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WATERMILL LANDSCAPE TRANSFORMATION IN STARE BOJANOWO (1793–2024): INSIGHTS FROM CONTEMPORARY LANDSCAPE STUDIES

PRZEMIANY W KRAJOBRAZIE MŁYŃSKIM W STARYM BOJANOWIE W LATACH 1793–2024 W ŚWIETLE WSPÓŁCZESNYCH STUDIÓW KRAJOBRAZOWYCH

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ABSTRACT: Watermills, together with the structures and infrastructure supporting their economic function, constituted an important element of the landscape. This article aims to analyze and interpret changes in the historical watermill landscape of Stare Bojanowo between 1793 and 2024, focusing on the continuity, disappearance, and coexistence of individual landscape features. The study draws on historical, cartographic, and remote sensing data, including aerial photographs, airborne laser scanning (ALS) data, and digital terrain model (DTM) visualizations. It identifies landscape transformations resulting from the operation of the watermill and examines the post-depositional processes affecting the preservation of the mill remains and their associated infrastructure. The study demonstrates how the landscape has been used and transformed over more than two centuries and highlights the destructive impact of contemporary peat extraction. Finally, it emphasizes the importance of ongoing archaeological research in documenting the site's significance and preserving its heritage for future generations.

KEY WORDS: watermill, landscape transformations, continuation, spatial data, memory, post-depositional processes

INTRODUCTION

Watermills were once an integral part of the rural landscape. Owing to a range of socio-economic factors, particularly during the twentieth century, many were dismantled or fell into ruin. As a result, most of these structures have not survived

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to the present day. Nevertheless, their construction and operation profoundly transformed the surrounding landscape, altering both the topography and local hydrological conditions. The disappearance of watermills also triggered further landscape changes (Fajer-Waga, 2017, p. 136). Over time, these sites became marginalized and eventually faded from collective memory. To some extent, contemporary landscape studies help to recover their significance and restore awareness of their historical presence.

When analyzing a landscape, a researcher encounters only the present, assigning meaning – including symbolic meaning – to particular places and objects by connecting them with past events. In this study, the landscape is approached holistically. This means that humans and other animate and inanimate entities are understood to possess agency. This perspective rejects the dualistic division between nature and culture and instead adopts a view of the landscape as the outcome of interaction of diverse forces and entities. This implies a further assumption that landscapes possess "historicity". This means that they contain traces of the actions of both contemporary people and past generations. Consequently, the landscape may be perceived as a "palimpsest" – a research category referring to the process by which landscapes are "inscribed" with particular meanings and contents that present and later actors either preserve alongside newly introduced elements or erase over time. This way of interpreting past human activity has led to the adoption of archaeological concepts, such as the chronological ordering of the landscape through "stratigraphy" and the identification of successive "layers" that are assigned specific meanings. The interpretative process itself, however, more closely resembles a "hermeneutic spiral" than a "linear record of time" (Kostyrko, Zamelska-Monczak, 2020, p. 139–140).

The aim of this article is to analyze and interpret a watermill landscape in terms of continuity and discontinuity, as well as the coexistence of its historical and contemporary forms, viewed as an element of the lived landscape shaped by human occupation over the centuries. To this end, the study adopts two principal conceptual assumptions: (1) the *longue durée* perspective on landscape transformation; and (2) the layered nature of the landscape (Roymans et al., 2009, p. 339). Consequently, the landscape cannot be analyzed by separating the past from the present, even though it is inevitably examined from a contemporary perspective. The landscape embodies the cumulative activities of successive generations, expressed through processes of continuity and succession, with each generation adding new elements to its existing fabric. As a result, even the present-day landscape remains in a constant state of transformation, reflecting its inherently dynamic character (Roymans et al., 2009, p. 339; Kolen, Renes, Bosma, 2017, p. 123–124).

This article analyses and interprets landscape transformations in Stare Bojanowo (Śmigiel Commune, Kościan County, Greater Poland Voivodeship, Poland) associated with the operation of a watermill from the late eighteenth century to the late 1920s. It further investigates the natural and anthropogenic processes that have affected the site since the mill was dismantled, with particular attention to their influence on the

preservation of the mill remains and associated infrastructure through post-depositional processes (Urbańczyk, 1986)[1].

The watermill in Stare Bojanowo has not survived to the present day and has attracted little attention from either historians or archaeologists. Consequently, it has never been the subject of a comprehensive study. The relevant sheet (61–24) of the Polish Archaeological Record (Archeologiczne Zdjęcie Polski, AZP), contains no record of the mill remains within the village or of an archaeological site in the vicinity of its most probable location[2]. This is most likely because the recording of post-medieval industrial features of this type was not envisaged within the scope of the AZP programme. As a result of the georeferencing and vectorisation of the most cartometrically accurate historical maps, including the 1892 *Kosten Messtischblatt*, the most probable location of the former watermill was identified. An archaeological field survey employing electronic survey equipment was conducted in 2024. Its primary objectives were to verify the location of the mill, identify and document its material remains, including earthworks and other surviving landscape features, and provide a basis for their legal protection, together with that of the artefacts discovered during the survey[3].

In landscape studies, a key issue is the assessment of landscape changes resulting from human habitation, particularly the construction of the mill and its infrastructure as relatively persistent elements of the mill landscape. In analyzing this landscape, attention is paid to changes in vegetation cover, water relations, and landforms as consequences of these human activities, which, themselves while undergoing transformation, trigger further landscape changes.

The above issues are closely related to a research question that requires an interdisciplinary approach, drawing on archaeology, history, geography, and ethnology. The question is whether it is possible to identify, analyze, and interpret changes in

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[1] Urbańczyk argues that archaeological information is inherently dynamic (1986, p. 184–185). He distinguishes four categories of processes affecting archaeological information: socio-cultural processes, stratification processes, post-depositional processes, and the archaeological research process itself. Post-depositional processes comprise all transformations affecting the material structure of an archaeological site after its formation through stratification and before its exposure during archaeological investigation (p. 187–188). According to Urbańczyk, archaeological information may undergo chronological, quantitative, spatial, and relational transformations (1986, p. 203–209). He further argues that the reduction of archaeological information is a multi-stage process that can be represented by a series of concentric circles of progressively decreasing size. Both natural and cultural post-depositional processes may result in a wide range of transformations as well as in the degradation of archaeological evidence (p. 243–244).

[2] National Heritage Institute (Narodowy Instytut Dziedzictwa), Map Portal. https://mapy.zabytek.gov.pl/nid/ (accessed: 16 April 2026).

[3] The recovered material and the accompanying report were submitted to the Greater Poland Voivodship Heritage Protection Office and are currently awaiting expert assessment (Permit No. 59/C/2024 of 12 March 2024). The recovered assemblage includes metal artefacts, such as nails, as well as numerous pottery sherds that can be preliminarily dated to the post-medieval and modern periods. These finds are not included in the present study.

the watermill landscape that occurred between 1793 and 2024 in the area of Stare Bojanowo on the basis of available spatial data, including cartographic sources, aerial photographs, and Digital Terrain Model (DTM) visualizations. Beyond the obvious distinction between the first stage involving the establishment and operation of the watermill together with its infrastructure, and the second stage concerning the material remains left after the cessation of its operation, it is necessary first to determine the relationship between the mill and the space it occupied. This includes examining how the functioning mill affected the environment and landscape, as well as how environmental conditions influenced the mill, and how these processes may have been perceived by contemporary inhabitants.

Subsequently, it is necessary to analyze post-depositional processes and phenomena affecting the preservation of the mill remains, particularly its infrastructure, as well as to consider their significance from a contemporary perspective and whether this significance extends beyond archaeological research.

First, it is necessary to define the term "watermill landscape". From a formal perspective, it comprises production facilities, such as mills and their associated infrastructure, which form the constituent elements of mill settlements (Pietrzak, 2013, p. 143–144). They comprised not only the mill itself, i.e. the miller's workplace, but also the miller's farmstead, together with residential and agricultural buildings. The mill landscape also included land owned by the miller, including agricultural plots (Szurowa, 2015, p. 353–354). These elements permanently transformed the landscape into one shaped and inhabited by humans, particularly through the constant need to supply and retain water for the operation of the mill. Of key importance were anthropogenic terrain modifications that altered the surface water network, including mill dams, mill races, bypass channels, millpond basins, as well as levelled surfaces and embankments. These features possessed their own distinct landforms, many of which have survived to the present day despite the cessation of mill operations. The purpose of this system was to deliver an adequate volume of water to the mill wheel and discharge it after use, thereby enabling the operation of the machinery (Kaniecki, 2004, p. 360; Podgórski, 2009, p. 154; Pietrzak, 2013, p. 137, 153).

