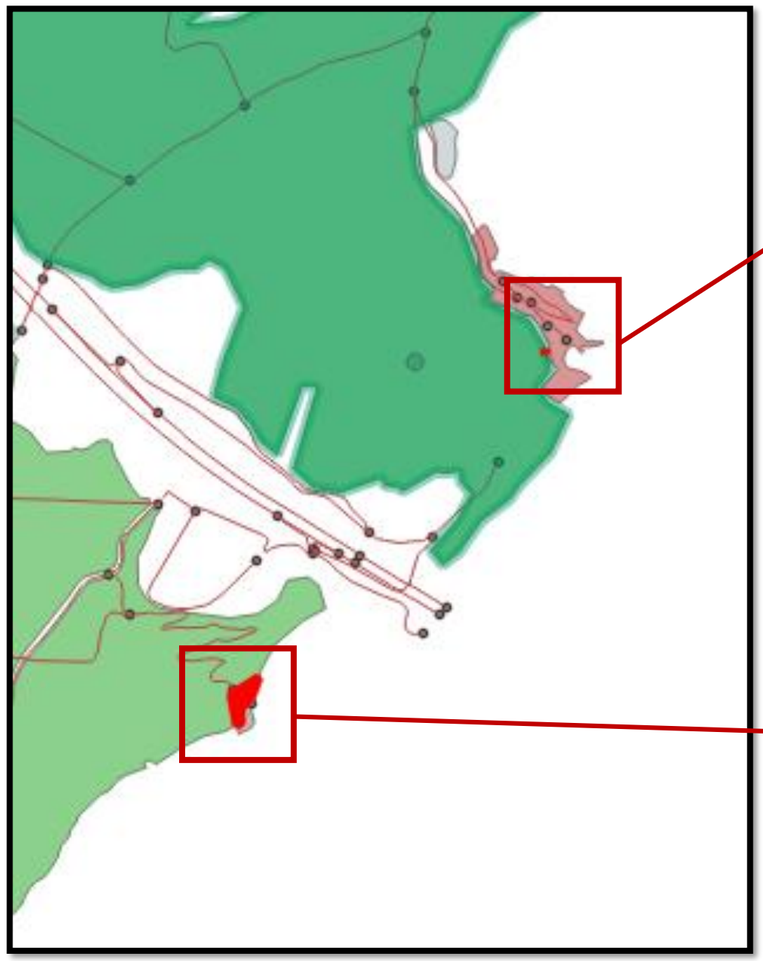


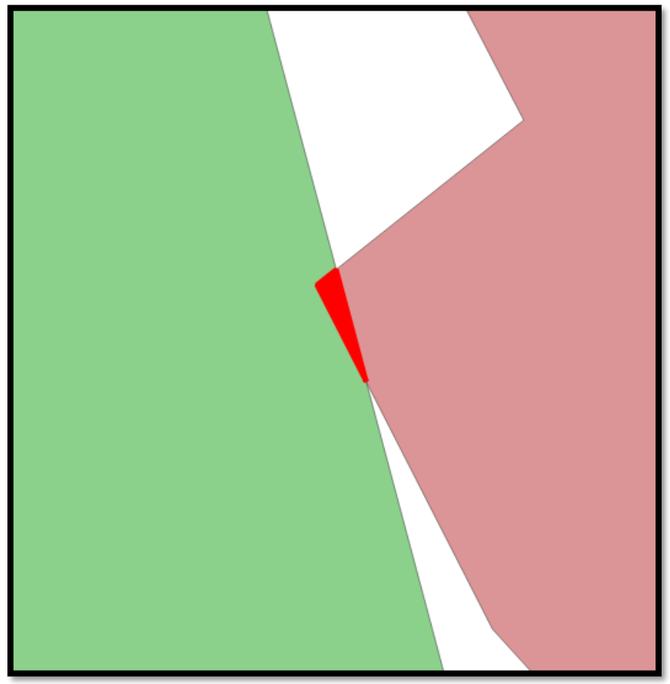
Validate all



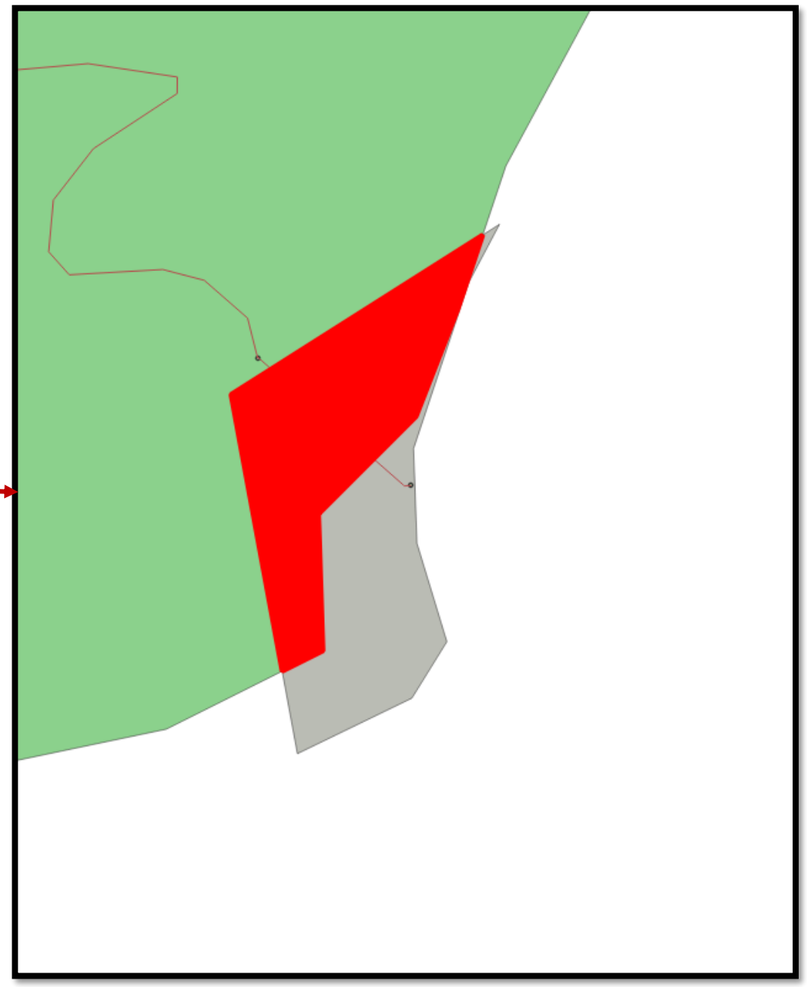
Polygon Topology Rules
Must not overlap

Conflict between forest and residential classes



