Vector Analysis

Lab_05: Vector Digitization & Spatial Queries

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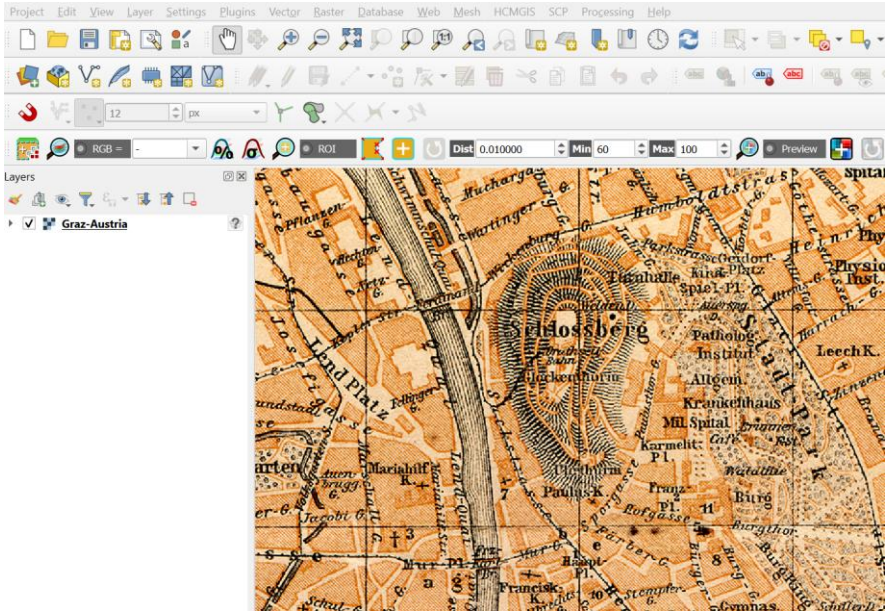
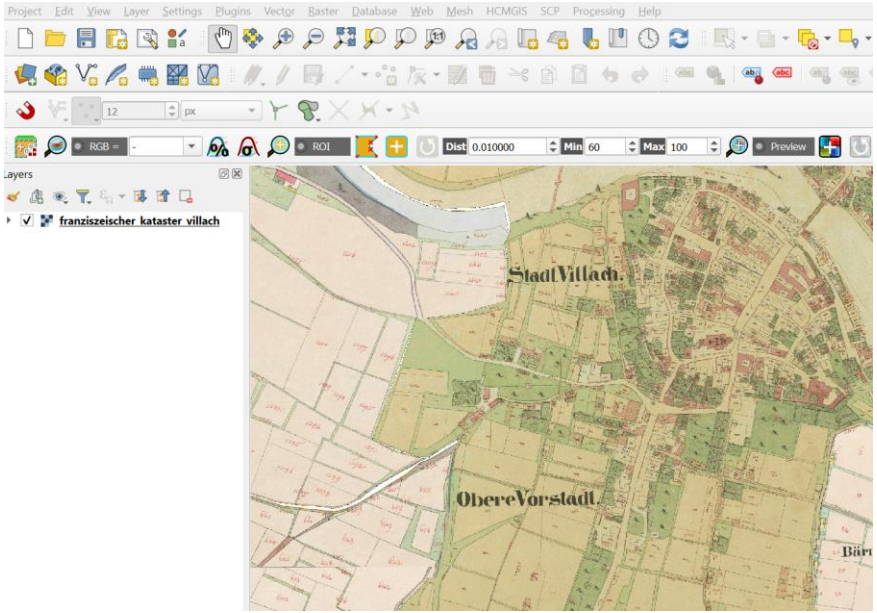
05 November 2025

