Digitally Reinterpreting the 1856 Map of Warsaw for Historical Engagement and Spatial Literacy

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Zarys treści: Artykuł stanowi krytyczną reinterpretację *planu Warszawy i okolic* z 1856 r. Zamiast traktować dawne mapy jako dziedzictwo statyczne, edycja map jest przedstawiona jako praktyka interpretacyjna łącząca analizę semantyczną i wizualne przeprojektowanie. W rezultacie powstaje ustrukturyzowana wersja mapy mająca na celu promowanie umiejętności interpretacji struktur przestrzennych i zaangażowania społecznego. Artykuł proponuje uniwersalną metodykę, a jednocześnie prezentuje refleksję na temat wyzwań związanych z edycją map dawnych w humanistyce cyfrowej.

Słowa kluczowe: kartografia historyczna, edycja map dawnych, humanistyka cyfrowa, kartografia krytyczna, edukacja historyczna, Warszawa

Abstract: The article presents a critical reinterpretation of the 1856 *Plan of Warsaw and Its Surroundings*. Rather than treating historic maps as static heritage, map editing is framed as an interpretive practice combining semantic analysis and visual redesign. The result is a structured version of the map aimed at fostering spatial literacy and public engagement. The article proposes a transferable workflow and reflects on the challenges of historical map editing in digital humanities.

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

1. Introduction

Historic urban maps are more than spatial 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,[1] they offer valuable insights into past urbanities. Yet, their interpretation poses challenges to contemporary readers due to their obsolete symbol systems and implicit visual conventions.[2]

Recent cartographic scholarship has shifted from passive reproduction toward critical reinterpretation. Rather than merely preserving visual appearance, researchers now engage with maps by decoding their logic, clarifying symbolic systems, and situating them historically. In this sense, the field has moved from treating such works as *historic* maps, preserved artefacts of their time, to reframing them as *historical* maps, interpretive resources embedded in contemporary research and education. Though labour-intensive, such editorial interventions enable the construction of spatial databases that enhance analytical depth and comparative potential.[3] Their goal is not to correct the past, but to render its spatial representations legible and meaningful for contemporary use.

Despite the growing digitisation in historical cartography, few maps have been fully re-edited for analytical or educational purposes. This article presents a critical reinterpretation of the 1856

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[1] J.B. Harley, 'Deconstructing the Map', *Cartographica*, 26, no. 2 (1989), pp. 11, 13–14.

[2] S.E. Wiberley, 'Editing Maps: A Method for Historical Cartography', *Journal of Interdisciplinary History*, 10, no. 3 (1980), p. 500.

[3] T. Panecki, 'Digital Methods in Cartographic Source Editing', *Digital Scholarship in the Humanities*, 36, no. 3 (2021), pp. 685–89, 691–94.

Plan of Warsaw and Its Surroundings. The map is approached not as a static artefact but as a semantically reconstructed spatial representation, enabling both analysis and public engagement, exceeding the capabilities of georeferenced rasters. As Schweyer et al. argue, well-designed representations of historic cartographic sources can bridge digital methods with embodied learning, particularly outside academic settings.[4]

The project aims to transform the plan into a structured, interpretable, and accessible spatial resource supporting research and educational use. It offers both a transferable methodological workflow and a conceptual reflection on the role of historical maps in digital heritage, spatial humanities, and historiography.

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?

To systematically engage with historical map editing, a clear conceptual and methodological framework is required, as outlined in the next chapter.

2. The Concept of Historical Map Editing

Historical map editing comprises a spectrum of critical interventions that transform historic documents into readable and analysable spatial representations.[5] Stephen E. Wiberley was among the first to outline this spectrum, ranging from facsimile reproduction to selective redrawing and semantic annotation. His work emphasises that the purpose of editing is not to "correct" past representations, but to make them legible as expressions of period-specific epistemologies and ideologies.[6]

Building on this foundation, Tomasz Panecki proposed a typology of editorial complexity within digital spatial environments.[7] At one end are scanned, unprocessed facsimiles; at the other, fully vectorised spatial databases enriched with semantic layers and metadata. This model supports a critical and comparative approach to spatial history and supports the idea that historic maps are best treated as structured geospatial datasets rather than static visual artefacts.

This digital-spatial turn resonates with the arguments of Richard Rodger and Susanne Rau,[8] who view historical maps not as static representations but as dynamic frameworks of spatial change, revealing processes such as infrastructure development, territorial transformation, and socio-spatial inequality. Editorial reinterpretation thus becomes an active engagement with historical change, rather than a passive reflection of its outcomes.

Several European initiatives exemplify this evolution. The Historic Towns Atlas (HTA) project offers standardised editions of pre-industrial cities, typically featuring a modern redrawn map at a fixed scale, accompanied by facsimiles and

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4 A.-V. Schweyer, E. Mermet, A. Paget, and E. Khounlivong, 'Contribution of the Digital Humanities to Historical Research in Central Vietnam: GIS & Semantic Web Annotations', *HAL Archives Ouvertes* (2021), pp. 1–10, https://hal.science/hal-03098418v1/file/Schweyer%20Mermet%20Contribution%20of%20the%20Digital%20Humanities%20to%20historical%20research%20in%20Central%20Vietnam.pdf (accessed 2 Nov. 2025).

5 Panecki, 'Digital Methods', pp. 685, 687, 693.

6 Wiberley, 'Editing Maps', pp. 499–502, 508–509.

7 Panecki, 'Digital Methods', pp. 683, 686, 697.

8 R. Rodger, S. Rau, 'Thinking Spatially: New Horizons for Urban History', *Urban History*, 47 (2020), pp. 373–74, 378–80.

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essays.[9] While GIS tools inform the production process, the outcome remains a printed atlas focused on urban morphology studies. Content tends to be generalised, and editorial practices differ between national editions.

In contrast, the present project adopts a focused, source-specific approach. Rather than synthesising multiple documents, it focuses on a single historic plan and reconstructs its internal structure. Its priorities are semantic fidelity, editorial transparency, and accessibility for modern audiences. The result is not an atlas plate, but an interactive spatial resource, enriched with metadata and open to reinterpretation, educational use, and digital integration.