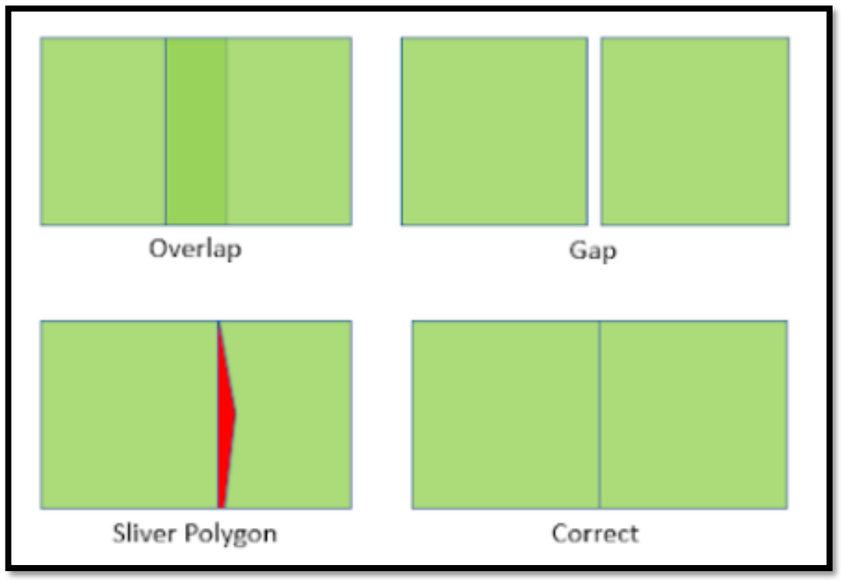


Conflict between forest and military classes

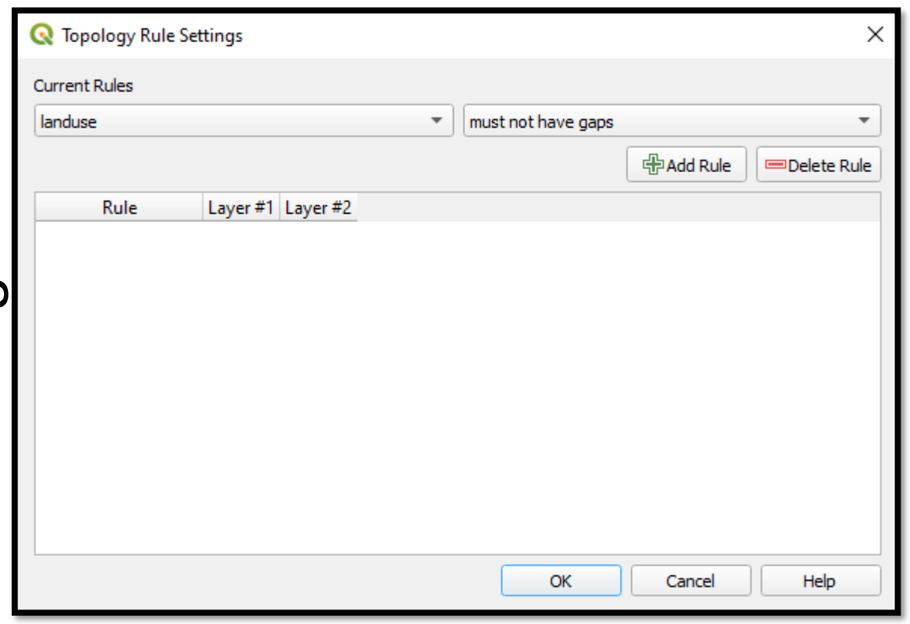


Polygon Topology Rules
Must not have gaps

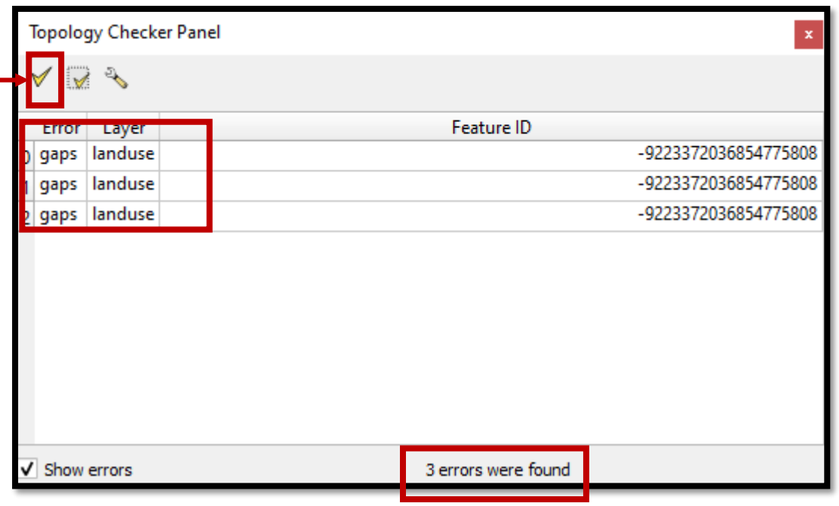
Gaps occurs where two adjacent features that share a common boundary, contains a blank area between. It is impossible for a parcel or a country which is neighbor with another parcel/country has no data area around their common boundary.