Non-georeferenced Vs georeferenced data

Lab04



Lab05



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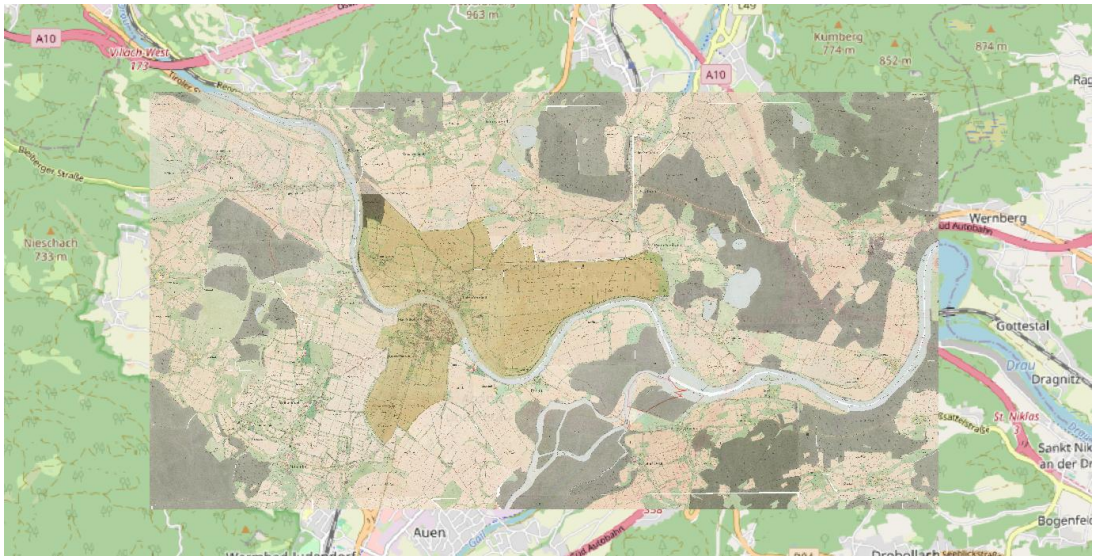
Turning historical maps into actionable insights

Unless you are going to use your georeferenced map as a simple background image, the next natural step is to digitize elements from it such as buildings, lakes, roads and more



https://docs.qgis.org/3.40/en/docs/training_manual/create_vector_data/create_new_vector.html

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Change detection example

c. 1826

Present day c. 2024

Silbersee area

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Benefits of digitizing old maps

1. Enhanced analytical capabilities
2. Cross-referencing with modern data
3. Collaborative research opportunities
4. Public engagement and education
5. Preserving research integrity

https://www.erecordsusa.com/how-to-digitize-old-maps

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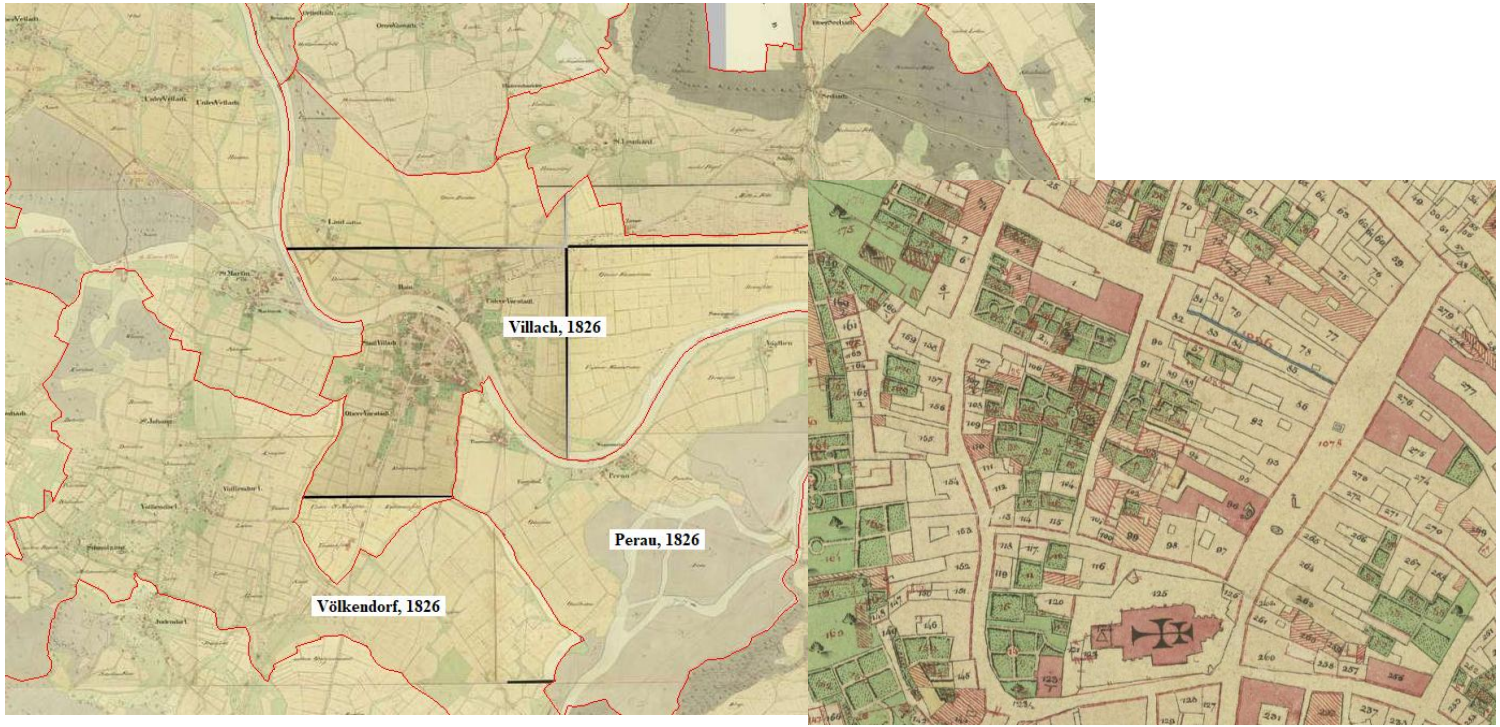
Mapire - Cadastral Survey of the Austrian Empire (Franciscan Cadastre)