The project corresponds to the highest level of editorial complexity in Panecki's typology: combining georeferencing, semantic analysis, structured vectorisation, and historical contextualisation. It preserves the map's internal logic while making it intelligible and analytically useful. This reflects a broader methodological shift in critical cartography and digital humanities: treating maps not as passive archival objects, but as active instruments of spatial dialogue and public scholarship.

This conceptual grounding informs the interpretive approach adopted in the present project, which begins by analysing the source map in its historical context before proceeding to the editorial methodology.

3. Historical Context and Source Map

In the mid-19th century, Warsaw was undergoing significant spatial and social transformation. As the capital of the Russian-controlled Congress Kingdom of Poland, it had developed into a major strategic centre in East-Central Europe. Its urban fabric reflected tensions between historical continuity and imperial modernisation. Industrialisation and migration reshaped the city's social dynamics, while military urbanism – most notably the construction of the Warsaw Citadel and integration of defensive infrastructure – redefined its spatial logic. With over 160,000 inhabitants, Warsaw embodied layered influences: the legacy of the Polish-Lithuanian Commonwealth and the instruments of Russian imperial control.[10]

The 1856 *Plan of Warsaw and Its Surroundings*,[11] issued by the General Staff of the Russian Imperial Army under the supervision of Colonel Kalikst Witkowski. Witkowski, who would later serve as mayor of Warsaw, commissioned the map as part of the imperial administration's spatial strategy. It was not intended for the public but for military and bureaucratic users and reflects the internal conventions of Russian military cartography.[12]

The map was printed as a monochrome lithograph with selective blue tinting (see Fig. 1), measuring 51×68 cm, oriented westward and labelled primarily in Russian. With a scale of approximately 1:16,800, it combines elements of urban overview and tactical detail. The plan depicts a wide range of urban elements, from street networks and buildings to waterways and fortifications, but its symbolic system was designed for professional users and lacks the aids needed for modern interpretation.

Two inset maps accompany the main composition: one showing seventeenth-century Warsaw, the other outlining the

[9] T. Panecki, 'Plan of Kalisz by Andrzej Politalski from 1785 – A Source Edition in the Polish Historic Towns Atlas', *Polish Cartographical Review*, 54, no. 2 (2022), pp. 93–94, 95–98, 104–06.

[10] P. Koryś, 'On the Peripheries of the Modern Western World: Delayed Social Reforms and Unfinished Industrial Revolution (1830–1870)', in id., *Poland from Partitions to EU Accession. A Modern Economic History, 1772–2004* (Cham, 2018), pp. 131–32.

[11] *Plan goroda Varšavy i okrestnostej = Plan miasta Warszawy i okolic*, drawn under the supervision of K. Witkowski (Warsaw, 1856), National Library of Poland, shelf mark ZZK 1064.

[12] S. Seegel, 'Four Purposes of Early 19th-Century Polish National Cartography', in *Mapping Europe's Borderlands: Russian Cartography in the Age of Empire* (Chicago, 2012), pp. 89–109.

Fig. 1. The 1856 Plan of Warsaw and Its Surroundings
Source: ZZK 1064, National Library of Poland

Kingdom of Poland's communication network, reflecting the imperial emphasis on historical framing and territorial control. Additional elements include a numbered list of 112 public buildings, a population table by district, notes on geographical context, and a decorative cartouche bearing the city's coat of arms. Despite its interpretive depth, the map's graphic system is opaque to contemporary readers.

Unlocking the map's analytical and educational value requires a methodological reworking that critically decodes its graphic language and recontextualises its content. The next chapter outlines the strategies used in this reinterpretation.

4. Methodology and Editorial Workflow

The reinterpretation of the 1856 Plan of Warsaw followed a multi-stage workflow shaped by the material characteristics of the source and the interpretative demands of historical cartography. The editorial process was adapted to the map's graphic language and visual inconsistencies, combining spatial analysis with semantic reinterpretation and design adaptation.

The entire workflow was carried out within a hybrid GIS and design environment. QGIS was used for georeferencing, classification, vectorisation, and symbolization of map features, while Adobe Illustrator was subsequently employed to refine the map's layout, typography, and annotations.

Three methodological principles informed editorial decisions across stages.

- Semantic triangulation involved cross-referencing with other maps, contextual reasoning, and consultation of textual and ontological sources. This supported the consistent interpretation of ambiguous features.
- Editorial transparency ensured that re-interpretative choices were made explicit, particularly in areas of uncertainty or symbol ambiguity.
- Educational adaptation addressed the needs of non-specialist audiences by adjusting visual hierarchy, adding explanatory overlays, and emphasising functional clarity over graphic fidelity. This principle was key in transforming the source into an accessible cartographic resource.

Importantly, these strategies intersected rather than followed a strict sequence. They shaped how categories were defined, how spatial features were modelled, and how the final cartographic representation communicates meaning. The following sections detail each phase of the editorial process: georeferencing, semantic encoding, vectorisation, cartographic redesign, and educational integration.

4.1. Georeferencing

The process began with georeferencing the 1856 map in QGIS, using the Web Mercator projection (EPSG:3857) to ensure compatibility with web-based GIS platforms. Although a local projection would minimise local distortions, the choice of Web Mercator reflects the intention to facilitate digital use.[13] Thirty-three control points were selected based on stable features such as intersections, fortifications, and gates. Due to significant spatial changes since the map's creation, reference points are concentrated in the historic core, while peripheral areas rely on reconstructed road alignments. Control point

locations are provided in the accompanying dataset.

A third-order polynomial transformation was applied to correct for survey inaccuracies and enable local spatial adjustments.[14] The resulting Root Mean Square Error is 34 metres, with the highest residuals at complex junctions, likely due to generalised representations on the original map. This relatively high error may be attributed to lithographic distortions, scale inconsistencies, and limitations in 19th-century surveying. Rather than treating spatial deviations as technical flaws, this editorial process interprets them as part of the source's production context.

4.2. Semantic Analysis and Interpretation

The graphic language of the 1856 plan requires close examination to enable accurate decoding and classification. This phase of the project focused on disambiguating the map's visual system and establishing a consistent semantic structure suitable for spatial analysis and educational applications.