For the purposes of this article, the watermill landscape is defined as specific places associated with the operation of a watermill, together with its mill infrastructure and farm buildings, which together formed a mill complex. This landscape was a dynamic entity in which humans undertook specific activities, transforming the world around them and attributing meanings to the outcomes of their actions. An essential element of this approach is the participation of people in shaping and experiencing the landscape. Similarly, the material remains – particularly those with their own distinct landforms – are considered to constitute part of the mill landscape, in which their contemporary perception by inhabitants of these places, as well as by researchers, is highly significant.

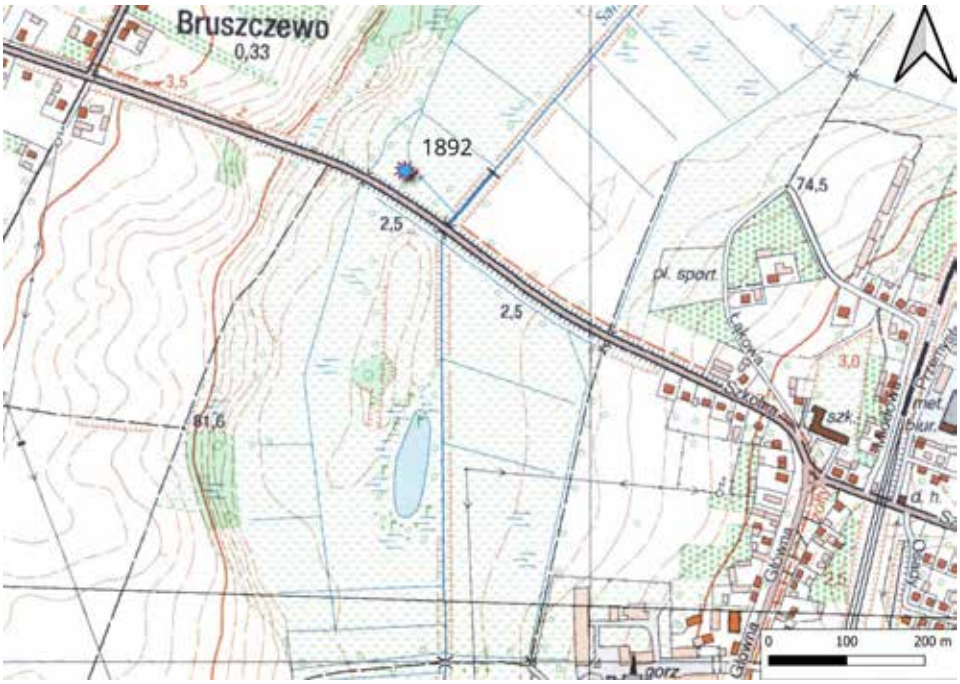

Fig. 1. The most probable location of the watermill (blue star, number 1892)

Ryc. 1. Najbardziej prawdopodobna lokalizacja młyna wodnego (niebieska gwiazdka, numer 1892)

HISTORICAL BACKGROUND

References to the Stare Bojanowo watermill can be found in *Słownik historyczno-geograficzny ziem polskich w średniowieczu* (*Historical-Geographical Dictionary of the Polish Lands in the Middle Ages*) and in *Liber beneficiorum dioecesis Posnaniensis* (Nowacki, 1950). The sources make it possible to trace selected events associated with the mill from the late Middle Ages to the end of the sixteenth century.

The earliest record of the watermill appears in the Kościan land court register of 1423, when Andrzej Bojanowski, the then owner of Stare Bojanowo, concluded an amicable settlement with Przybysław Gryżyński, the Poznań Lord Steward (*stolnik*) and owner of Bruszczewo, concerning the dam and the mill situated between Stare Bojanowo and Bruszczewo. The agreement regulated the costs of repairing the dam, the mill race, and the fascine reinforcement (*gać*), expenditures on the mill, issues relating to pig husbandry, and the division of the mill's revenues between the two parties[4].

[4] *Słownik historyczno-geograficzny ziem polskich w średniowieczu. KoścZ* 5, 433v; *KoścZ* 8, 9. Stare Bojanowo: http://www.slownik.ihpan.edu.pl/search.php?id=16144&q=bojanowo&d=0&t=0 (accessed: 16 April 2026). Information concerning this matter is also included in the entry for Bruszczewo in the *Słownik historyczno-geograficzny ziem polskich w średniowieczu* (*Historical-Geographical Dictionary of*

The second reference to the watermill comes from 1540 and is found in the Kościan castle court records. In that year, Mikołaj and Sebastian Śmigielski of Bruszczewo granted Andrzej Bojanowski, the subsequent owner of Stare Bojanowo, the right to use the bank of the Młynisko River, which flowed from the direction of Robaczyn toward Stare Bojanowo and Bruszczewo, together with the right to construct a watermill there[5]. This record clearly points to a complex pattern of property ownership and the absence of clearly defined boundaries between the two villages. It may be inferred that the earlier watermill had been dismantled, as it could otherwise have become the subject of future disputes. This interpretation appears to be supported by a reference in *Liber beneficiorum dioecesis Posnaniensis anni 1510* to an abandoned windmill at Stare Bojanowo, but not to a watermill (Nowacki, 1950). It is therefore impossible to determine whether a new watermill was erected at a different location or whether the previous one was rebuilt.

The next reference to a watermill dates from 1542, when the brothers Jakub and Marcin Ramsz of Robaczyn (a village situated southwest of Stare Bojanowo) brought a legal action against Andrzej Bojanowski, alleging that he had caused the flooding of meadows belonging to them and to their peasants, as well as pastures, a track, and a mill known as Ostrów, which marked the boundary between Robaczyn and Stare Bojanowo[6]. This information is significant because it suggests that hydraulic infrastructure designed to modify the local water regime must already have existed. Such features – including millponds, dams, and weirs – regulated the flow and retention of water, thereby substantially transforming the landscape and influencing local patterns of human settlement. The existence of the watermill is further confirmed by the tax registers in the Crown Treasury Archive for 1563 and 1581. The 1563 record states that the mill was equipped with a single undershot waterwheel, allowing it to be identified as an undershot watermill[7]. No comprehensive studies of the written sources relating to the village from the seventeenth and eighteenth centuries have been published. Consequently, the history of the watermill during this period is not examined here, as the present study is concerned with a much later period. Nevertheless, the fifteenth- and sixteenth-century records attest to the long-established presence of a watermill at Stare Bojanowo.

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the Polish Lands in the Middle Ages – Bruszczewo) (accessed: 16 April 2026). It should be noted, however, that the two entries, although based on the same source, contain certain discrepancies. In the entry on Stare Bojanowo, J. Luciński mentions only the existence of a dam and a mill, whereas K. Górska-Gołaska, in the entry on Bruszczewo, refers to the same source but additionally records the presence of a mill race and fascine reinforcements.

[5] *Słownik historyczno-geograficzny ziem polskich w średniowieczu*. PG 17, 402v. Bruszczewo: http://www.slownik.ihpan.edu.pl/search.php?id=16355&q=bruszczewo&d=0&t=0 (accessed: 16 April 2026).

[6] *Słownik historyczno-geograficzny ziem polskich w średniowieczu.* Robaczyn: http://www.slownik.ihpan.edu.pl/search.php?id=22415&q=robaczyn&d=0&t=0 (accessed: 16 April 2026).

[7] In an undershot watermill, the water flows beneath the waterwheel, and the wheel is driven by the kinetic energy of the current. By contrast, in an overshot watermill, water is supplied from above and falls onto the wheel, which is driven primarily by the weight of the water (Baranowski, 1977, p. 19–20; Dembińska, 1973, p. 96–97; Kubicki, 2012, p. 120–122; Szurowa, 2015, p. 99).

LANDSCAPE DATA

The analysis and interpretation of changes in the watermill landscape at Stare Bojanowo were based primarily on cartographic sources. Remote sensing data, including aerial photographs, airborne laser scanning (ALS) data, and Digital Terrain Model (DTM) visualizations integrated within a Geographic Information System (GIS) were highly significant. The aerial photographs used in this study were not acquired specifically for archaeological research. Both the vertical aerial photographs and the airborne laser scanning data came from the Polish Head Office of Geodesy and Cartography (GUGiK). The archaeological information they contain is available largely as a matter of chance rather than as the result of a survey designed for archaeological purposes. Moreover, the research questions and the investigator's interpretative skills inevitably influence the character of the resulting dataset.

Only a selected portion of the available data was included in the analysis according to clearly defined selection criteria. The principal criterion was the presence and recurrence of post-mill features across the assembled spatial datasets, including historical maps, digital terrain models, and aerial photographs from different periods. Accordingly, those spatial data offering the greatest potential for identifying the phenomena and processes that shaped both the historic watermill landscape and the post-mill landscape were selected, encompassing both natural and anthropogenic factors.

CARTOGRAPHIC DATA

Among the available cartographic sources, priority was given to maps that accurately depicted spatial features, allowing the individual components of the watermill infrastructure to be identified. The selected maps and site plan were characterized by a high level of spatial detail, a low degree of generalization, and the largest available scales, enabling a detailed representation of the watermill complex.

