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# Cartographic palimpsest: A reinterpretation of the 1856 plan of Warsaw as a tool for education and historical analysis

*Keywords*: historical cartography, historical map editing, digital humanities, critical cartography, historical education, Warsaw

*Summary*: The paper presents a critical reinterpretation of the 1856 *Plan of Warsaw and Its Surroundings*, created during a period of political and spatial transition. Rather than treating historical maps as static artefacts, the project approaches cartographic editing as a narrative and interpretive process oriented towards semantic clarity, visual accessibility, and historical accuracy. Through comparative analysis, ambiguous symbols and outdated visual codes were decoded and transformed into a structured spatial dataset. This informed a new visual design using a contemporary graphic language that preserves the informational logic of the original. The result is a foldable printed map with educational overlays and historical annotations, aimed at fostering spatial literacy and public engagement.
The project combines digital tools with principles of critical cartography and proposes a replicable workflow for editing, visualising and publishing historical maps. It also addresses the subjective, editorial, and historiographic challenges involved in reinterpretation. Emphasis is placed on the pedagogical value of the map in embodied, place-based learning, and the evolving role of the cartographer as mediator and educator. The final dataset is openly accessible to support research in digital humanities, heritage studies and urban historical analysis.

## Introduction

Historic urban maps are more than representations of past landscapes — they are complex cultural artefacts embedded in political, epistemological, and technological contexts. Reflecting the spatial imaginaries and power structures of their time (Harley 1989: 11, 13–14), they offer valuable insights into historical urbanities. Yet, their interpretation poses challenges due to obsolete symbol systems and implicit visual conventions (Wiberley 1980: 500).
Recent cartographic scholarship has moved from passive reproduction toward critical reinterpretation. Rather than preserving visual appearance, researchers now engage with maps by decoding their symbolic logic and situating them historically. Although labour-intensive, such interventions enable the construction of spatial databases that enhance analytical depth and comparative potential (Wiberley 1980: 500). Their aim is not to correct the past, but to render its spatial representations legible and meaningful for contemporary use.
Despite advances in digitisation, few historic maps have been fully re-edited for analytical or educational purposes. This article presents a critical reinterpretation of the 1856 *Plan of Warsaw and Its Surroundings*, issued by the Russian Imperial Army. The map is approached not as a static artefact, but as a semantically reconstructed spatial resource that exceeds the capabilities of georeferenced rasters. Well-designed reinterpretations of historic maps, as Schweyer et al. (2021: 1–10) argue, can bridge digital tools with embodied learning, especially outside academic settings.
This project seeks to transform the plan into a structured, interpretable and accessible spatial tool for research and education. It proposes a transferable editorial workflow and reflects on the role of historical maps in digital heritage, spatial humanities, and historiography.

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The research is guided by four questions:
(1) How can the semantic ambiguities of nineteenth-century cartographic symbols be resolved and standardised?
(2) How can historic maps be transformed into structured spatial datasets for analysis and visualisation?
(3) How can design strategies improve the legibility of historic urban maps for contemporary users?
(4) How can such maps be adapted for educational purposes while preserving historical integrity and semantic richness?
A clear conceptual and methodological framework is required to address these questions, as outlined in the next chapter.

## The Concept of Historical Map Editing

Historical map editing involves a range of interventions that transform archival documents into readable and analysable spatial representations. Stephen E. Wiberley (1980: 499–502, 508–509) was among the first to describe this spectrum — from facsimile reproduction to redrawing and semantic annotation. The aim is not to "correct" past representations but to render them legible as expressions of historical worldviews.
Building on this, Tomasz Panecki (2021: 685, 687, 693) proposed a typology of editorial complexity for digital environments. At one end are unprocessed facsimiles; at the other, fully vectorised databases enriched with semantic layers. This supports critical and comparative spatial history by treating historic maps as structured geospatial data rather than static images.
This digital-spatial turn aligns with Richard Rodger and Susanne Rau's (2020: 373-374, 378-380) argument that maps should be seen as dynamic frameworks of spatial change, revealing processes such as infrastructure development or socio-spatial inequality. Editorial reinterpretation thus becomes an active engagement with history, not just a reflection of it.
The Historic Towns Atlas (HTA) exemplifies this evolution, offering standardised editions of pre-industrial cities with modern redrawings and essays (Panecki 2022: 93–106). While GIS tools inform production, the result remains a printed atlas focused on urban morphology. Content is often generalised, and practices vary between countries.
In contrast, the present project adopts a focused, source-specific approach. Rather than synthesising documents, it reconstructs a single map's internal logic. Its priorities are semantic fidelity, editorial transparency, and accessibility. The output is not an atlas plate, but a dynamic spatial resource open to reinterpretation and integration.
The project reaches the highest level in Panecki's typology — combining georeferencing, semantic analysis, vectorisation, and historical contextualisation. It reflects a broader methodological shift: treating maps not as passive records, but as active instruments of spatial dialogue and public scholarship.
This conceptual framework underpins the interpretive and editorial strategies discussed in the following chapters.