Unlike modern topographic standards, the map's graphic language diverges markedly from contemporary norms.[15] It lacks a legend, uses multiple line styles without clear differentiation, and employs inconsistent labelling systems across objects and categories. Identical lines are used, for instance, to mark paths, boundaries, and waterways, making them visually indistinct and semantically ambiguous (see Fig. 2). These features suggest that the map was intended for professional use within administrative and military contexts, rather than for public interpretation.[16]

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13 S. Battersby, 'Web Mercator: Past, Present, and Future', *International Journal of Cartography*, 11, no. 2 (2025), pp. 272–273.

14 V. Baiocchi, K. Lelo, M.V. Milone, and M. Mormile, 'Accuracy of Different Georeferencing Strategies on Historical Maps of Rome', *Geographia Technica*, 1 (2013), pp. 13–16.

15 M.H. Edney, 'Putting 'Cartography' into the History of Cartography: Arthur H. Robinson, David Woodward and the Creation of a Discipline', *Cartographic Perspectives*, 51 (2005), pp. 17–20.

16 Ibid.

Fig. 2. Comparison of graphical conventions used for (1) paths, (2) plot boundaries, and (3) waterways, demonstrating the symbolic ambiguity of line styles
Source: Own elaboration based on ZZK 1064, National Library of Poland

To decode the system, the editorial process drew on comparative reasoning, expert contextualisation, and further cartographic sources to decode these conventions. The 1925 topographic manual supported tracing the continuity of symbols,[17] while the 1825 Warsaw plan, together with the commentary by Bartoszewicz and Weszpiński,[18] clarified earlier conventions. In turn, the 1897 Lindley plan,[19] being more semantically consistent, served as a reference aligned with present-day urban ontologies.[20] These sources enabled triangulated interpretation, particularly when symbol meanings were ambiguous or inconsistently applied.

A central outcome of this stage was the classification of buildings by hachure

pattern into four categories (see Fig. 3): military (solid fill), public (dense parallel lines), religious (grid pattern), and others (residential, commercial, industrial – sparse lines), generalised as built-up areas. This visual classification was complemented by a printed list of 112 buildings, further dividing them by institutional function: churches and cloisters, hospitals and almshouses, military sites, and public offices. Notably, hospitals and almshouses do not have distinct hachure styles unless operated by religious or military entities.

Additional semantic cues were found in building labels with their common names. These labels vary in font style and occasionally appear in only one language (Russian or Polish), hinting at symbolic or functional distinctions (see Fig. 4). Such variation further complicated the classification process, requiring close attention to typographic hierarchy and historical usage patterns.

The map depicts fortification elements with precise conventions, underscoring its strategic purpose. Streets lack explicit hierarchy: width is the main indicator inside the city ramparts, in line with nineteenth-century mapping conventions. Outside the ramparts, *chaussées* appear as double parallel lines, sometimes with black central markers implying elevated status. Flanking circular markers indicate tree rows, and urban streets are symbolised by single parallel lines. Alleys and paths are drawn identically to streams or boundaries, resulting in visual ambiguity. The Warsaw–Vienna railway is shown as bold double lines, and the under-construction line to St. Petersburg as a dashed line, misplaced by 1.5 km, which may indicate speculative data.

Sandy areas appear as dense dot patterns, and dunes and the surroundings of clay pits are depicted with short, tight dashes. Water bodies are tinted blue, though inconsistently, likely by a separate author, leaving some known features uncoloured. Waterways are drawn as

[17] *Zestawienie znaków topograficznych map: austrjackich, niemieckich i rosyjskich* (Warszawa, 1925), pp. 38–51.

[18] H. Bartoszewicz, P.E. Weszpiński, *Plan Warszawy 1825. Korpus Inżynierów Wojskowych* (Warszawa, 2017).

[19] *Plan niwelacyjny miasta Warszawy*, drawn under the supervision of W.H. Lindley, 1897–1901, State Archives in Warsaw, shelf mark 785.

[20] K. Słomska-Przech, 'Lindleys' Map of Warsaw (1:2,500) as a Tool for Understanding the Urban Space Preservation", *Studia Geohistorica*, 11 (2023), pp. 161–67.

black lines indistinguishable from paths, requiring interpretation based on sinuosity, branching, and proximity to escarpments or wetlands. A georeferenced diagram of historic streams by Chełmiński and Wasilewicz[21] supported this disambiguation. Vegetation is represented using period conventions.[22] Parks and gardens are drawn in detail, including paths and individual trees. Forests appear as dense hatched circles; shrubs as smaller, open circles in tight clusters. A recurring, ambiguous symbol, both inside and outside the city, is interpreted here as general vegetation, orchards, or cultivated land (see Fig. 5). Cemeteries are symbolised using distinct styles: crosses for Christian burials and upright slab symbols for Jewish ones, reflecting religious diversity.

Military zones are not enclosed by boundaries but labelled in bold uppercase letters, usually in Russian, assuming familiarity with the intended audience. Statues are marked as black squares with reference numbers. Religious monuments, such as those of the Virgin Mary and Saint John, are omitted, reflecting Russification policies that favoured secular or state-approved symbols over religious ones.[23] Wayside crosses, windmills, and watermills use standard symbols of the period.[24] Water features – fountains, springs, and wells are marked uniformly as black circles, linked by dashed lines indicating the early pipeline network designed by Henryk Marconi. Additional features, including brick yards, city gates, factories, forges, guard posts, inns, slaughterhouses, and wells, are labelled in cursive script. Named inns such as Biała, Czerwona, Gęsia, Ochota
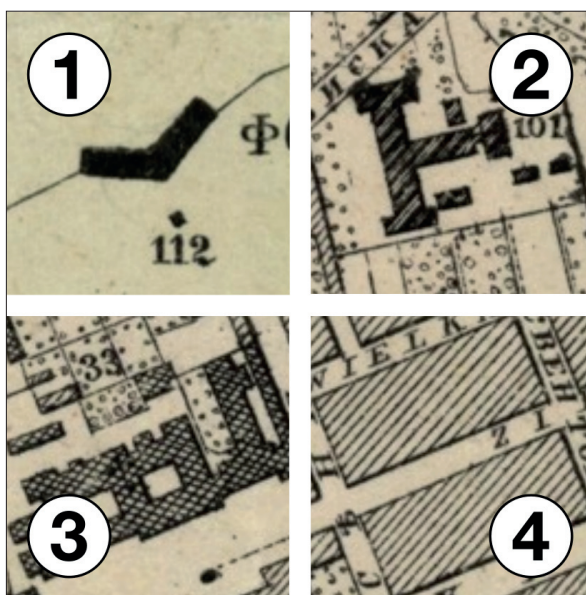