These considerations were closely linked to the reliability of the cartographic sources evaluated through comparison with one another, as well as with aerial photographs and Digital Terrain Model (DTM) visualizations. The recurrence of particular features across independent sources provided strong evidence for their long-term existence.

The analysis of cartographic sources followed three main criteria: establishing the spatial location of the mill and its associated infrastructure in relation to other topographic features; determining the presence and extent of mill infrastructure; and identifying processes and phenomena resulting from the interaction between the mill and its environment, including both the mill's active transformation of its surroundings and the influence of environmental factors on the mill.

The existence of the watermill or elements of its infrastructure between 1793 and 1929 is confirmed by cartographic sources. The mill site or associated features can be identified on the following maps: *Karte von Südpreußen von Gilly und Cron* [*Map of South Prussia*] from 1793, scale 1:50,000; *Gilly Specialkarte von Südpreußen*

[*Special Map of South Prussia*] from 1803, scale 1:150,000; the Gaul-Raczyński Map from 1807–1812, scale 1:125,000; sheets of the *Urmesstischblatt* survey from 1824–1826, scale 1:25,000; *Karte des Kostener Kreis* [*Map of the Kościan District*] from 1836 and 1861, scale 1:150,000; Reymann's *Topographische Special-Karte von Central Europa* from around 1850, scale 1:200,000; and a village plan from 1862, forming part of the *Verhandlungen über die Vermessung und Einschätzung Gut Alt Boyen* (1862–1867), scale 1:5,000[8]; *Messtischblatt* from 1892, scale 1:25,000; *Kreis Schmiegel* [*Map of the Śmigiel District*] from 1913, scale 1:100,000; *Mapa Taktyczna Polski* [*Tactical Map of Poland*] from 1924, scale 1:100,000; *Mapa Operacyjna Polski* [*Operational Map of Poland*] from 1925, 1927, and 1929, scale 1:300,000; and *Karte des Deutschen Reiches* (so-called Großblatt) from 1928, scale 1:100,000.

Maps with a high degree of content generalization, limited positional accuracy, and insufficient scale were excluded from the collected cartographic sources, since these characteristics directly affected the ability to identify components of the mill complex. Maps that represented the mill solely as a point symbol, without depicting associated infrastructure, were also excluded.

The following maps were thus selected for analysis: sheet XXV of the *Karte von Südpreußen von Gilly und Cron* [*Map of South Prussia*] from 1793, scale 1:50,000[9]; the Kosten sheet of the *Urmesstischblatt* survey from 1826[10] and the Leipe sheet from 1824[11], scale of 1:25,000; the village plan from 1862, forming part of the *Verhandlungen über die Vermessung und Einschätzung Gut Alt Boyen* (1862–1867), scale 1:5,000[12]; the Kosten sheet of the *Messtischblatt* survey from 1892, scale 1:25,000[13]; the Kościan sheet of the *Mapa Taktyczna Polski* [*Tactical Map of Poland*] from 1924, scale 1:100,000[14]; and the Śmigiel sheet of the *Mapa Szczegółowa Polski* [*Detailed Map of Poland*] from 1933, scale 1:25,000[15]. With the exception of the village plan, all of the selected sources were topographic maps.

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[8] Kościan Cadastral Office (Urząd Katastralny w Kościanie), record group 53/432/0/-/124. State Archives in Poznań (Archiwum Państwowe w Poznaniu).

[9] *Karte von Südpreußen von Gilly und Cron*, 1:50,000 (1793), SBB IIIC Kart N 14431, sheet 25. Staatsbibliothek zu Berlin Kartenabtailung.

[10] *Preußische Urmesstischblätter*, 1:25,000 (1826), SBB IIIC Kart N 729, sheet 2197. Staatsbibliothek zu Berlin Kartenabtailung.

[11] *Preußische Urmesstischblätter*, 1:25,000 (1824), SBB IIIC Kart N 729, sheet 2267. Staatsbibliothek zu Berlin Kartenabtailung.

[12] *Verhandlungen über die Vermessung und Einschätzung Gut Alt Boyen* (1862–1867). Kościan Cadastral Office, record group 53/432/0/-/124, State Archives in Poznań.

[13] *Topographische Karte (Messtischblatt)*, scale 1:25,000 (1892), sheet 2197. Mapster, based on the collections of the State Archives in Poznań, reference no. 25-xxxx.

[14] *Mapa Taktyczna Polski* [*Tactical Map of Poland*], scale 1:100,000 (1924), sheet A40 B23. Mapster: The Library of Congress, Washington, DC, USA. Available at: http://maps.mapywig.org/m/WIG_maps/series/100K/A40_B23_(324)_Koscian_1924_LoC_G6520_s100_.P6.jpg (accessed: 24 January 2026).

[15] *Mapa Szczegółowa Polski* [*Detailed Map of Poland*], scale 1:25,000 (1933), sheet P 40 S 23 H (4023 H). Mapster, based on the collections of the Institute of Geography of the Pedagogical University in Kraków. Available at: http://maps.mapywig.org/m/WIG_maps/series/025K/P40-S23-H_SMIGIEL_1933.jpg (accessed: 4 November 2025).

All of the cartographic sources confirm the earlier historical information concerning the location of the mill at Stare Bojanowo in the valley area of the Samica River, between the villages of Stare Bojanowo and Bruszczewo. The topological relationships also remained unchanged: the mill was situated on the northern side of the road connecting Stare Bojanowo and Bruszczewo, adjacent to the western branch of the Samica River. The mill no longer appears on *Mapa Szczegółowa Polski* [*Detailed Map of Poland*] from 1933; therefore, it may be assumed that it was most likely dismantled between 1929 and 1933.

By their very nature the cartographic sources do not provide information on whether the mill continued to operate as an undershot watermill or whether it had been modified into an overshot watermill. It is possible that the structure was converted into an overshot mill, for example in the nineteenth century, as this period witnessed a general shift in mill infrastructure towards such solutions. The maps from 1826, 1836, 1850, and 1861 additionally indicate that the watermill was in fact a fulling mill, marked with the abbreviations WLK. or WLK.M., standing for *Walkmühle*. On later maps from 1892, 1913, 1924, and 1928, the abbreviation M. appears, representing *Mühle* (mill). These cartographic abbreviations suggest that during the first half of the nineteenth century the facility was used for fulling cloth, whereas by the end of the century it most likely served for grinding grain into flour or groats. Importantly, the cartographic sources from 1793–1928 also confirm the existence of a windmill in the village.

People connected with the mill, particularly the millers themselves, constitute an essential element of the landscape analysis in this study. Archival and museum research has revealed that Josef Wels, a miller, lived in Stare Bojanowo and signed the statutes of the Millers' Guild in Śmigiel in 1887[16]. He had already been mentioned in the *Verhandlungen über die Vermessung und Einschätzung Gemeinde Alt Boyen* (1862–1867)[17]. Another miller from Stare Bojanowo is mentioned in the *Stamm-Rolle der Müller-Innung zu Schmiegel* [*Register of Members of the Millers' Guild in Śmigiel*][18] namely Anton Welz. He passed his journeyman's examination on 1 April 1885 and his master miller's examination on 22 April 1894. It is likely that the two millers were related as father and son and were probably of German origin. Based on the available sources, it has been established that Anton Welz owned a windmill, but it remains unclear whether he also owned a watermill[19]. Discovered cadastral documentation does not resolve the issue[20].

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[16] The statutes were signed on 4 May 1887. Next to the miller's first name and surname, the German name of the village, Alt Boyen, was also recorded. *Statut der Müller-Innung zu Schmiegel*. Records of the Śmigiel District Office concerning the Millers' Guild in Śmigiel, archival unit 34/5/0/4/279, p. 40. State Archives in Leszno.

[17] Source no. 41 mentions Josef Wels, a miller. Kościan Cadastral Office, group record 53/432/0/-/125. State Archives in Poznań.

[18] *Stamm-Rolle der Müller-Innung zu Schmiegel*. Regional Museum in Kościan. Anton Welz was entered under no. 59.

[19] Anton Welz signed a document in which the owners of windmills undertook to provide mutual assistance in the event of fire or strong winds. Records of the Śmigiel District Office concerning the Millers' Guild in Śmigiel, record group 34/5/0/4/279, p. 210–211, State Archives in Leszno.

[20] The document describes the property of Josef and Anton Welz as Mühlengrund ("mill land"). The source does not specify the type or number of mills, and the way in which the word Mühle is recorded may

Cartographic data confirm the existence of the mill at Stare Bojanowo, its operation at the same location over several centuries, and thus the relative persistence and continuity of the mill landscape.