## Historical Context and Source Map

In the mid-nineteenth century, Warsaw was undergoing major spatial and social transformation. As the capital of the Russian-controlled Congress Kingdom of Poland, it developed into a key strategic centre in East-Central Europe. Its urban fabric reflected tensions between historical continuity and

imperial modernisation. Industrialisation and migration reshaped social dynamics, while military urbanism — including the Warsaw Citadel and new fortifications — redefined spatial logic. By 1856, the city had over 160,000 inhabitants and embodied both Polish and Russian imperial influences (Koryś 2018: 131–132).

The 1856 *Plan of Warsaw and Its Surroundings* was issued by the General Staff of the Russian Imperial Army under Colonel Kalikst Witkowski (Witkowski 1856), who later became mayor. Intended for military and bureaucratic use, the map followed internal conventions of Russian cartography (Seegel 2012: 89–109). Printed as a monochrome lithograph with selective blue tinting (see Figure 1), the plan measures 51 × 68 cm, is west-oriented, and labelled mostly in Russian. Its scale (~1:16,800) balances urban overview and tactical detail. It depicts street networks, buildings, waterways and fortifications, but uses a symbolic system aimed at professionals and lacks aids needed for modern interpretation.


Figure 1. The 1856 Plan of Warsaw and Its Surroundings

Two inset maps show seventeenth-century Warsaw and the Kingdom of Poland's communication network. Other elements include a list of 112 public buildings, a population table by district, geographical notes, and a decorative cartouche with the city's coat of arms. Despite its richness, the map's symbolic system is opaque to contemporary readers. Unlocking its analytical and educational potential requires editorial reinterpretation — the methods of which are outlined in the next chapter.

## Methodology and Editorial Workflow

The reinterpretation of the 1856 Plan of Warsaw followed a multi-stage workflow shaped by the source's material characteristics and the interpretive demands of historical cartography. The editorial process was adapted to the map's graphic inconsistencies, combining spatial analysis with semantic reinterpretation and design adaptation. All work was conducted in a hybrid GIS and design environment: QGIS was used for georeferencing, classification, vectorisation and symbolisation; Adobe Illustrator refined the map's layout, typography and annotations.

Three methodological principles guided the process:

- Semantic triangulation: interpreting ambiguous features through cross-referencing and historical sources;
- Editorial transparency: making reinterpretive decisions explicit, especially in uncertain cases;
- Educational adaptation: tailoring visual design for non-specialists, prioritising clarity over graphic fidelity.

These principles shaped category definitions, data modelling, and final representation. The following sections detail each phase: georeferencing, semantic analysis, vectorisation, cartographic design, and educational integration.

### *Georeferencing*

The map was georeferenced in QGIS using the Web Mercator projection (EPSG:3857) to enable web compatibility. Although a local projection would minimise distortions, the choice prioritised digital usability (Battersby 2025: 272–273). Thirty-three control points were selected based on stable features such as intersections and gates. Due to major spatial changes since 1856, control points are concentrated in the historic core.

A third-order polynomial transformation corrected for distortions, yielding a Root Mean Square Error of 34 metres. Higher residuals at complex junctions likely reflect generalisations in the original. Lithographic artefacts and 19th-century surveying limits also contribute to the error. These deviations are interpreted not as flaws but as part of the source's historical production context.