Fig. 3. Typological classification of buildings by hachure style: (1) military, (2) public, (3) religious, and (4) other buildings
Source: Own elaboration based on ZZK 1064, National Library of Poland

Fig. 4. Examples of labelled buildings from the original plan showing variation in font style and languages
Source: Own elaboration based on ZZK 1064, National Library of Poland

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[21] J. Chełmiński, M. Wasilewicz, 'Przez centrum Warszawy płynęły rzeki. Zobacz je na mapie', *Gazeta Wyborcza*, https://warszawa.wyborcza.pl/warszawa/7,54420,26981804,przez-centrum-warszawy-plynely-rzeki-zobacz-je-na-mapie-a.html (accessed: 16 July 2025).

[22] *Zestawienie znaków topograficznych*, pp. 41–42.

[23] Seegel, 'Four Purposes of Early 19th-Century Polish National Cartography'.

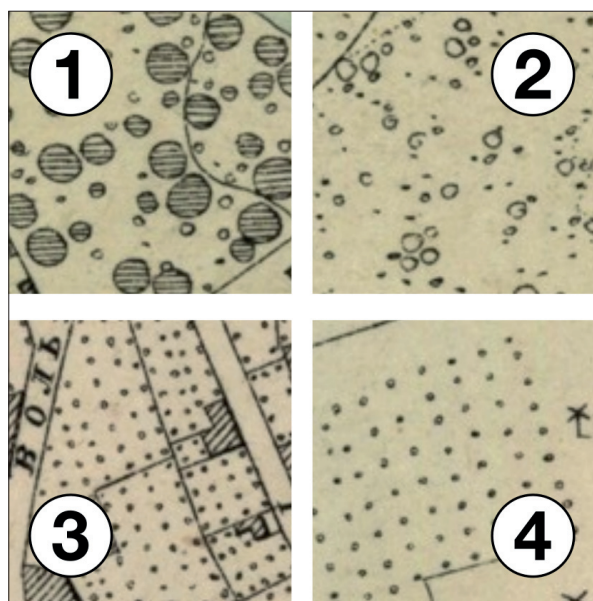[24] *Zestawienie znaków topograficznych*, pp. 38–39.

Fig. 5. Vegetation types depicted on the map: (1) forests, (2) shrubs, and (3-4) general vegetation or cultivated land
Source: Own elaboration based on ZZK 1064, National Library of Poland

and Pociecha indicate their prominence as landmarks. This semantic interpretation underpins symbol standardisation and informs vectorisation and database modelling described in the next section.

4.3. Vectorisation and Data Modelling

Building on the semantic interpretation, features were manually vectorised in QGIS and organised into a geospatial database for analysis and map design. Digitisation followed principles of geometric precision, topological integrity, and thematic consistency. The data model contains over 20 layers grouped by geometry: polygons (land cover, water bodies, buildings, military and cemetery areas), lines (roads, railways, escarpments, waterways, pipelines, and ramparts) and points (points of interest and toponyms).

Each vector layer includes attribute names in Polish and English to ensure clarity for local and international users. Selected layers are annotated with custom semantic attributes reflecting the earlier

classification. Cemeteries are tagged by religious affiliation (Calvinist, Catholic, Evangelical, Jewish and Orthodox), points of interest (POIs) by type (city gate, factory, inn, monument, etc.), and streets by function. Toponymy is recorded both historically and currently, where available. Tree rows include alignment and density indicators.

External historical sources supported reconstruction where the original map lacks detail. Street names were supplemented from Świątkowski's 1852 *Taryfa*,[25] and street hierarchy was informed by commentary from Bartoszewicz and Weszpiński.[26] Contemporary street names are sourced from the TERYT register,[27] and hydronyms follow the diagram by Chełmiński and Wasilewicz.[28] Several post-processing steps improved data quality after manual vectorisation. The PAEK smoothing algorithm, applied in ArcGIS Pro, reduced angular noise[29] by refining line geometry. Building footprints were orthogonalized, and topology checks removed overlaps, slivers and gaps.

The full geospatial dataset is available with this article, supporting independent analysis, integration with other spatial sources and future historical research. This modelling phase laid the semantic and technical groundwork for the final map design.

4.4. Cartographic Design and Symbol System

With the spatial data model established, the next stage focused on transforming this dataset into a coherent, legible and

[25] H. Świątkowski, *Taryfa domów miasta Warszawy i Pragi z planem ogólnym i 128 szczegółowych planików ulic i domów* (Warsaw, 1852).

[26] Bartoszewicz, Weszpiński, *Plan Warszawy 1825*.

[27] Central Statistical Office of Poland, National Official Register of the Territorial Division of the Country, https://eteryt.stat.gov.pl/eTeryt/english.aspx (accessed: 16 July 2025).

[28] Chełmiński, Wasilewicz, 'Przez centrum Warszawy płynęły rzeki'.