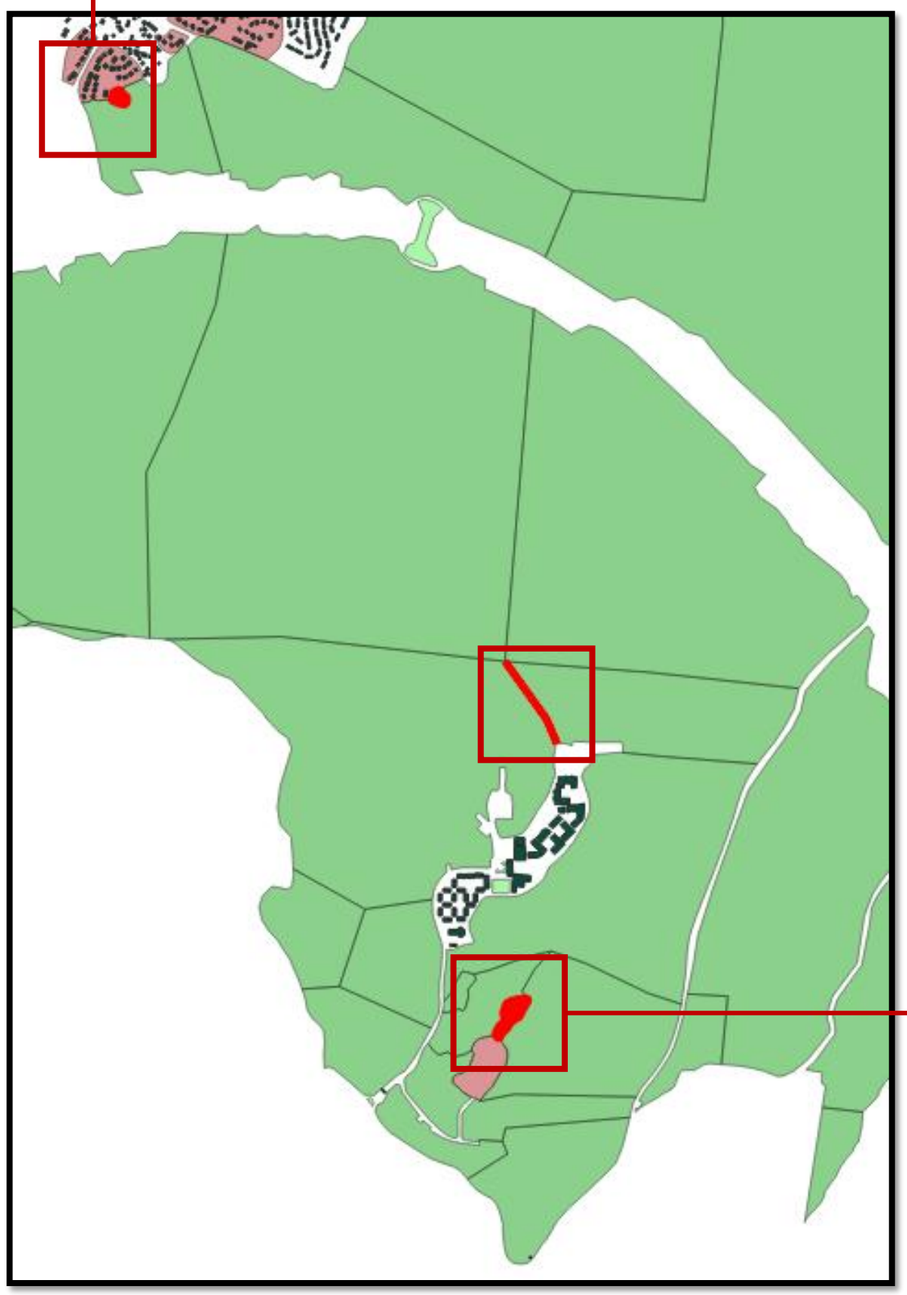
Configure

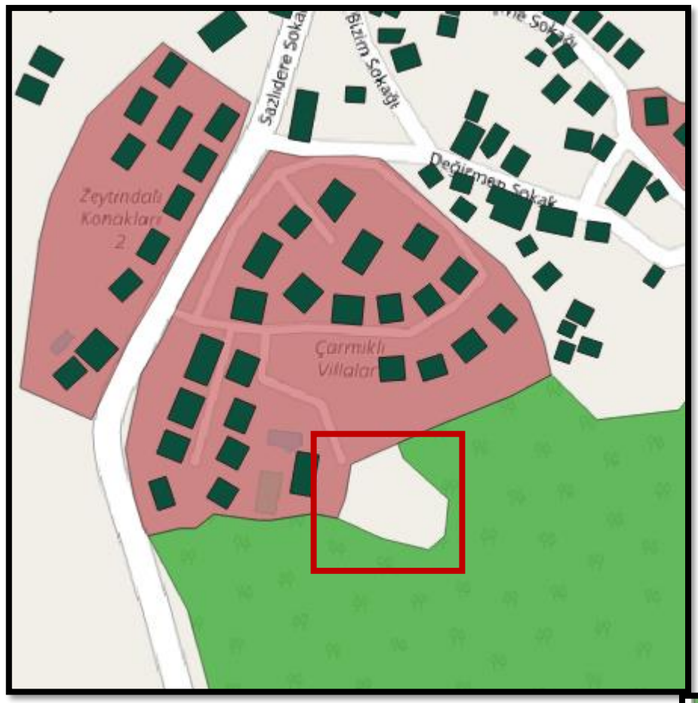


Validate all



Polygon Topology Rules
Must not have gaps

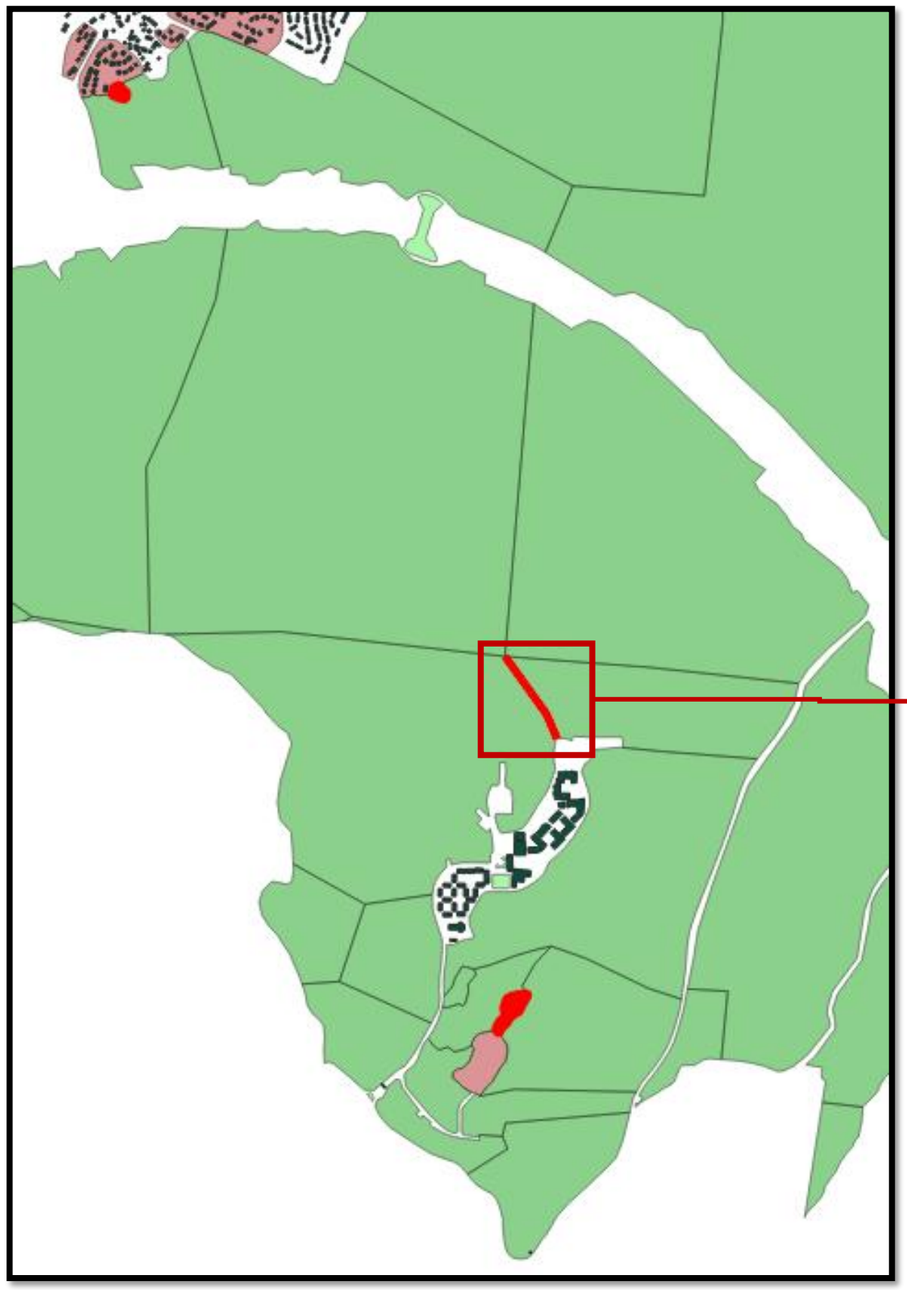




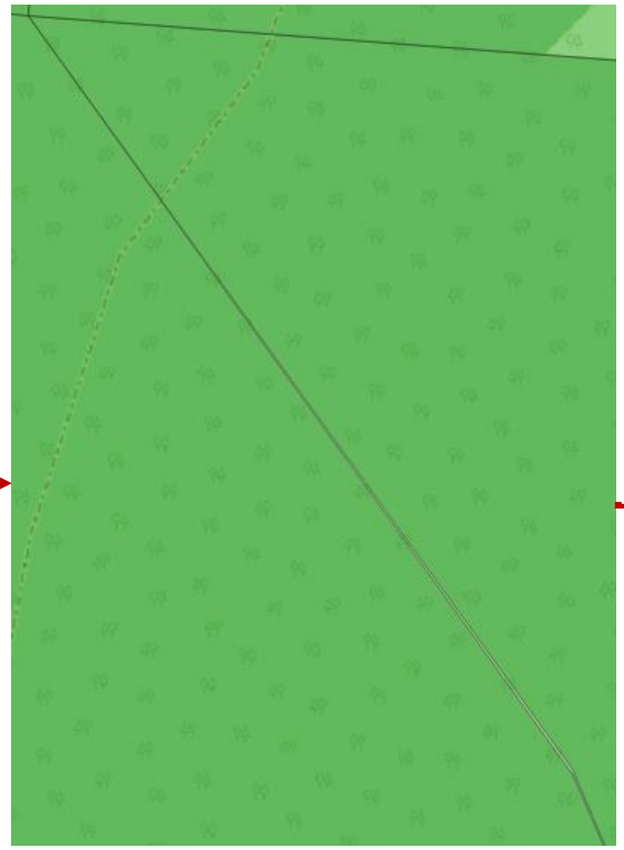
No Topological Error.
As we can see from the basemap, that space is empty.