### *Semantic Analysis and Interpretation*

To enable consistent classification and interpretation, the 1856 map's graphic system required detailed analysis. Unlike modern topographic standards, it lacks a legend, uses inconsistent labelling, and applies identical line styles to distinct features (e.g. paths, boundaries, waterways), leading to visual and semantic ambiguity (see Figure 2; Edney 2005: 17–20). These conventions suggest that the map was intended for professional military or administrative use rather than for the public. Decoding these symbols required comparative reasoning, historical cartographic references, and expert contextualisation — enabling the reinterpretation of otherwise unclear or overlapping graphical codes.


Figure 2. Comparison of graphical conventions used for (1) paths, (2) plot boundaries and (3) waterways, demonstrating the symbolic ambiguity of line styles

The 1925 topographic manual helped trace symbol continuity (Military Geographical Institute 1925), while the 1825 and 1897 Warsaw plans, and their commentaries (Bartoszewicz and Weszpiński 2017; Słomska-Przech 2023), clarified historical conventions. These sources supported triangulated interpretation where meanings were unclear or inconsistent.

A key outcome was the classification of buildings by hachure style: solid fill for military, dense lines for public, grid for religious, and sparse lines for other buildings (see Figure 3). This was cross-checked with a printed list of 112 buildings, categorised by function. Hospitals and almshouses lacked distinct styles unless affiliated with religious or military institutions.

Further semantic cues came from building labels, whose fonts and languages varied — hinting at symbolic or institutional distinctions (see Figure 4). Fortifications were depicted with specific forms, but streets lacked hierarchy. Inside city walls, width suggested status; outside, chaussées used double lines, sometimes with central markers or flanking tree rows. Strokes resembled paths, streams or plot boundaries, complicating interpretation. Railways used bold or dashed lines, but the St. Petersburg line was misplaced by ~1.5 km, possibly due to speculative data.

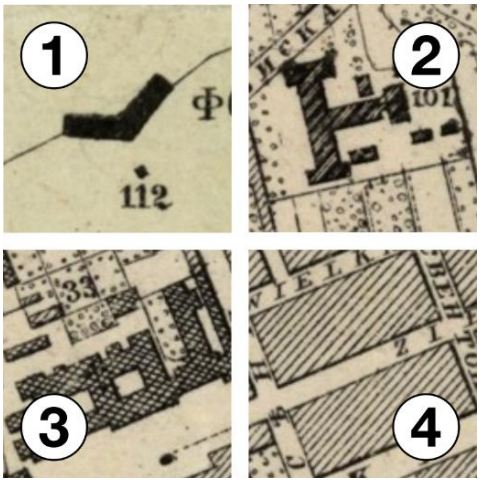


Figure 3. Typological classification of buildings by hachure style: (1) military, (2) public, (3) religious and (4) other buildings


Figure 4. Examples of labelled buildings from the original plan showing variation in font style and languages

Sandy areas used dotted textures; dunes and clay pits appeared as dashes. Water features were inconsistently tinted blue — likely by a different author — and many remained uncoloured. Water-

ways resembled paths; they were interpreted based on branching, sinuosity, and proximity to escarpments or wetlands, aided by Chełmiński and Wasilewicz's hydrological diagram (2021). Parks and gardens were drawn in detail; forests and shrubs used period symbols. Ambiguous green patterns likely depict orchards or general vegetation (see Figure 5). Cemeteries differed by religion: crosses for Christian, slabs for Jewish burial grounds.

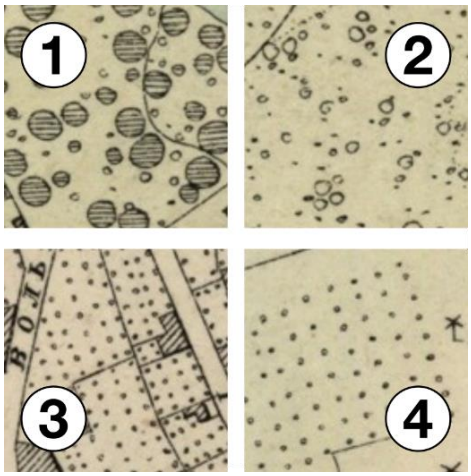


Figure 5. Vegetation types depicted on the map: (1) forests, (2) shrubs and (3-4) general vegetation or cultivated land