[29] E. Bodansky, M. Pilouk, 'Using Local Deviations of Vectorization to Enhance the Performance of Raster-to-Vector Conversion Systems', *International Journal on Document Analysis and Recognition*, 3 (2000), pp. 67–72.

city gate	important road	important building	public square
inn	main street	military building	public park
factory	general street	religious building	cemetery
windmill	alley	other building	garden
watermill	path / track	military area	greenery
statue	tree row	district borders	forest
fountain / spring	railroad		sand
wayside cross	stream		wetland
	water pipe		water
	escarpment		

Fig. 6. Legend of the redesigned map, showing the symbols used for various thematic layers
Source: Own elaboration

historically informed map. Spatial layers were prepared in QGIS and refined in Adobe Illustrator, where labels, overlays and infographics were added. The final output is a print-ready, layered PDF file in CMYK format. A modern design approach was adopted instead of a historicist style. The cartographic logic draws on the OpenStreetMap Carto stylesheet,[30] chosen for its clarity and cognitive accessibility, especially for users unfamiliar with nineteenth-century map conventions.[31] Alternative styles, such as sepia-toned palettes or nostalgic stylisations, were rejected, as they reduce the clarity of dense spatial content and decrease legibility.[32]

Map features follow a layer-based hierarchy, with visual styles derived directly from database attributes to maintain semantic consistency (see Fig. 6). Building footprints are grouped into four functional types, following the structure of the original map, and styled using patterns based on historical hachures. Key buildings retain visual dominance to preserve the original visual hierarchy. Roads follow a five-level hierarchy based on function, expressed through line weight, colour, and casing. Dashed and patterned lines differentiate features such as railways and escarpments. Point features use simplified symbols to replace text-based or ambiguous labels. Symbols from the SVG Repo[33] library were adapted for uniform weight and colours. Labels replace numerical codes from the original map, with colours indicating feature type (e.g., religious, public).

The map's visual coding follows intuitive conventions (e.g. green for vegetation) and employs a restrained palette of muted colours to differentiate land use. Bright tones are limited to overlays marking temporal layers. Earlier versions used more saturated colours (e.g. brown or orange buildings) but were abandoned after print tests revealed visual imbalance and excessive contrast. Additionally, colour-blind readability was verified for print and screen. Typeface selection prioritises legibility and neutrality: sans-serif fonts replace historicist styles to support the map's intended pedagogical

30 'OpenStreetMap Carto Stylesheet', GitHub, https://github.com/gravitystorm/openstreetmap-carto (accessed: 16 July 2025).

31 J. Zejdlik, V. Voženílek, 'Exploring Cartographic Differences in Web Map Applications: Evaluating Design, Scale, and Usability', *ISPRS International Journal of Geo-Information*, 14 (2025), p. 9.

32 P. Justová, J. Cajthaml, 'Cartographic Design and Processing of Originally Printed Historical Maps for Their Presentation on the Web', *ISPRS International Journal of Geo-Information*, 12, no. 230 (2023), pp. 14–15, https://www.mdpi.com/2220-9964/12/6/230 (accessed: 2 Nov. 2025).

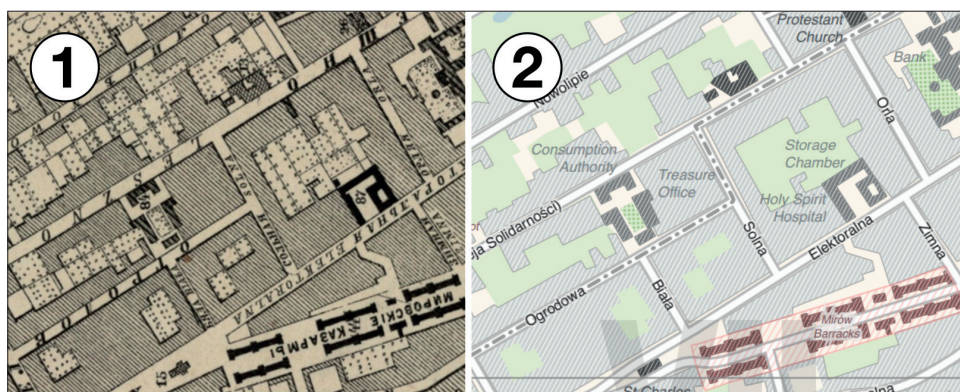33 SVG Repo, https://www.svgrepo.com/ (accessed: 16 July 2025).

Fig. 7. Visual comparison of the same urban area in the (1) original and (2) redesigned versions of the map
Source: Own elaboration based on ZZK 1064, National Library of Poland

Fig. 8. Decorative cartouche in (1) the original 1856 plan and (2) its reinterpreted version, preserving historical visual identity
Source: Own elaboration based on ZZK 1064, National Library of Poland

function over archival replication[34] (see Fig. 7). The design was refined through informal consultations with cartographers and students at the Research Unit Cartography at TU Wien. Multiple print tests informed adjustments to hierarchy, hatch density, symbol colours, label clarity

and background tones. Though modern, select historical elements are retained as visual anchors of the original identity (see Fig. 8).

4.5. Educational and Comparative Features

Several overlays and annotations were added to link data from the 1856 plan with the contemporary urban landscape and to assist spatial orientation (see Fig. 9). Present-day landmarks sourced from Open-StreetMap, such as the Palace of Culture and Science and the National Stadium, are overlaid in bright orange, clearly distinguished from the historical base. The current course of the Vistula River is also included. Street names follow a dual-label system: historical names appear in regular text, while modern names are shown in parentheses with the prefix "c.". Where no historical name exists, only the contemporary name is displayed with the prefix. Based on Gawryszewski's reconstruction,[35] twelve historical districts are marked with dashed boundaries and Roman numerals, linking them to statistical content from the original map.

Seventeen orange markers identify historically significant but vanished landmarks,

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[34] R. Deeb, K. Ooms, and P. De Maeyer, 'Typography in the Eyes of Bertin: Gender and Expertise Variation', *Cartographic Journal*, 49, no. 2 (2011), pp. 176–85.