REMOTE SENSING DATA

Another source of spatial data were vertical aerial photographs. They were used to determine the presence of remnants of mill infrastructure and to assess their state of preservation. The photographs were taken at different times of the year, resulting in varying observation conditions that could either facilitate or hinder the interpretation of particular landscape features by affecting their visibility. As mentioned above, these photographs were not acquired specifically for the analysis of mill landscapes. By compiling and comparing sequences of aerial photographs from different years, it was possible to observe the same structures over time and assess the preservation state of the mill remains. The analysis of these photographic sequences enabled the identification of post-depositional processes and phenomena that influenced the visibility of the mill infrastructure.

The selection of photographs was also based on their resolution and the visibility of the structures recorded in them. Photographs with insufficient resolution that prevented analysis and interpretation were excluded, including the photograph from 1986. Ultimately, six aerial photographs were selected as those that best illustrated changes in the landscape and documented the remains of the mill infrastructure. The selected photographs were black-and-white images from 1940[21], 1964, and 2004, as well as color images from 2012, 2019, and 2024[22].

The study also made use of the results of 2016 ALS measurements[23] available in the form of a point cloud (geoportal.gov.pl). Using the Relief Visualization Toolbox algorithm, the Digital Terrain Model (DTM) visualizations were generated, including Hillshade, Multi-Directional Hillshade, Simple Local Relief Model (SLRM), Sky-view Factor (SVF), Positive and Negative Openness Analysis, and Local Dominance Analysis. These methods were applied to obtain additional spatial data enabling a more precise identification of the mill location, and thus to analyze features related

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suggest that more than one mill was involved. Kościan Cadastral Office, record group 53/432/0/-/655, State Archives in Poznań.

[21] *Bildplan/Bildskizze*, 1:25,000 (1942). Mapster, made available from the collections of the Faculty Cartographic Archive/Library of Collegium Geographicum, Faculty of Geographical and Geological Sciences, Adam Mickiewicz University, Poznań. Sheet 3965. Available at: http://maps.mapywig.org/m/German_maps/series/025K_Bildplan/600dpi/3965_(2197)_Kosten_Bildplanwerk25_1942.jpg (accessed: 1 March 2026).

[22] Aerial photographs from the years 1964–2024 were obtained from geoportal.gov.pl, including indexes, vertical aerial photographs, and downloadable orthophoto maps.

[23] Digital Terrain Model (DTM) visualizations were generated from a point cloud obtained from geoportal.gov.pl.

to specific human activities. The generated visualizations differed in their parameters, which resulted in mill infrastructure remains being more or less clearly visible depending on the visualization method applied (Banaszek 2014, p. 235; 2015, p. 64; Kiarszys, Banaszek, 2023, p. 125)[24].

As a result of comparing and combining the generated visualizations, the local dominance analysis was identified as the most useful for the purposes of this study. It demonstrated that the area corresponds to an abandoned channel of the Samica River, enabling the recognition of a substantial part of its course. It also revealed that the area had been intensively modified and used for mill-related purposes, as indicated by the presence of an upper mill race and a millpond. A limitation of this visualisation was the shading of the northern side of the road by the simulated light source, which made any possible remains of the mill itself or mill buildings north of the road difficult to identify.

THE STARE BOJANOWO WATERMILL LANDSCAPE AND ITS TRANSFORMATIONS

An important issue, namely the use of the landscape for mill-related activities, should be considered in relation to studies of mill remains associated with water management and related hydraulic features possessing their own distinct landforms[25].

From 1793 to 1924, the spatial transformations resulting from the presence of the watermill can be traced, particularly through cartographic sources. The hydraulic features depicted on the maps were designed to regulate water levels. For this reason, mills were often constructed not on the main river channel but on its side branches or on artificially excavated mill races (Kaniecki, 2004, p. 360). An excessive volume of water could damage the waterwheel, whereas an insufficient supply might not provide enough power to drive it (Kaniecki, 2004, p. 363). In lowland areas, where the river current was relatively slow, it was necessary to impound and retain wa-

[24] The generated Digital Terrain Model (DTM) visualizations represent the land surface using different parameters, including the direction of simulated illumination and shadow casting. In some cases, this may result in a further loss of information caused by inappropriate lighting conditions and the consequent masking of features (Banaszek, 2014, p. 225–226).

[25] Stare Bojanowo is situated at the junction of three physiogeographical units: it borders the Kościan Plain to the north, the Krzywiń Lake District to the east, and the Sława Lake District to the west (Kondracki, 2009, p. 152–154). The area's relief was shaped during the Leszno Phase of the last (Weichselian) glaciation. The study area is characterized by morainic uplands forming island-like elevations separated by valley depressions created by the flow of fluvioglacial waters during the last glaciation (Silska, 2012, p. 15; Hildebrandt-Radke, 2013, p. 20–21). The principal watercourse within the study area is the Samica River, which rises from Lake Krzyckie and flows through a broad, flat-bottomed valley before joining the Southern Obra Canal (Wiślański, 1984, p. 8; Silska, 2012, p. 15; Niebieszczański et al., 2023, p. 544). The river valley was formed during the Late Weichselian, when the retreating ice sheet and its meltwaters carved a tunnel valley. Today, the valley has a flat floor and is filled with Holocene peat deposits (Niebieszczański et al., 2022, p. 2; Kołaczek et al., 2025, p. 416).

ter. This required, among other measures, excavating a millpond basin, constructing dams and sluices, and digging mill races (Kaniecki, 2004, p. 360). The construction of dams and millponds[26], which were used to impound water to an appropriate level, was not essential for the operation of undershot waterwheels, although it represented an important technological improvement. By contrast, overshot watermills required impounded water, with the head of water needing to be at least equal to the diameter of the wheel in order to drive it effectively (Dembińska, 1973, p. 96). On the basis of the available sources, it is difficult to determine what type of waterwheel was used in the mill during the period under investigation and, consequently, which hydraulic and technical solutions were required.

Prior to drainage works, the Samica River valley was waterlogged and, in places, even marshy, while the river itself locally lost its well-defined channel (Kurnatowska, 1967, p. 39; Hildebrandt-Radke, Przybycin, 2011, p. 331). Rivers with unregulated channels were typically characterized by a meandering course. It was only the drainage and river regulation works that led to the disappearance of abandoned channels, sandbars, and shoals (Dobrowolska, 1961, p. 54). This situation in the study area is confirmed by the Gilly and Cron map of 1793 (see fig. 2A). At the end of the eighteenth century, the Samica River had three meandering branches along the analyzed section, and the valley floor was most likely waterlogged or marshy. The available evidence provides no indication that the area had undergone either river regulation or drainage works at that time. The valley was covered with trees and shrubs, most probably forming a riparian woodland. The mill was situated on the western branch of the river. Water did not flow directly from the river to the waterwheel but was instead conveyed through a mill race[27]. This engineering solution made it possible to regulate the flow of water and protected the mill from excessive discharge. In addition, the mill complex was crossed by a road running across the waterlogged valley. It is reasonable to assume that this route followed an embankment (mill dam)[28], connecting

[26] As M. Dembińska observes, the construction of ponds, particularly those located on rivers, was closely associated with the ability to build earth embankments (Dembińska, 1973, p. 109). These embankments served to retain water in millponds at the required level, whereas dams or weirs were intended to impound water in river channels (Szurowa, 2015, p. 123).

[27] A mill race is a channel that conveys water to the waterwheel in order to set it in motion (Kubicki, 2012, p. 133). Two sections of a mill race are generally distinguished: the upper mill race (headrace) and the lower mill race (tailrace). The upper mill race conveyed water to the millpond, while water was directed from the pond to the waterwheel through a supply channel (Wesołowska, 1969, p. 86). The lower mill race then discharged the water used to drive the wheel back into the river (Wesołowska, 1969, p. 88). Archaeological excavations at Otolążka identified the remains of a mill race. Its base was flat, with a slight gradient following the direction of the river flow. The channel fill contained numerous freshwater mussel and snail shells. The mill race was approximately 5–7 m wide, 17.5 m long within the excavated area, and about 1.2 m deep. Its eastern bank had been reinforced with fascines consisting of three rows of vertically driven alder, pine, and birch stakes (Bender, 1974, p. 219–222).

[28] The construction of embankments, like that of weirs, served to impound and retain water in order to create the hydraulic head required for mill operation (Kubicki, 2012, p. 142). From a geomorphological perspective, embankments are convex landforms created by the accumulation of earth deposits (Podgórski, 2004, p. 70). They were typically built using fieldstones, earth, shrubs, and material excavated from

Stare Bojanowo, Bruszczewo, and Śmigiel, which is consistent with the documentary reference from 1423.

The road currently also runs across an area elevated above the valley floor, as confirmed by the analysis of local dominance based on the Digital Terrain Model (DTM). It is likely that its course has not changed significantly, as no structures indicating its presence in another location have been identified (see fig. 4A, 4B). Furthermore, the existence of the embankment is confirmed by the millpond excavated in the first quarter of the nineteenth century. The road together with the embankment formed its northern boundary (see fig. 2B).