https://maps.arcanum.com/en/map/cadastral/?layers=3%2C4&bbox=1533802.582218791%2C5875968.131302737%2C1552004.1495791986%2C5882493.942592584

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Digitization

What is digitization?

"It is the process of converting the geographic features on a map (analogue, scanned) into digital x, y coordinates, or spatial data". (ESRI GIS Dictionary)

Points for single locations

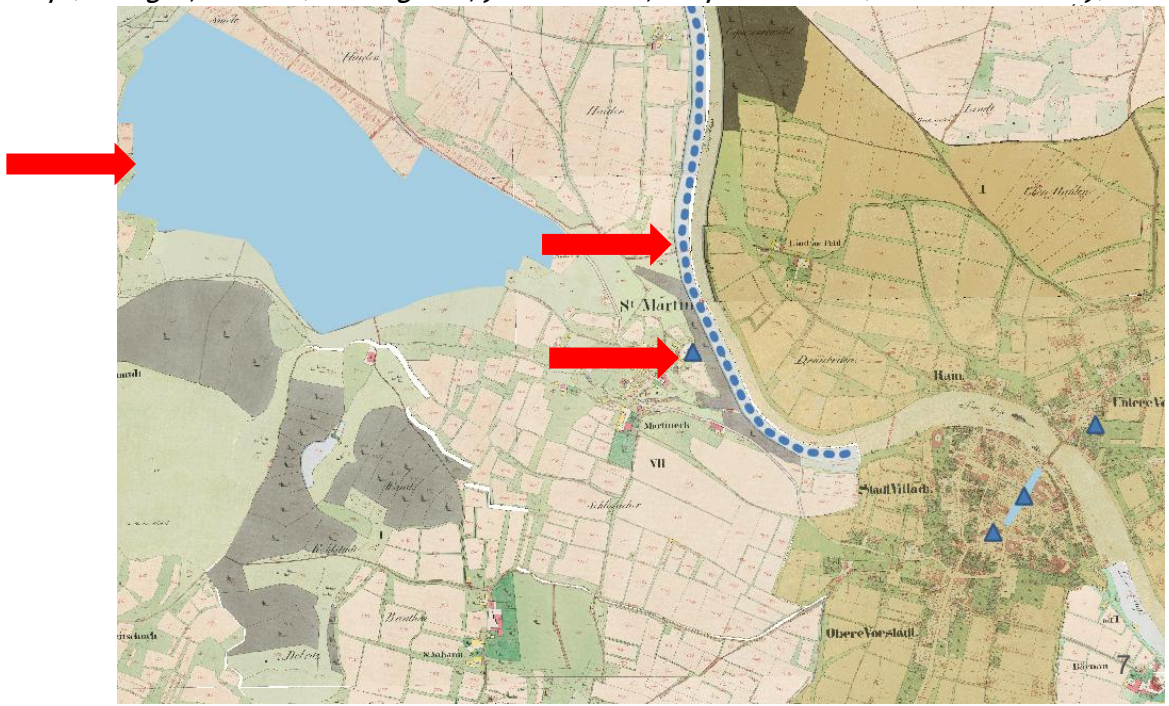
"Where is St. Jakob Church"?

Lines for features with length

"What is the path of the Drau River"?