[35] A. Gawryszewski, *Ludność Warszawy w XX wieku* (Warszawa, 2009), pp. 56–57.
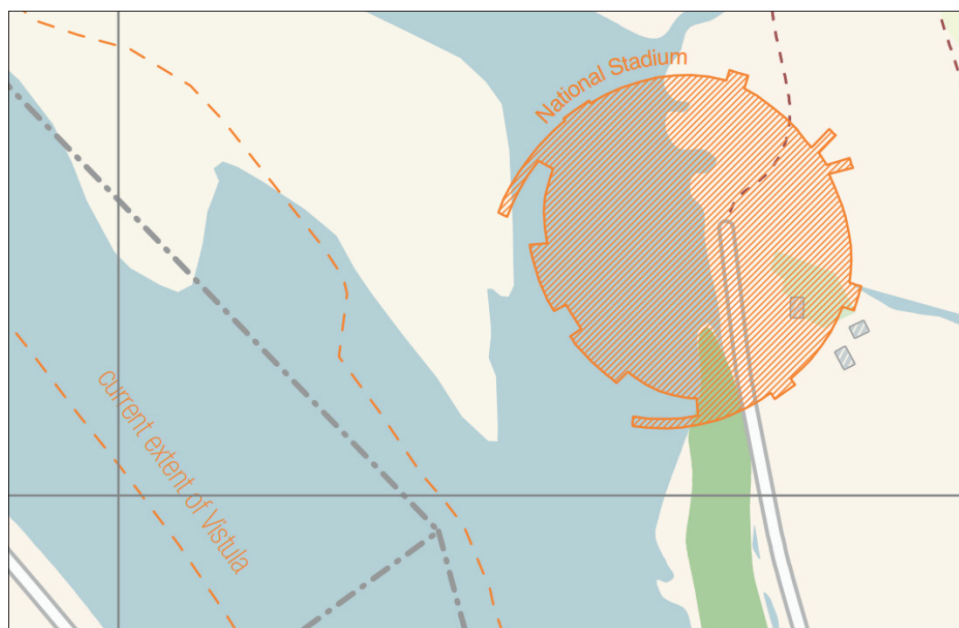
Fig. 9. Overlay of the current Vistula course and the National Stadium on the historical base map
Source: Own elaboration

Fig. 10. Orange markers identifying vanished historical landmarks, linked to archival descriptions on the map's reverse
Source: Own elaboration based on ZZK 1064, National Library of Poland

each with a brief description and archival photo on the map's reverse. The reverse also includes a complete reproduction of the 1856 map, illustrating editorial decisions and cartographic conventions of the period (see Fig. 10). Additional contextual elements include a demographic chart comparing Warsaw's 1856 population with those of nine European cities, a timeline of key historical events with the date of the map's creation highlighted, and a sequence of maps showing Warsaw's territorial expansion since 1770. Original statistical tables and textual annotations were also reproduced. Together, these additions situate the plan within broader demographic and territorial trends and highlight its historical context (see Fig. 11).
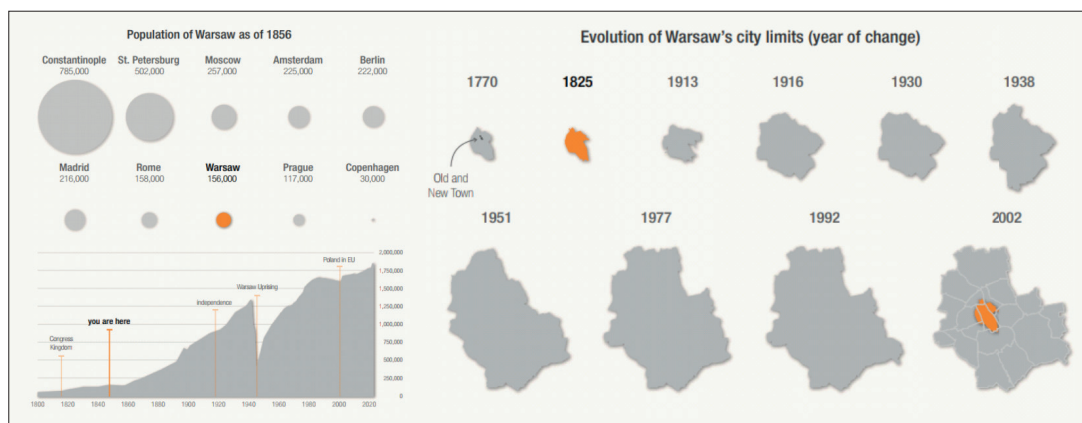
Fig. 11. Supplementary educational elements: population chart, timeline and territorial evolution diagrams
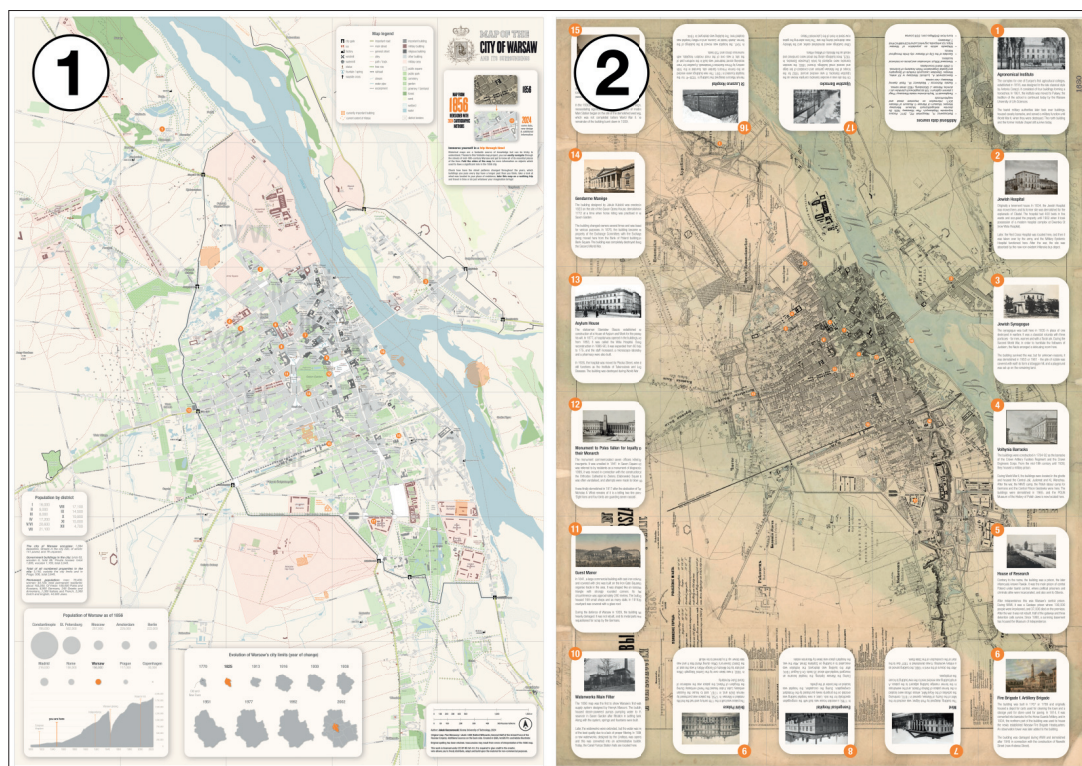Source: Own elaboration

Fig. 12. Final printed design: (1) recto and (2) verso
Source: Own elaboration based on ZZK 1064, National Library of Poland

The map is designed as a double-sided A1 sheet (6×5 panels) that folds down to a pocket-sized 119×280 mm format. Informational cards on the reverse margins enable partial unfolding, allowing users to consult annotations while viewing the front (see Fig. 12). Orientation is supported by a north arrow, dual scale bars

(metres and Russian fathoms) and a usage guide.