In the nineteenth century, the area was drained through an extensive network of canals and ditches, and the river now flows within an artificial channel. The valley floor is covered by meadows and pastures. The Samica River has been protected by embankments, which prevent flooding. The slopes above the valley are occupied mainly by arable fields (Silska, 2012, p. 16; Niebieszczański et al., 2022, p. 2; 2023, p. 544–545; Kołaczek et al., 2025, p. 417). Subsequent maps and aerial photographs indicate that drainage works were carried out gradually and that the intended objective was not achieved immediately[29].

In the first quarter of the nineteenth century, the spatial structure of the mill complex underwent changes. To the south, on the western branch of the river, the aforementioned millpond was constructed[30]. It collected the flowing water, which was directed northwards beneath the bridge. When the water level in the millpond became too high, or when the mill was not operating, the water could be discharged into the river through a bypass channel[31].

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the bottom of the millpond (Prarat, 2023, p. 71–72). Their cross-section was generally trapezoidal, with side slopes inclined at approximately 40–50 degrees, and they were reinforced with turf to improve stability (Prarat, 2023, p. 72). For example, at Otalążka the embankment consisted of rows of posts and stakes (52 elements in the riverside section) and was constructed using a timber grillage framework (Bender, 1974, p. 222–223). The remains of a similar embankment were also identified during archaeological monitoring at Raduszyn, where it had been built of oak beams supporting, or fitted with, pine planks inserted into cut rebates (Kowalczyk, Paprocki, 2012, p. 158–159).

[29] Drainage works in the Obra river region continued throughout the nineteenth century and until the end of the first half of the twentieth century. During this period, canals and weirs were constructed along the main Obra canals. The drainage works carried out in the middle Obra region involved draining the Great Obra Wetland (Wielki Łęg Obrzański) and transforming rivers flowing through glacial tunnel valleys into canals. After the Second World War, maintenance and renovation works were undertaken to preserve the existing hydraulic infrastructure. By 1826, 52% of the existing canal network had been constructed, while by 1940 this figure had reached 94% (Hildebrandt-Radke, Przybycin, 2011, p. 331–332, 339).

[30] Millponds are artificial water bodies, usually 1–3 m deep and surrounded by embankments. They have a basin-like form (Podgórski, 2004, p. 75–76; Adamczewski, 2005, p. 104). Their primary function was to retain water, particularly during periods of drought, as well as to provide a greater hydraulic head for the waterwheel (Podgórski, 2004, p. 75; Kubicki, 2012, p. 136; Prarat, 2023, p. 106).

[31] A bypass channel discharged excess water from an impounded watercourse or served as a reserve channel for diverting water during the cleaning of, or maintenance work on, the mill race (Podgórski, 2004, p. 75; Kubicki, 2012, p. 134). The lengths of bypass channels ranged from several dozen to several hundred metres (Podgórski, 2004, p. 75).

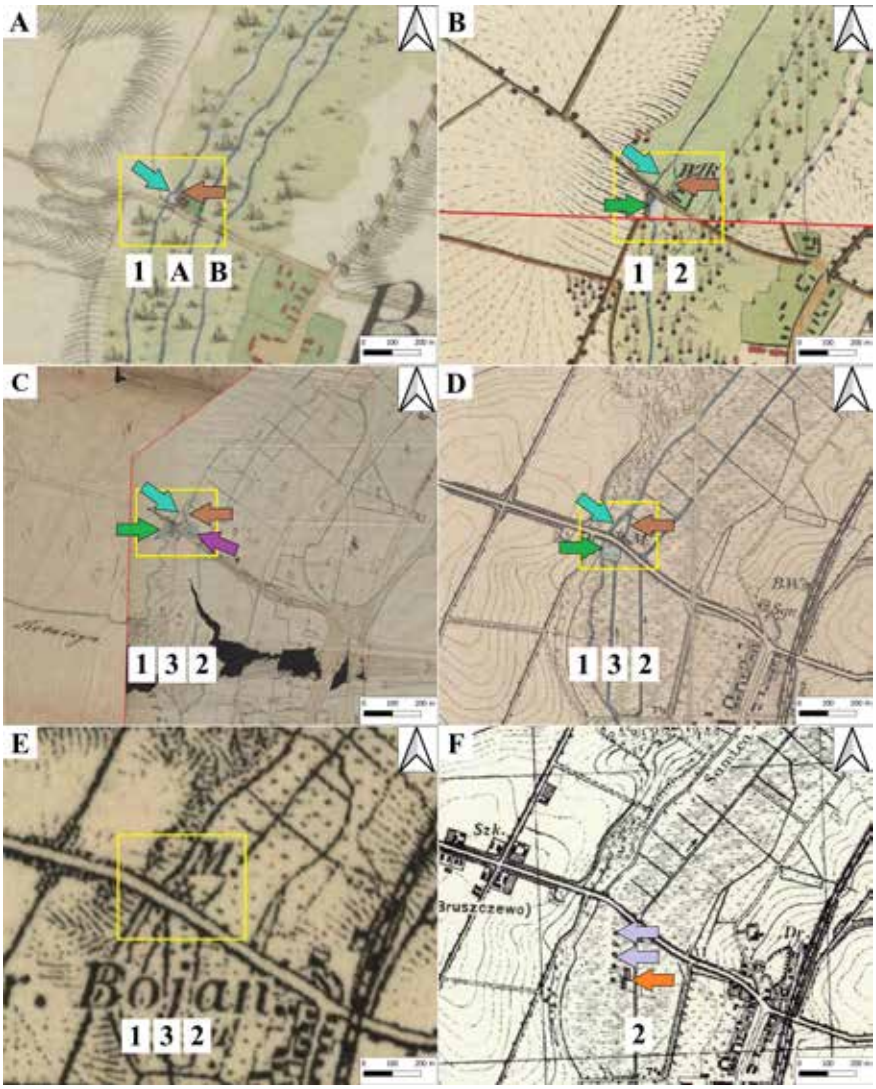

Fig. 2. The watermill landscape: A. in 1793; B. in 1824–1826; C. in 1862; D. in 1892; E. in 1924; F. in 1933. Legend: Yellow rectangle – mill complex; Arrows: brown – lower mill race; mint green – bypass channel; dark green – millpond; purple – second pond; light purple – remains of the upper mill race; orange – peat extraction pit (1933); Numbers: 1 – western branch of the Samica river; 2 – eastern branch of the Samica River; 3 – upper mill race. Letters: A and B – other unidentified branches of the Samica river; Red line in Fig. B and C – boundary between map sheets

Ryc. 2. Krajobraz młyński: A. w 1793 r.; B. w latach 1824–1826; C. w 1862 r.; D. w 1892 r.; E. w 1924 r.; F. w 1933 r. Legenda: Żółty prostokąt – założenie młyńskie; Strzałki: brązowa – młynówka dolna; miętowa – kanał ulgi; ciemnozielona – staw młyński; fioletowa – drugi staw; jasnofioletowa – pozostałości młynówki górnej; pomarańczowa – wyrobisko torfu (1933 r.); Cyfry: 1 – zachodnia odnoga rzeki Samicy; 2 – wschodnia odnoga rzeki Samicy; 3 – młynówka górna. Litery: A i B – inne, niezidentyfikowane odnogi rzeki Samicy; Czerwona linia na rycinach B i C – granica arkuszy mapy