Military zones were labelled in bold Russian text rather than enclosed. Religious monuments were often omitted, likely reflecting Russification (Seegel 2012). Standard symbols marked windmills, watermills and crosses (Military Geographical Institute 1925: 38–39). Fountains, springs and wells used uniform black circles and linked with dashed lines representing Marconi's early pipeline network. Additional features — e.g. brick yards, city gates, inns, factories — were labelled in cursive. Named inns such as Biała, Czerwona and Gęsia were retained as prominent landmarks. This semantic structure guided the standardisation of symbols, which in turn informed vectorisation and database modelling in the next phase.

### *Vectorisation and Data Modelling*

Based on the semantic analysis, features were manually vectorised in QGIS and organised into a geospatial database. Digitisation followed principles of geometric precision, topological integrity, and thematic consistency. The model includes over 20 layers grouped by geometry: polygons (buildings, land cover, cemeteries), lines (roads, railways, waterways, ramparts), and points (POIs, toponyms).

Attribute names are provided in Polish and English. Selected layers contain semantic tags — e.g. cemeteries by religion, POIs by type, streets by function. Toponymy includes historical and current names where available. Tree rows record alignment and density.

Missing details were supplemented from historical sources: street names from Świątkowski (1852), hierarchies from Bartoszewicz and Weszpiński (2017), modern names from TERYT (GUS 2025), and hydronyms from Chełmiński and Wasilewicz (2021). Several post-processing steps improved geometry: the PAEK algorithm reduced angular noise (Bodansky and Pilouk 2000: 67–72), buildings were orthogonalised, and topology errors removed.

*Cartographic Design and Symbol System*

With the dataset completed, the next step was to create a coherent, legible and historically informed map. Layers were styled in QGIS and refined in Adobe Illustrator. The final output is a print-ready, layered PDF in CMYK format.

A modern design was chosen over historicist styles. The cartographic logic follows the OpenStreetMap Carto stylesheet (OpenStreetMap contributors 2025), selected for its clarity and accessibility, especially for users unfamiliar with 19th-century conventions (Zejdlik and Voženílek 2025: 9). Sepia palettes and nostalgic effects were avoided to preserve legibility (Justová and Cajthaml 2023: 14–15).

Map features follow a layer-based hierarchy linked to database attributes (see Figure 6). Buildings are grouped into four types based on hachure logic and styled accordingly. Roads follow a five-level hierarchy using line weight, colour and casing. Railways, escarpments and other features use dashed or patterned lines. POIs are shown as icons, replacing text codes. Colours indicate feature type (e.g. religious, public).


Figure 6. Legend of the redesigned map, showing the symbols used for various thematic layers

A restrained colour palette and intuitive coding (e.g. green for vegetation) enhance readability. Earlier saturated versions were rejected after print tests. Font choice prioritises clarity over historical mimicry, supporting the map's educational function (Deeb et al. 2011: 176–185). Select historical elements, such as the cartouche (see Figure 8), were retained as visual anchors.

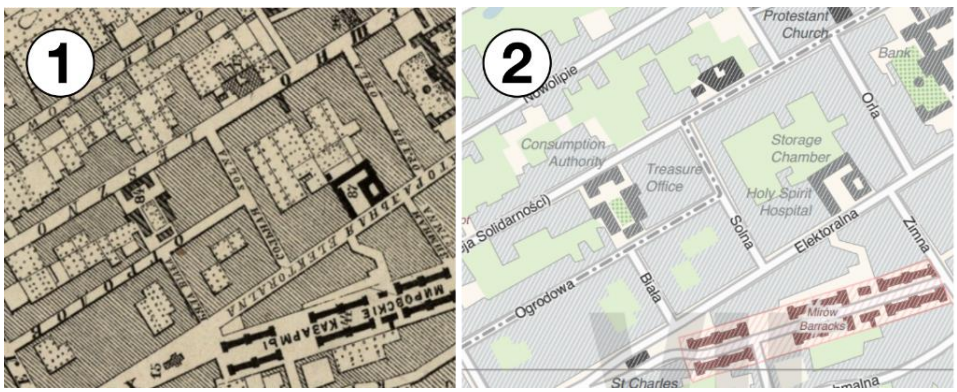


Figure 7. Visual comparison of the same urban area in the (1) original and (2) redesigned versions of the map