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.

5. Discussion

5.1. Methodological Constraints and Interpretive Challenges

The editorial process, while effective in creating an accessible spatial resource, was marked by several methodological and interpretive challenges. Georeferencing was limited by irregular distortions typical of historic lithographic maps, hindering precise alignment with other sources. The map also poses interpretive issues due to ambiguous and non-standardised symbols – some, such as general vegetation, remain unresolved despite comparative analysis. These ambiguities were addressed through triangulation: combining historical references, spatial analysis and logical inference, with unresolved cases handled transparently based on editorial judgment.

The redesign phase introduced tensions between historical conventions and contemporary clarity. A modern visual language was adopted to enhance legibility, diverging from the original symbolic system in elements such as POI markers and road hierarchies. These changes reframe the map as a pedagogical tool rather than an administrative record. They enhance interpretability and support engagement, in line with Panecki's view of historic maps as interpretable artefacts.[36] The editorial workflow remains highly labour-intensive

and dependent on interpretive judgement. While this ensures fidelity to the source, it also limits scalability and hinders automation.

Every design decision, from categorisation to symbolization, carries interpretive consequences. As Słomska-Przech and Lilley argue, maps are inherently "subjective, partial and selective".[37] This project engages with that subjectivity by making editorial interventions visible, for instance, replacing militarised symbols with neutral equivalents, thereby reframing the ideological tone. Whether this decision clarifies or obscures meaning remains open to future evaluation. Ultimately, the project positions historical map editing as a complex interpretive practice that balances preservation with transformation and fidelity with usability.

5.2. Educational and Historiographic Potential

The interpretive choices discussed above not only affect how the map encodes historical meaning: they also shape how it is used, read, and understood by different audiences. The design decisions presented earlier, such as using overlays, dual labelling, contextual back matter, and a foldable print format, serve not only navigational or explanatory purposes. They are also intended to activate the map as a tool for spatial reflection and historical inquiry. Conceived not merely as a structured dataset or visual artefact, the map aims to invite users to engage with Warsaw's past as a dynamic, lived environment. Contemporary overlays and visual contrasts between surviving and vanished structures prompt users to ask not only "what was here", but also "why did it change" and "how do we know". These questions foster

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36 Panecki, 'Digital Methods', pp. 682–97.

37 K. Słomska-Przech, K.D. Lilley, 'Cartography and the City: Exploring Urban Ontologies through Historic Town-Maps', in: *Modelling the City: Formal Ontology and Spatial Humanities*, ed. W. Duży (London – New York, 2024), p. 177.
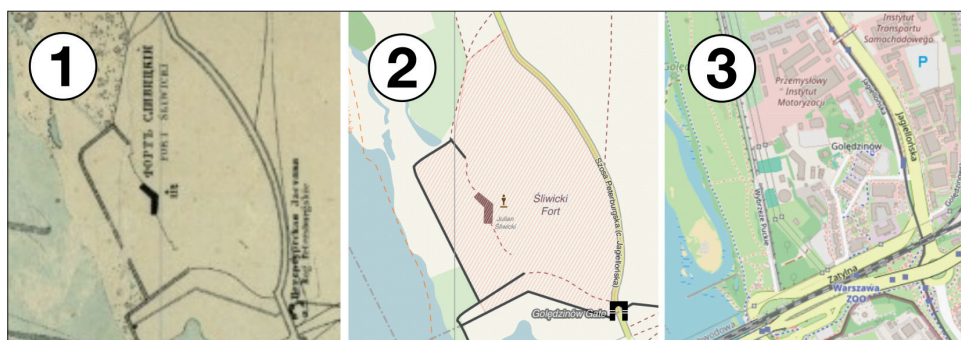
Fig. 13. Comparison of Jagiellońska Street's curve on (1) the 1856 map, (2) its redesign and (3) OpenStreetMap
Source: Own elaboration based on ZZK 1064, National Library of Poland and OpenStreetMap © OpenStreetMap contributors

historiographic awareness and critical reflection on urban transformation.

The map is designed to support interdisciplinary learning. In urban history, it visualises how governance and military planning shaped Warsaw's spatial form. In cartographic education, it exemplifies a critical approach to historical map editing. In heritage studies, it helps restore the spatial context of forgotten or erased sites. Pole Mokotowskie park is revealed as a former parade ground, while the Saxon Garden reservoir forms part of a nineteenth-century water infrastructure system. A slight rise, now overlooked during daily commutes, regains significance as the former site of the Praga Synagogue. Jagiellońska Street's curve follows the outline of a former fortress (see Fig. 13), and the Copernicus Science Centre, shown mid-river on the 1856 map, illustrates the changing course of the Vistula River. Toponymic interpretation further deepens this reflective function: *Młynów* commemorates its windmills, *Ochota* derives from a roadside inn, and *Solec* recalls its salt warehouses.