Polygons for areas

"What is the boundary of this lake"?



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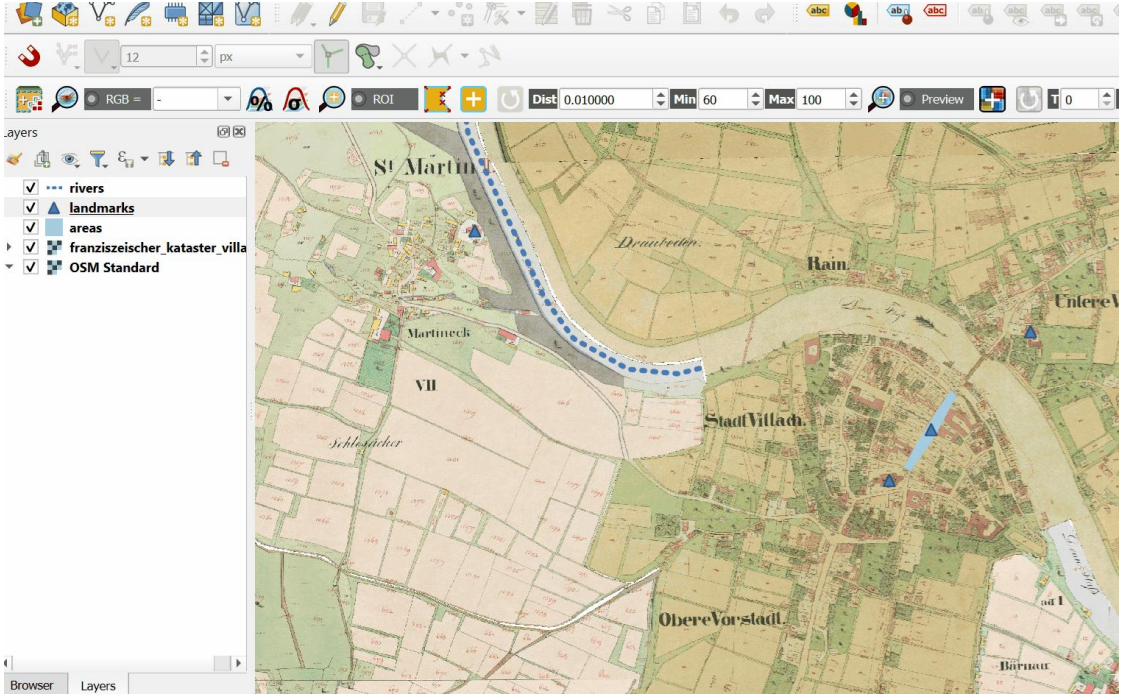
The importance of attributes in digitizing

Attribute table
Add fields:
-name
-type

This way we can conduct spatial queries!



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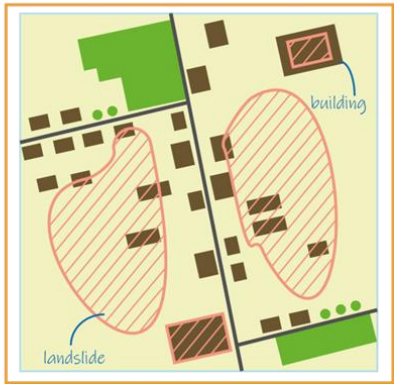
Spatial queries

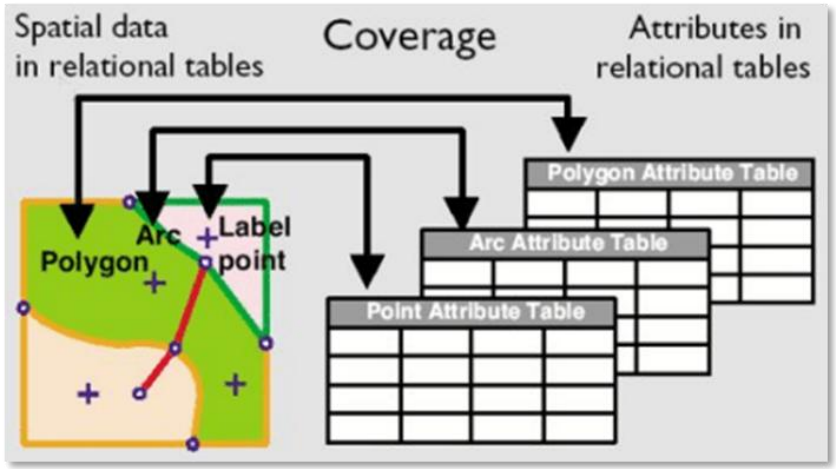
ATTRIBUTE QUERY
(select by attribute)