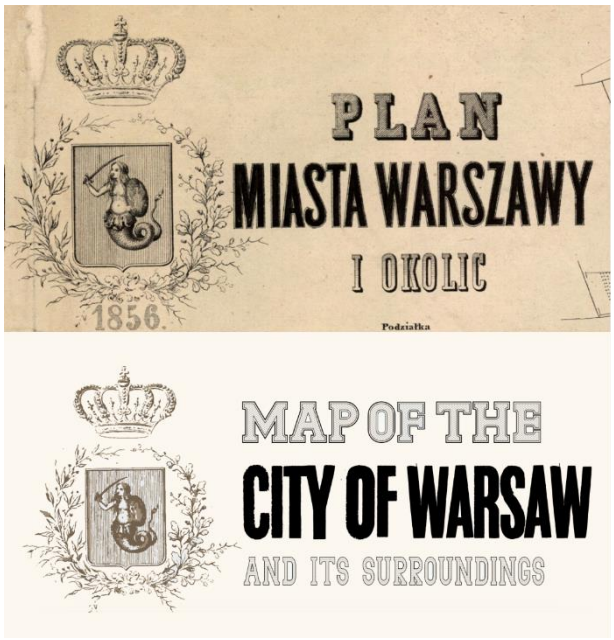


Figure 8. Decorative cartouche in (1) the original 1856 plan and (2) its reinterpreted version, preserving historical visual identity

*Educational and Comparative Features*

Several overlays and annotations were added to connect the 1856 plan with the present-day city and support user orientation (see Figure 9). Landmarks such as the Palace of Culture and the National Stadium were overlaid in orange, clearly distinct from the historical base. The modern Vistula River course is also shown. Street names use a dual-label system: historical in plain text, modern with the prefix "c.". Historical districts were reconstructed based on Gawryszewski (2009: 56–57) and marked with dashed boundaries and Roman numerals.


Figure 9. Overlay of the current Vistula course and the National Stadium on the historical base map

Seventeen vanished landmarks are identified with orange markers, linked to brief descriptions and archival photos on the reverse (see Figure 10). The reverse also includes a full reproduction of the original map, a population chart, a timeline of key events, and a sequence of Warsaw's territorial expansion since 1770 (Figure 11). Original statistical tables and annotations were retained.

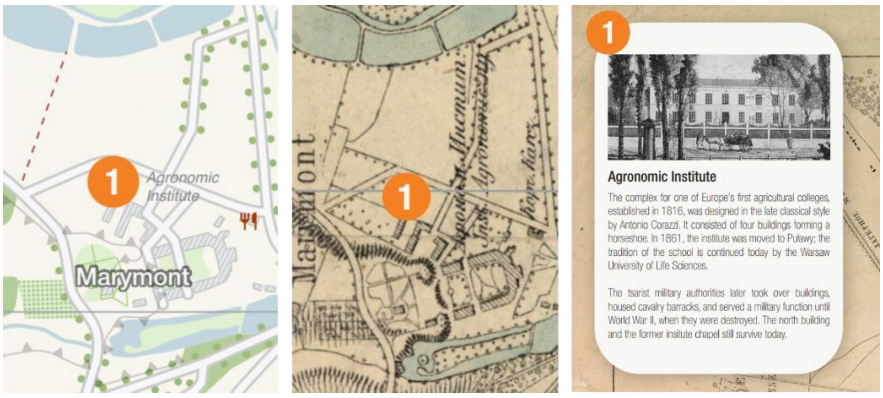


Figure 10. Orange markers identifying vanished historical landmarks, linked to archival descriptions on the map's reverse