The foldable print format encourages embodied engagement. It enables users to connect their physical movement to the map's spatial logic, thereby supporting locational awareness and experiential learning, particularly during walking tours and

site-based education.[38] Institutions such as schools, city museums and heritage organisations can use the map as a resource for place-based learning. By juxtaposing historical and contemporary layers, the map invites users to construct narratives, formulate hypotheses and test them through spatial reasoning. This aligns with the constructivist educational approach, in which learners become interpreters rather than passive recipients of historical knowledge.[39]

5.3. Contributions to Digital and Spatial Humanities

Beyond its pedagogical applications, the project also contributes methodologically to the fields of digital and spatial humanities. It demonstrates how historic maps can be transformed to support not only interpretation and learning, but also data integration, semantic modelling, and interdisciplinary analysis by creating structured and narratively expressive resources. A semantically rich vector database helps address key challenges in historical GIS: encoding meaning, supporting temporal comparison and interpreting analogue

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[38] A.L. Black, G. Crimmins, *Listening to Children: Using Children's Perspectives to Inform the Provision of Responsive Environmental Education at the Mary Cairncross Scenic Reserve and Discovery Centre* (University of the Sunshine Coast, 2017), pp. 20–39.

[39] H. Dumont, D. Istance, and F. Benavides (eds), *The Nature of Learning: Using Research to Inspire Practice* (Paris, 2010), pp. 39–40.

sources digitally.[40] Three editorial strategies underpin the approach: semantic vectorisation (preserving the internal logic of the original while enabling queries), visual recoding (translating content into an accessible graphical syntax) and hybridisation (integrating GIS, print and educational design). These practices exemplify how critical cartography can bridge scholarly interpretation with public engagement.

The resulting database enables integration with WebGIS platforms and supports linking with other historical geospatial datasets. Beyond cartographic visualisation, spatial data can contribute to broader research in the spatial humanities, including analyses of land use and urban governance. While geometric accuracy is sufficient for intra-map analysis, such as studies of urban morphology or space syntax, it poses limitations for diachronic and multi-source comparisons.

Potential applications include narrative and immersive formats, such as story maps, interactive city guides, and AR visualisations that reconstruct lost urban layers. With further development, such applications could support 3D reconstructions of historical Warsaw in educational and museum settings. The open publication of the dataset and schema seeks to encourage community-led enrichment and integration with collaborative initiatives such as OpenHistoricalMap.[41] These directions align with the core values of digital humanities: openness, participation and interdisciplinarity.[42]

6. Conclusion and Future Work

Beyond the specific tools and methods discussed above, the reinterpretation of the 1856 Plan of Warsaw offers broader insights into the contemporary role of historical cartography. This project explored how a historic map can be reinterpreted into a meaningful resource for contemporary users by combining semantic analysis, spatial modelling, and visual redesign. Rather than merely preserving the 1856 Plan of Warsaw, the editorial process aimed to reframe it as a critical, accessible, and narratively rich tool. The reinterpretation revealed not only technical challenges, but also epistemological tensions around fidelity, legibility and historical framing. These challenges foreground the inherently subjective and interpretive nature of historical cartography when reactivated for modern educational and public uses.

The role of the historical cartographer emerges here not as a passive reproducer but as a mediator, negotiating between historical evidence, contemporary design, and pedagogical objectives. This positions the reinterpretation as an active preservation that transforms archival artefacts into tools for inquiry, spatial reasoning, and historical reflection.

Future research and development should focus on three key areas:

1. Developing semi-automated and scalable workflows for historical map editing to reduce manual labour and improve transparency and reproducibility;
2. Integrating historical ontologies, such as UrbanOnto,[43] to support semantic interoperability across projects;
3. Empirically evaluating the educational impact of the map through fieldwork with educators, students, and museum visitors, assessing interpretability, engagement, and learning outcomes.

The editorial model developed here offers a transferable framework for the reinterpretation of historical urban maps beyond Warsaw. It invites further comparative research in digital heritage, critical

[40] I. Gregory, P. Ell, *Toward Spatial Humanities: Historical GIS and Spatial History* (Cambridge, 2007), pp. 196–202.

[41] OpenHistoricalMap, https://openhistoricalmap.org (accessed: 16 July 2025).

[42] E. Scanlon, 'Digital Scholarship: Identity, Interdisciplinarity, and Openness', *Frontiers in Digital Humanities*, 5, no. 3 (2018), https://doi.org/10.3389/fdigh.2018.00003.

[43] Słomska-Przech, 'Lindleys' Map of Warsaw', pp. 159–82.

cartography, and spatial humanities, fields in which the past is not only archived, but also interpreted, reimagined, and made legible for the present.　　■

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Cyfrowa reinterpretacja mapy Warszawy z 1856 r. w celu pogłębienia wiedzy historycznej i umiejętności orientacji przestrzennej

Streszczenie

Artykuł przedstawia krytyczną reinterpretację planu Warszawy i okolic z 1856 r., sporządzonego w okresie przemian politycznych i przestrzennych. Zamiast traktować historyczne mapy jako statyczne artefakty, projekt traktuje edycję kartograficzną jako proces narracyjny i interpretacyjny, mający na celu zapewnienie jasności semantycznej, dostępności wizualnej i integralności historycznej. Niejasne symbole i przestarzałe konwencje wizualne mapy zostały rozszyfrowane poprzez analizę porównawczą i przekształcone w semantycznie ustrukturyzowany zbiór danych przestrzennych. Na tej podstawie opracowano nowy projekt wizualny przy użyciu współczesnego języka graficznego, który zachowuje logikę informacyjną oryginalnej mapy. Efektem końcowym jest składana mapa drukowana, uzupełniona nakładkami edukacyjnymi i adnotacjami historycznymi, mająca na celu promowanie umiejętności przestrzennych i zaangażowania społecznego. Pod względem metodologicznym projekt łączy narzędzia cyfrowe z krytyczną kartografią i proponuje uniwersalny sposób pracy przy edycji map historycznych, wykorzystaniu edukacyjnym i zastosowaniach związanych z dziedzictwem cyfrowym. Artykuł zawiera również refleksję na temat wyzwań redakcyjnych, subiektywnych decyzji i implikacji historiograficznych związanych z reinterpretacją map. Szczególny nacisk położono na potencjał pedagogiczny mapy w nauczaniu opartym na doświadczeniu i miejscu oraz na ewoluującą rolę kartografa jako mediatora i edukatora. Zbiór danych jest publicznie dostępny w celu wsparcia dalszych badań w dziedzinie humanistyki cyfrowej, studiów nad dziedzictwem kulturowym i historycznej analizy miejskiej. ∎

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