As we can see from the basemap, that space belongs to Koç Üniversitesi Rektörlüğü. It is not a topological error, that place just didn't represented in landuse data

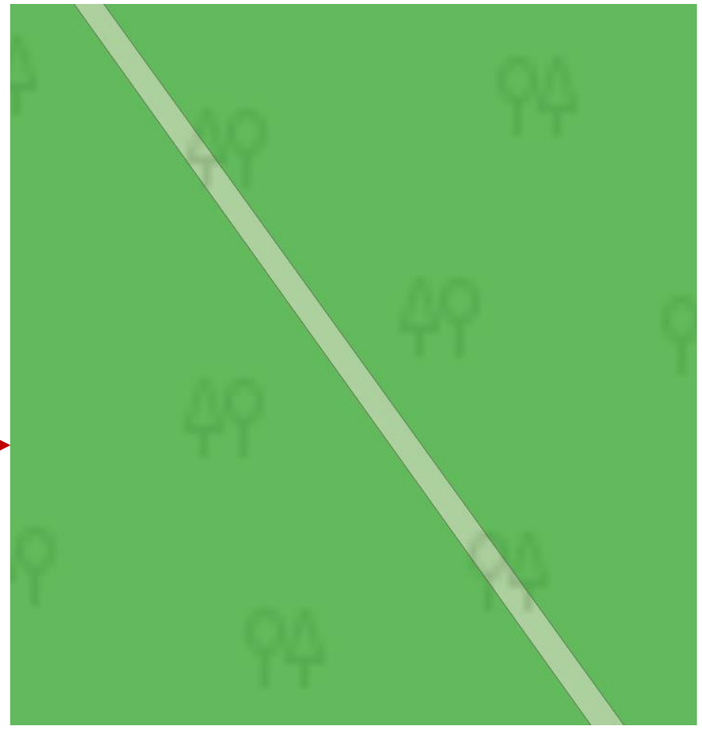
Polygon Topology Rules
Must not have gaps



Zoom In



Zoom In



There is a topological error. Both of the landuse classes are represented as forest in Basemap. This should be edited.

Results & Take Home

Our aims were

- *Check the errors of given vector data by following topology*

Take Home Part

- *Edit overlap and gap issues of landuse by using editing/snapping toolbars in QGIS*
- *Try other topologic rules by using given data and try to explore possible errors further.*

Contact:

akinom@itu.edu.tr