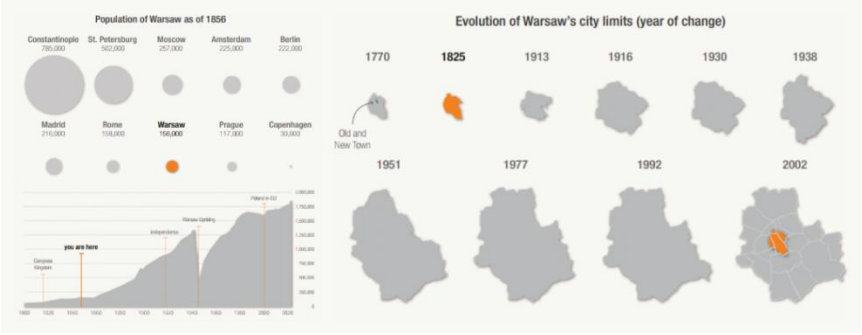


Figure 11. Supplementary educational elements: population chart, timeline and territorial evolution diagrams

The map is printed as a double-sided A1 sheet (6×5 panels), folding to 119×280 mm. Marginal information cards allow partial unfolding for use during walking or teaching. Orientation is supported by a north arrow, dual scale bars (metres and Russian fathoms), and a usage guide (see Figure 12). These features enhance the map's role as an interpretive and educational tool.

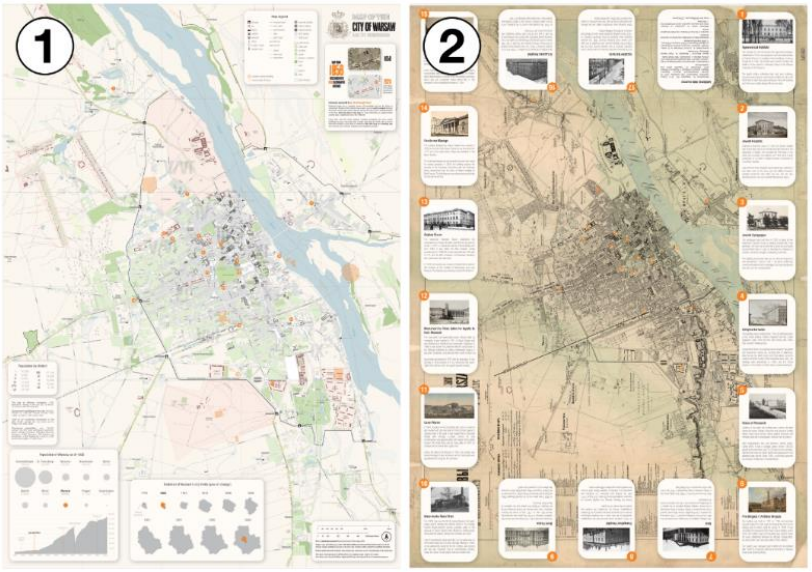


Figure 12. Final printed design: (1) recto and (2) verso

The design choices were guided not only by technical considerations but also by interpretive goals. They reflect a broader set of editorial decisions shaped by the limitations of the source material, the

challenges of visual reinterpretation, and the aim to create an educational tool. The following section reflects critically on these methodological and epistemological tensions.

## Discussion

### *Methodological Constraints and Interpretive Challenges*

The editorial process was effective in creating an accessible spatial resource, but presented several challenges. Georeferencing was hindered by distortions typical of lithographic maps, complicating alignment with other sources. Symbol ambiguity was also a key issue. Some features, such as general vegetation, remained unclear despite triangulation. Unresolved cases were handled transparently using editorial judgement.

The redesign introduced tensions between historical accuracy and modern clarity. A contemporary visual language replaced some original conventions to support interpretability and engagement — consistent with Panecki's (2021: 682–697) view of maps as interpretable artefacts. The workflow remained labour-intensive and dependent on judgement, limiting scalability.

As Słomska-Przech and Lilley note, maps are inherently "subjective, partial and selective" (2024: 177). This project addressed that subjectivity by making interventions visible — for example, replacing militarised symbols with neutral ones. Whether such changes clarify or obscure meaning remains open to future evaluation. Ultimately, the project highlights the interpretive nature of historical map editing.