ID	owner	street	no.	area
1	Jones	Lisson St.	4	96,25
2	Smith	Bell St.	1	112,37
3	Smith	Bell St.	5	147,76
4	Williams	Homer St.	2	128,91
5	Evans	Lisson St.	8	64,28
6	Johnson	Lisson St.	6	281,42
7	Black	Homer St.	10	121,73
8	Evans	Bell St.	7	210,58
9	Thomas	Homer St.	6	88,25
10	Smith	Lisson St.	2	114,87
11	Taylor	York St.	3	73,14

SPATIAL QUERY
(select by location)



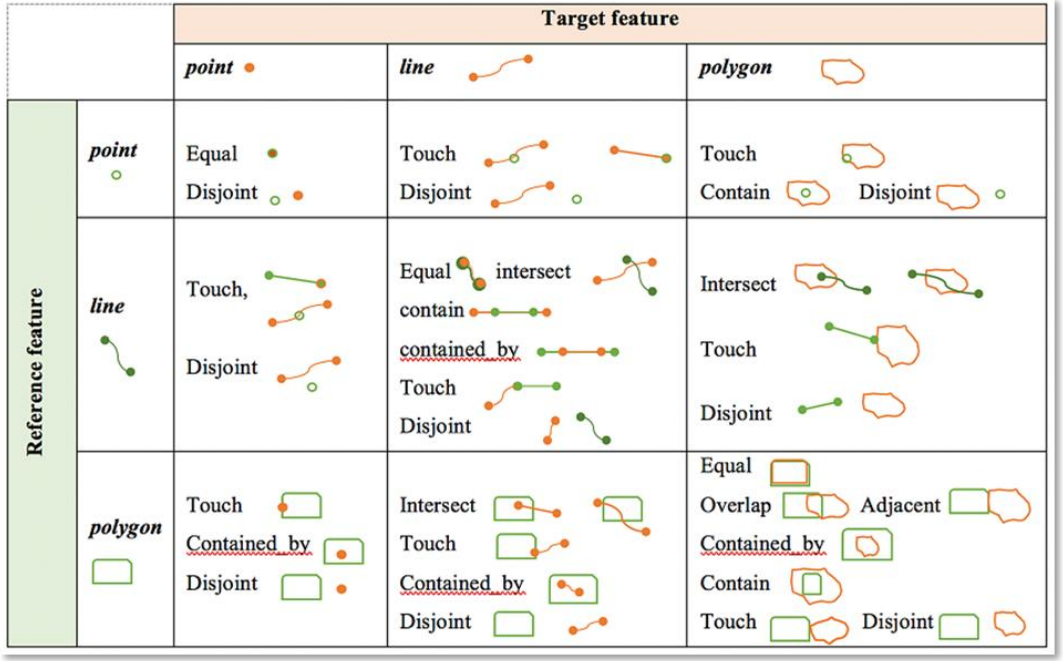
In GIS we use spatial queries to ask location-based questions!



https://docs.qgis.org/3.40/en/docs/training_manual/spatial_databases/spatial_queries.html
https://saylordotorg.github.io/text_essentials-of-geographic-information-systems/s10-02-searches-and-queries.html

Spatial query by location

- **Intersect**: select features that touch, cross, or overlap
- **Contain/within**: select features fully inside others
- **Are within distance of**: select features close to others (uses an implicit buffer)
- **Touch**: select features whose boundaries touch