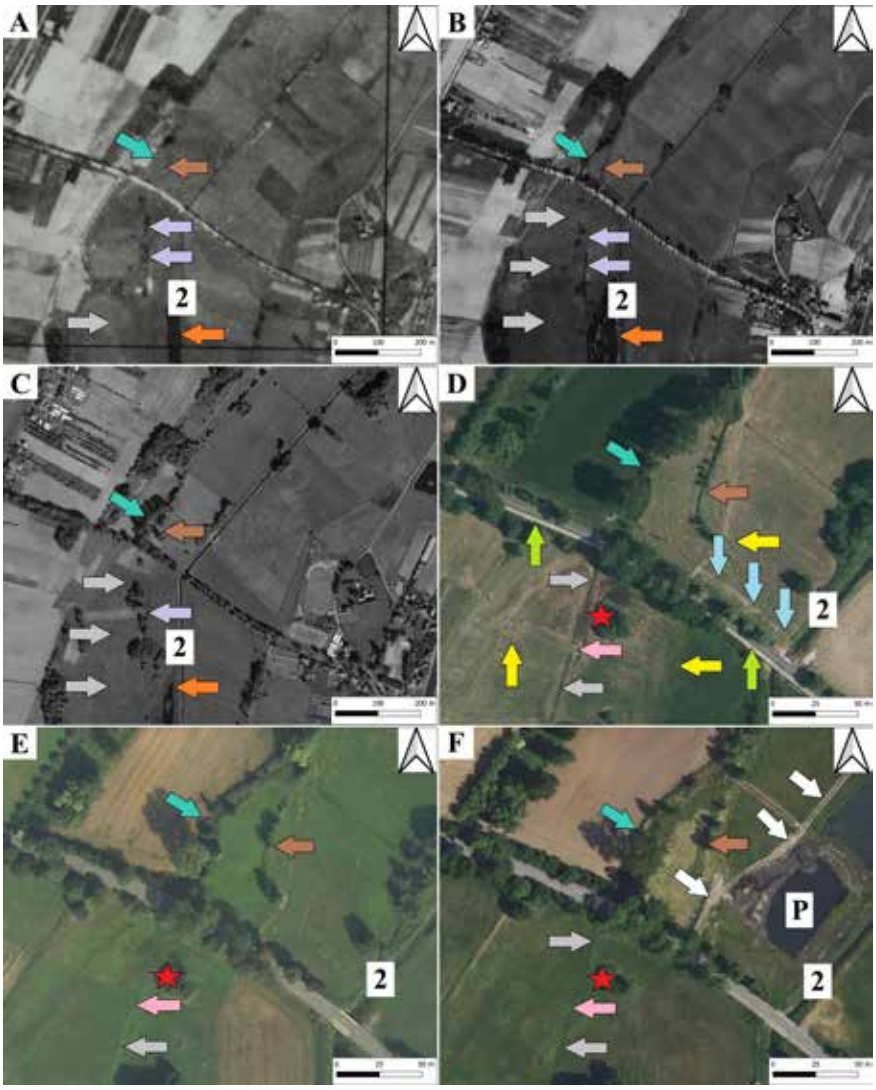

Fig. 3. The watermill landscape: A. in 1940; B. in 1964; C. in 2004; D. in 2012; E. in 2019; F. in 2024. Legend: Arrows: brown – lower mill race; mint green – bypass channel; light purple – remains of the upper mill race; grey – drainage ditch; pink – footbridge; white – road to the mine; yellow – hay bales; light green – cycle path; light blue – traces of the trench excavated for the sewer pipeline; orange – peat extraction pit (1933); Stars: red – remains of the millpond; Numbers: 2 – eastern branch of the Samica; Letters: P – post-extraction pits

Ryc. 3. Krajobraz młyński: A. w 1940 r.; B. w 1964 r.; C. w 2004 r.; D. w 2012 r.; E. w 2019 r.; F. w 2024 r. Legenda: Strzałki: brązowa – młynówka dolna; miętowa – kanał ulgi; jasnofioletowa – pozostałości młynówki górnej; szara – rów odwadniający; różowa – kładka; biała – droga do kopalni; żółta – bele siana; jasnozielona – ścieżka rowerowa; jasnoniebieska – ślady wykopu pod linię kanalizacyjną; pomarańczowa – wyrobisko torfu (1933); Gwiazdki: czerwona – pozostałości stawu młyńskiego; Cyfry: 2 – wschodnia odnoga Samicy; Litery: P – wyrobiska poeksploatacyjne

When the mill was in operation, water was conveyed through the mill race directly to the waterwheel. The recorded spatial arrangement was repeated on subsequent maps. At that time, the area had most likely already undergone partial drainage, as the river had two branches: the main western channel and the eastern channel, as well as two small streams or ditches branching off from it. Both branches had a common origin, as they diverged from a single channel undergoing bifurcation. This also represents a significant difference compared with the situation at the end of the eighteenth century, when the river branches did not share a common origin. This arrangement is confirmed by the combined Leipe map sheet of 1824 and Kosten sheet of the 1826 *Urmesstischblatt*, as well as by the village plan from 1862 (see figs. 2B and 2C).

In the first quarter of the nineteenth century, the valley area surrounding the mill was waterlogged and covered with trees and shrubs. It was only at the beginning of the second half of the nineteenth century that it was transformed and used as meadowland (see figs. 2B and 2C). In the first quarter of the nineteenth century, two wooden buildings were located east of the mill, which is also confirmed by the *Urmesstischblatt* (see fig. 2B).

More substantial landscape changes took place after the mid-nineteenth century. This was a period of intensified drainage works and land regulation. Numerous drainage channels appeared, and the course of the Samica River was regulated. The main flow was redirected through the eastern branch, while the western channel was gradually drained and converted into meadowland. The eastern channel has remained the main and only branch of the river to the present day. At the beginning of the second half of the nineteenth century, the existing spatial arrangement of the mill complex was preserved; however, the way in which it was supplied with water changed. The millpond was no longer fed by an abandoned river channel but by an artificially excavated channel referred to as the upper mill race. It formed a branch of the eastern river channel and ran parallel to it. This situation is confirmed by the village plan from 1862, which documents both the landscape conditions before regulation and drainage works and the state of the landscape after these transformations had been introduced (see fig. 2C). East of the lower mill race, on the northern side of the road, another pond appears, connected to the eastern channel of the Samica River. Importantly, this pond is not shown on either earlier or later maps. The presence of its remains is also not confirmed by remote sensing data.

The spatial arrangement of the mill complex and the land-use pattern did not undergo any major modifications until the end of the nineteenth century. During this period, the mill was located between the lower mill race and the bypass channel, while a single farm building was situated to the east of the mill. The abandoned river channel remained visible in the landscape, as confirmed by the Kosten sheet of the *Messtischblatt* map series from 1892 (see fig. 2D). In the first quarter of the twentieth century, the landscape underwent further transformation. By this time, the millpond was no longer visible, as it had most likely been filled in or had become silted up and overgrown, a process already indicated on the 1892 map (see fig. 2D). The upper mill race was extended and most likely conveyed water directly from the eastern river

channel to the waterwheel. At that time, the abandoned channel of the western branch was still discernible in the landscape. This is confirmed by the Kościan sheet of the Polish Tactical Map from 1924 (see fig. 2E).

In terms of the qualitative changes to the landscape resulting from the mill's operations, it can be concluded that the mill utilized the landscape through its economic activities by introducing new elements in the form of buildings, channels and water reservoirs (Fajer, Waga, 2017, p. 136). It can only be assumed, on the basis of ethnographic evidence, that the hydraulic structures were maintained during the mill's operation. Millponds and channels were cleaned regularly. These activities were carried out in summer, before the harvest, when water levels were low. The banks of the mill race were also reinforced with stakes and fascines, and embankments were raised (Wesołowska, 1969, p. 139)[32].

Watermills had a significant impact on the landscape through their economic activities, as they were accompanied by specific infrastructure. Historical records demonstrate that mills raised water levels by impounding water, which sometimes resulted in the flooding of areas such as meadows and pastures, causing adverse effects on agricultural production (Dobrowolska, 1961, p. 54). The exact reasons for the closure of the mill in Stare Bojanowo remain unknown. It can only be assumed that these areas gradually became more intensively used for agriculture and that drainage works were required in the formerly waterlogged areas, which conflicted with the principles of mill operation.

An example of such processes can be found in the case of mills that had already been abandoned earlier. In 1775, within the Obra River catchment, mills with water impoundment structures located in the upper sections of rivers were removed because they obstructed the free flow of water (Hildebrandt-Radke, Przybycin, 2011, p. 331–332). Ultimately, the direct reasons for the dismantling of the Stare Bojanowo watermill have not been identified. Apart from the increase in water levels, other potential causes may have included low profitability, the declining competitiveness of traditional milling compared with industrial mills, and possible financial difficulties experienced by the owner (see Duma et al., 2020, p. 574).

The second major stage in the transformation of the mill landscape encompasses all changes occurring after the abandonment of mills, such as the destruction of embankments, the dismantling or infilling of hydraulic structures, including mill races and millpond basins, and, consequently, the degradation of the mill landscape (Fajer, Waga, 2017, p. 136). The state of preservation of the remains was influenced by stratigraphic processes and phenomena, but above all by post-depositional processes, both cultural and natural in character (Urbańczyk, 1986, p. 243–244).

The dismantling of the mill most likely took place in the late 1920s or early 1930s. In addition to the mill itself, the associated farmstead was also removed, as confirmed both by the Śmigiel sheet of the Detailed Map of Poland from 1933 (see fig. 2F) and

[32] The information is based on ethnographic research conducted in the Opole region (Wesołowska, 1969, p. 16–17).

by a German aerial photograph from 1940 (see fig. 3A). No buildings or traces associated with the dismantling process are visible in the study area. Neither the map nor the aerial photograph confirms the presence of remains of the hydraulic infrastructure, such as the millpond, bypass channel, lower mill race, or abandoned river channel. The date on which the aerial photograph was taken may explain this situation. The photograph was taken on 1 October 1940, and it is highly probable that at that time all channels were overgrown and had not been cleaned. The poor visibility of drainage ditches may also support this interpretation. In contrast, the upper mill race remains relatively clearly visible, which is further emphasized by the presence of linear rows of trees growing along it. These trees were also marked as a straight line on the Detailed Map of Poland.