### *Educational and Historiographic Potential*

Editorial choices affect not only how the map encodes historical meaning, but how it is used and understood. Overlays, dual labelling, contextual back matter, and foldable format serve both explanatory and interpretive functions. The map encourages users to ask not only "what was here" but also "why did it change" and "how do we know" — prompting critical reflection on urban transformation.

It supports interdisciplinary learning: in urban history, it shows how planning shaped Warsaw's form; in cartographic education, it exemplifies critical editing; in heritage studies, it restores erased spatial contexts. For example, Pole Mokotowskie appears as a parade ground, the Saxon Garden reservoir links to 19th-century infrastructure, and Jagiellońska Street's curve follows a former fortress (see Figure 13). The mid-river location of the Copernicus Science Centre reflects the Vistula's shifting course. Toponyms like Młynów (*mill area)* or Solec *(connected to salt warehouse)* reveal buried layers of urban memory.

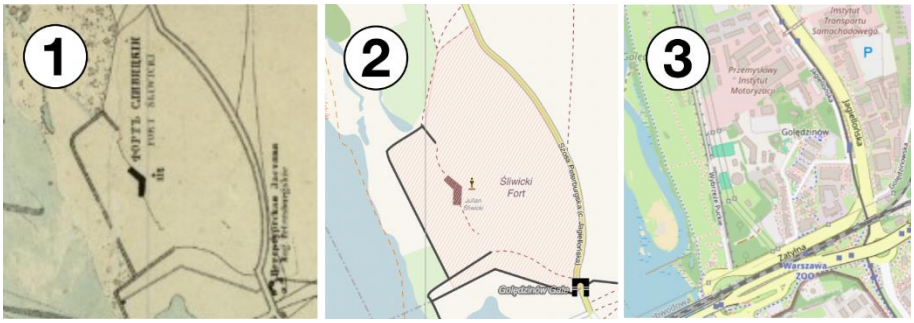


Figure 13. Comparison of Jagiellońska Street's curve on (1) the 1856 map, (2) its redesign and (3) OpenStreetMap.

The foldable format enables embodied engagement and site-based education (Black and Crimmins 2017: 20–39). Museums and schools can use the map to support constructivist learning, where users actively interpret rather than passively receive historical information (Dumont et al. 2010: 39–40).

### *Contributions to Digital and Spatial Humanities*

Beyond pedagogy, this project contributes methodologically to digital and spatial humanities. It demonstrates how historic maps can support semantic modelling, interdisciplinary analysis, and public engagement. The resulting vector dataset addresses key challenges in historical GIS: encoding meaning, enabling temporal comparison, and interpreting analogue sources digitally (Gregory and Ell 2007: 196–202).

Three strategies underpin the approach:

- Semantic vectorisation — preserving the map's internal logic while enabling queries;
- Visual recoding — translating content into accessible graphic syntax;
- Hybridisation — combining GIS, print and educational design.

The dataset can be integrated with WebGIS platforms and linked to other historical geodata. While accurate enough for intra-map studies like morphology or space syntax, geometric limitations constrain diachronic comparisons. Potential applications include story maps, AR reconstructions, and interactive city guides. Open publication invites community-led enrichment and aligns with core values of digital humanities: openness, participation and interdisciplinarity (Scanlon 2018).

## Conclusion and Future Work

This project explored how a historic map can be reinterpreted into a meaningful resource for contemporary users through semantic analysis, spatial modelling and visual redesign. Rather than merely preserving the 1856 Plan of Warsaw, the goal was to reframe it as a critical and accessible tool. The process revealed not only technical challenges, but also epistemological tensions around fidelity, legibility and historical framing.

The historical cartographer emerges not as a passive reproducer, but as a mediator — negotiating between sources, design, and pedagogy. Reinterpretation becomes a form of active preservation, transforming archival artefacts into tools for inquiry, reflection and spatial reasoning.

Future work should focus on:

1. Developing scalable workflows for historical map editing;
2. Integrating historical ontologies for semantic interoperability (Słomska-Przech 2023: 159–182);
3. Empirically evaluating educational outcomes through user testing.

This editorial model offers a transferable framework for critical reinterpretation of historical urban maps in spatial humanities and digital heritage.

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