https://gistbok-topics.ucgis.org/FC-06-013

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Buffer

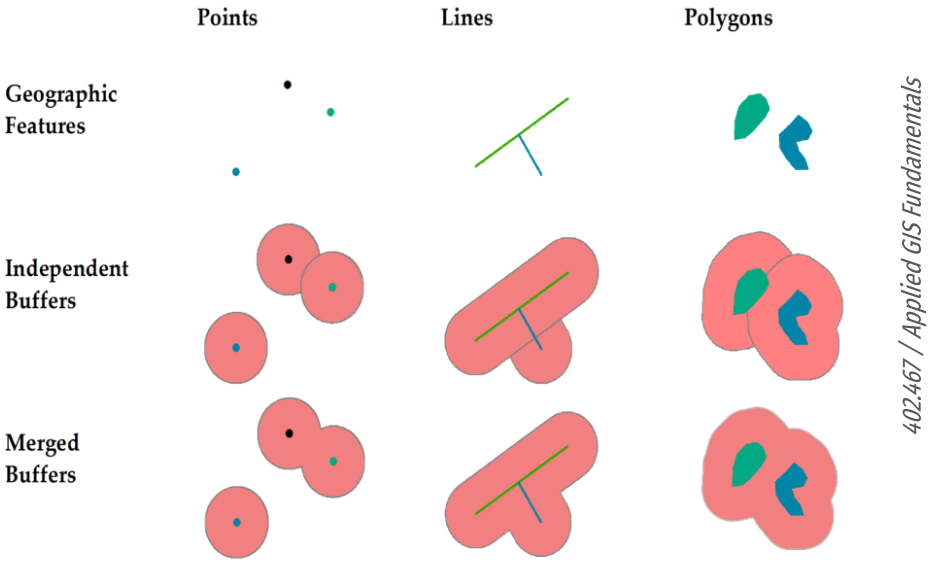
Creates a polygon (a buffer zone) **around** input **features** (points, lines, or polygons) **at a specified distance**

➡️ What's within X distance of...?

Real-world Examples

- Protecting rivers (no building within 100m)
- Defining service areas (customers within 3mi of a store)
- Identifying areas affected by noise pollution (within 500m of a highway)

The output layer of a buffer operation is always a polygon



https://gistbok-topics.ucgis.org/AM-02-003

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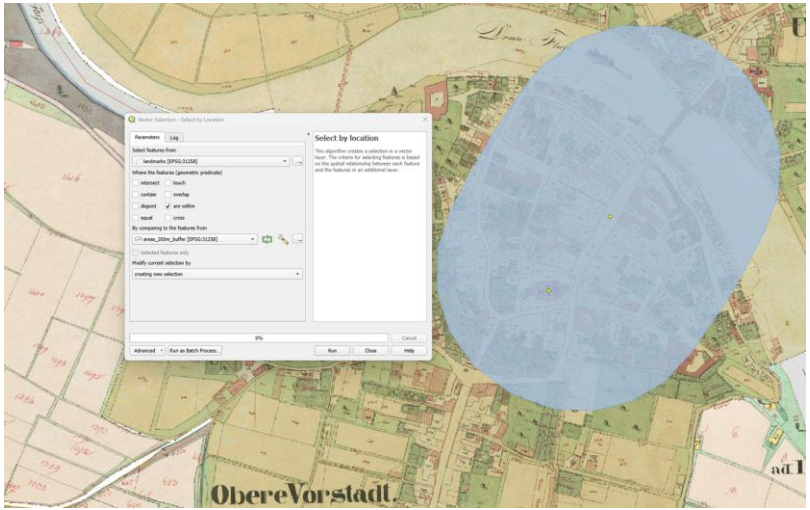
Examples

Select by location



Buffer zone around the lake of 400 meters

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Related readings

- Király G, Walz U, Podobnikar T, Czimber K, Neubert M, Kokalj Ž. Georeferencing of historical maps – methods and experiences. In: Csaplovics E, Wagenknecht S, Seiler U, editors. *Spatial Information Systems for Transnational Environmental Management of Protected Areas and Regions in the Central European Space*. Berlin: Rhombos-Verlag; 2008. p. 53-63, available at https://www.researchgate.net/publication/256307982_Georeferencing_of_historical_maps_--_methods_and_experiences
- Pope R-No-A-Rangi, Frean M. Georeferencing Historical Maps at Scale. In: Sila-Nowicka K, Moore A, O'Sullivan D, Adams B, Gahegan M, editors. Proceedings of the 13th International Conference on Geographic Information Science (GIScience 2025); 2025 Aug 26-29; Christchurch, New Zealand. Leibniz Int Proc Informatics (LIPIcs), vol 346:11:1-11:11. DOI: 10.4230/LIPIcs.GIScience.2025.11, available at: https://drops.dagstuhl.de/storage/00lipics/lipics-vol346-giscience2025/LIPIcs.GIScience.2025.11/LIPIcs.GIScience.2025.11.pdf
- Novak A, Ostash V. Digitizing Historical Maps and their presentation in Online Map Collections. E-Perimetron. 2022;17(1):33-44, available at: https://www.e-perimetron.org/Vol_17_1/Novak_Ostash.pdf