A completely different type of land use, i.e. peat extraction, is shown on the 1933 map. The peat excavation area was marked between the upper mill race and the Samica River, south of the road (see fig. 2F), and it remained visible on subsequent aerial photographs.

Between 1940 and 1964, further landscape changes took place (see fig. 3A, 3B). In the study area, the drainage network was expanded. South of the road, at the location of the former abandoned river channel, a central drainage ditch appeared, cutting through the remains of the millpond. Smaller perpendicular ditches drained into it. The infilling or silting up of the pond probably increased soil moisture levels, making the existing drainage system insufficient and hindering agricultural work. The visibility of the abandoned channel of the western branch of the Samica River decreased, most likely as a result of the introduction of additional drainage ditches (see fig. 3A, 3B).

For the same reason, the extent of the preserved remains of the millpond also changed, as a footbridge was constructed across the newly created drainage ditch. A slight elevation of this part of the pond bank is visible. Consequently, the southern boundary of the pond may have been obscured by much later agricultural activity and the movement of agricultural machinery along the pond margin. This interpretation is supported by vertical aerial photographs from 1964, 2004, 2012 (see figs. 3B, 3C, 3D), as well as by the Analysis of Local Dominance derived from the DEM (see figs. 4A, 4B).

As early as the 1960s, north of the road, the former lower mill race was modified and adapted for a new function as a drainage ditch. Its southern section was extended and redirected at an angle towards the eastern branch of the Samica River. The channel was also probably widened and deepened, as indicated by the clearly visible shadow recorded in the 1964 aerial photograph (see fig. 3B). At the same time, the upper mill race did not undergo similar modifications. It remained visible in the landscape, but 40 years later a substantial part of it had become obscured, as confirmed by subsequent aerial photographs from 2004 and 2012. The levelling of the mill race was most likely caused by the use of the area as meadowland (see figs. 3B, 3C, 3D).

In areas where agricultural activity was not undertaken, the upper mill race remains visible to the present day, as confirmed primarily by the analysis of local dom-

inance derived from the ALS-based DEM generated from measurements conducted in 2016 (see figs. 4A, 4B). The use of heavy agricultural machinery and agrotechnical practices, such as fertilisation, mowing, and harrowing, carried out several times a year, may have contributed to the infilling and levelling of parts of the upper mill race. The effects of these activities are visible in the 2012 photograph, which shows hay bales and a light green grass tone indicating recently mown vegetation. In contrast, in areas where the grass had not been cut, for example above the lower mill race or drainage channels, the vegetation appears darker (see fig. 3D).

The remains of the millpond are particularly visible under conditions of vegetation stress caused by drought. At such times, positive vegetation marks become apparent – increased and accelerated plant growth within the former pond area compared with the surrounding vegetation. The visibility of such phenomena is possible during the full growing season (Wilson, 2000, p. 69–70; Pietrzak, Rączkowski, 2009, p. 14, 15; Kostyrko, Kiarszys, Hanus, 2017, p. 151). This situation is indicated by a photograph taken on 1 September 2019. It was a period after haymaking, when the grass had begun to regrow, revealing vegetation marks (see fig. 3E).

When the grass is cut short, anomalies related to soil moisture conditions within the former pond area can also be observed. A darker colouration appears there, indicating increased soil moisture levels. This can be seen in the photograph taken on 24 June 2012 (see fig. 3D). The Local Dominance Analysis makes it possible to interpret the trapezoidal depression preserved in the landscape south of the road as the remains of the millpond (see fig. 4A, 4B). This is a depressed area that accumulates water and retains soil moisture for a longer period, which also has a positive effect on vegetation growth[33].

The Local Dominance Analysis reveals the path of a significant section of the abandoned western branch of the Samica River (see fig. 4A, 4B). However, the abandoned channel is not visible in the analyzed sequence of aerial photographs. The visualisation confirms that, despite various drainage and agricultural treatments, the abandoned channel has not been completely obliterated. Its northern section near the millpond, however, has become poorly discernible, and the course of the palaeochannel in this area remains only hypothetical.

The visualization also reveals clearly identifiable remains of a drainage ditch north of the road, part of which coincided with the course of the lower mill race. It also shows the south-eastern extension of the channel, directed towards the Samica River, which is not visible in the 2004 aerial photograph and was excavated in the 1960s. The bypass channel is also clearly visible in this visualization, which may suggest that it was maintained and cleaned. The remains of the mill and the nearby buildings are not discernible either in the subsequent aerial photographs or in the DEM visualizations (see figs. 4A, 4B).

[33] Water is a crucial element, as it transports nutrients essential for plant growth and development. The most important nutrients are nitrogen and calcium. Nitrogen is responsible for plant growth and vitality, influencing plant size, leaf area, and colour, as well as extending the growing season. Calcium, in turn, is necessary for the proper absorption of other nutrients (Wilson, 2000, p. 70).

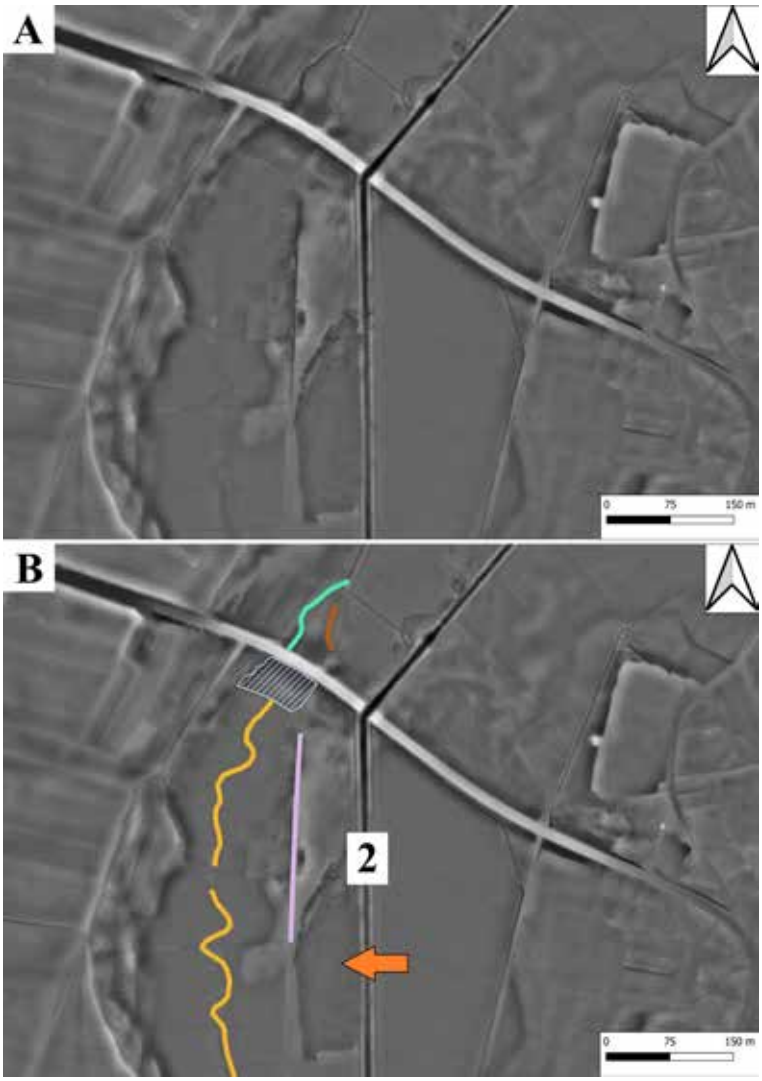

Fig. 4. A – mill remains identified through local dominance analysis; B – interpretation of the landform remains associated with the mill landscape identified through Local Dominance Analysis. Legend: Lines: orange – remains of the western branch of the Samica river; light purple – remains of the upper mill race; mint green – remains of the bypass channel; brown – remains of the lower mill race; Light blue diagonal lines – remains of the millpond; Arrows: orange – peat extraction pit (1933); Numbers: 2 – eastern branch of the Samica

Ryc. 4. A – pozostałości młyna zidentyfikowane na podstawie analizy lokalnej dominacji; B – interpretacja pozostałości form terenu związanych z krajobrazem młyńskim, zidentyfikowanych na podstawie analizy lokalnej dominacji. Legenda: Linie: pomarańczowa – pozostałości zachodniej odnogi rzeki Samicy; jasnofioletowa – pozostałości młynówki górnej; miętowozielona – pozostałości kanału ulgi; brązowa – pozostałości młynówki dolnej; jasnoniebieskie linie ukośne – pozostałości stawu młyńskiego; Strzałki: pomarańczowa – wyrobisko potorfowe (1933); Cyfry: 2 – wschodnia odnoga Samicy

A different form of utilization of the mill landscape during this period is indicated by the presence of utility infrastructure and the fact that the area was repeatedly excavated for the construction of a gas pipeline, a telecommunications network, and a sewer line[34]. Traces of the trench excavated for the sewer system are visible in the 2012 aerial photograph. Similarly, the southern side of the road was widened to include a cycle path, which is also documented in the same photograph (see fig. 3D).

The most significant landscape changes occurred in mid-2023, when an open-cast peat extraction site was established north of the road. At that time, the access road was reconstructed by laying concrete slabs and simultaneously raising the ground level. The road provided access to the excavation site and raw material storage areas. The two resulting extraction pits filled with water, forming ponds. This situation is confirmed by the 2024 aerial photograph. The landscape of the study area was modified once again, in a way that was clearly destructive to the mill landscape (see fig. 3F).

CONCLUSION

In response to the question of whether the mill landscape underwent continuity, it can be stated that, considering the period of more than 200 years and the profound socio-economic changes that occurred during this time, the initial continuity was eventually interrupted. However, this did not happen abruptly, but rather gradually, through the transformation of the mill landscape into an agricultural landscape. Certain elements of the former infrastructure coexisted with newly introduced features, gradually becoming obscured and forgotten, and today even subject to destruction.

The first significant transformation of the landscape was associated with the establishment of the mill itself and its infrastructure. This resulted in changes to local water relations. At the end of the eighteenth century, the mill was most probably supplied by water from the western branch of the Samica River. Subsequently, at the beginning of the nineteenth century, a mill pond was constructed to collect water flowing from the western channel of the river. Excess water was discharged through a relief channel, while during mill operation water was directed onto the wheel through a millrace. In the mid-nineteenth century, most probably as a result of drainage works, the western branch of the river was eliminated. Consequently, a new source of water supply was required in the form of an upper millrace, which conveyed water from the eastern channel of the river. The modification of the system supplying water to the mill was most likely connected with the drainage and regulation of the area. At the beginning of the twentieth century, the pond became overgrown or silted up, and it appears that water was supplied to the mill wheel exclusively through the upper millrace.

The infrastructure introduced into the landscape was essential for ensuring the operation of the watermill. After the mill ceased functioning, the landscape rapidly

[34] Geoportal.gov.pl, *Geodesy and Cartography*. https://mapy.geoportal.gov.pl/imapnext/imap/index.html?moduleId=modulGiK&mapview=52.005001%2C16.577097%2C1000s (accessed: 16 April 2026).

underwent degradation. The characteristic landforms of former mill sites, especially concave forms, became overgrown and gradually lost their visibility in aerial photographs and digital terrain model visualizations.

Another source of landscape transformation was the repeated reconstruction of the road and roadside areas, which affected the relief by levelling irregularities, including both concave and convex landforms.

From the perspective of the significance of all activities undertaken within the mill landscape from the end of the eighteenth century to the twenty-first century, they did not differ from the strictly economic functions that had characterized this landscape from its very beginning. Whoever established the mill and constructed its infrastructure transformed the landscape primarily for economic and practical purposes. A similar process occurred when the landscape was converted into an agricultural one through the filling of former river channels, millraces, and ponds.

A more pronounced destruction of parts of the mill remains occurred, however, at the end of the twentieth and the beginning of the twenty-first century, when the northern roadside area, where the mill and associated buildings most probably had been located, was excavated for the installation of a sewer line, telecommunications network, and gas pipeline. The peat extraction site established in mid-2023 has had the most destructive impact on the surviving mill remains of all previous transformations, as it is entirely subordinated to economic objectives.

Preserving the "original" character of this mill landscape primarily depends on archaeologists. This is an important argument for protecting what remains of the landscape's intensive exploitation and restoring its historical memory. In the twenty-first century, this would be its most significant achievement: recognizing this place as worthy of heritage protection.

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REFERENCES

Adamczewski, J. (2005). *Młynarstwo magiczne*. Wrocław: Wydawnictwo Polskie Towarzystwo Ludoznawcze.

Banaszek, Ł. (2014). Lotniczy skaning laserowy w polskiej archeologii. Czy w pełni wykorzystywany jest potencjał prospekcyjny metody? *Folia Praehistorica Posnaniensia*, *19*, 207–251.

Banaszek, Ł. (2015). *Przeszłe krajobrazy w chmurze punktów.* Poznań: Wydawnictwo Naukowe UAM.

Baranowski, B. (1977). *Polskie młynarstwo*. Wrocław: Zakład Narodowy im. Ossolińskich.

Bender, W. (1974). Młyn z początku XIII wieku na południowym Mazowszu. *Kwartalnik Historii Kultury Materialnej*, *22*(2), 213–230.

Duma, P. et al. (2020). Młyn Dolny w Bystrzycy na Pogórzu Kaczawskim. Zanik młynarstwa tradycyjnego w czasach industrializacji. *Kwartalnik Historii Kultury Materialnej*, *68*(4), 555–580.

Dembińska, M. (1973). *Przetwórstwo zbożowe w Polsce średniowiecznej (X–XIV wiek)*. Wrocław: Zakład Narodowy im. Ossolińskich.

Dobrowolska, M. (1961). *Przemiany środowiska geograficznego Polski do XV wieku*. Warszawa: PWN.

Fajer, M., Waga J. M. (2017). Młyny wodne – zanikający element krajobrazu dolin rzecznych (na przykładzie Wyżyny Woźnicko-Wieluńskiej). In A. Przybyła-Dunin, B. Grabny, P. Roszak-Kwiatek (eds.), *Młynarstwo tradycyjne – wczoraj, dzisiaj, jutro…: Problemy zachowania ginącego dziedzictwa* (p. 117–139). Chorzów: Muzeum Górnośląski Park Etnograficzny.

Hildebrandt-Radke, I. (2013). *Pradziejowa i wczesnohistoryczna antropopresja i jej zapis w środowisku przyrodniczym na przykładzie regionu środkowej Obry (Wielkopolska)*. Poznań: Bogucki Wydawnictwo Naukowe.

Hildebrandt-Radke, I., Przybycin, J. (2011). Zmiany sieci hydrograficznej i zalesienia a melioracje regionu środkowej Obry (centralna Wielkopolska) w świetle danych historycznych i materiału kartograficznego. *Przegląd Geograficzny*, *83*, 323–342.

Kaniecki, A. (2004). *Poznań: Dzieje miasta wodą pisane*. Poznań: Poznańskie Towarzystwo Przyjaciół Nauk.

Kiarszys, G., Banaszek Ł. (2023). Lotnicze skanowanie laserowe w archeologii. In A. Makowska, W. Rączkowski (eds.), *Metody teledetekcyjne dla archeologów*. Poradnik, część 1 (116–134). Warszawa: Narodowy Instytut Dziedzictwa.

Kolen, J., Renes, H., Bosma, K. (2017). Landscape biography. In A. Van den Brink, D. Bruns, H. Tobi, S. Bell (eds.), *Research on Landscape Architecture: Methods and Methodology* (p. 120–135). London – New York: Routledge.

Kołaczek, P. et al. (2025). The impact of Lusatian Urnfield and subsequent prehistoric cultures on lake and woodland ecosystems: Insights from multi-proxy palaeoecological investigations at Bruszczewo, western Poland. *Vegetation History and Archeobotany*, *34*, 415–437.

Kondracki, J. (2009). *Geografia regionalna Polski*. Warszawa: Wydawnictwo Naukowe PWN.

Kostyrko, M., Kiarszys, G., Hanus, K. (2017). Teledetekcja. Zaginione miasto w Dzwonowie oraz efekt szczęśliwego trafu. In M. Krzepkowski, M. Moeglich, P. Wroniecki (eds.), *Dzwonowo; Średniowieczne zaginione miasto*, t. 1: *Środowisko naturalne, zarys dziejów, badania nieinwazyjne* (p. 148–177). Wągrowiec: Muzeum Regionalne w Wągrowcu.

Kostyrko, M., Zamelska-Monczak, K. (2020). Biografia krajobrazu zbiegu Noteci do Warty w perspektywie archeologicznej interpretacji danych teledetekcyjnych. *Przegląd Archeologiczny*, *68*, 137–162.

Kowalczyk, A., Paprocki, D. (2012). Relikty nowożytnego kompleksu młyńskiego w Raduszynie, gm. Murowana Goślina, pow. poznański. *Wielkopolskie Sprawozdania Archeologiczne*, *13*, 153–160.

Kubicki, R. (2012). *Młynarstwo w państwie Zakonu Krzyżackiego w Prusach w XIII–XV wieku (do 1454 r.)*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.

Kurnatowska, Z. (1967). *Dorzecze górnej i środkowej Obry od VI do początków XI wieku*. Wrocław: Zakład Narodowy im. Ossolińskich.

Niebieszczański, J., Bahyrycz, C., Żurkiewicz, D., Szambelan, W. (2022). In search for an island: non-invasive, geoarchaeological investigations in Bruszczewo microregion (Central-western Poland). *Journal of Archaeological Sciences: Reports*, *45*, 103584.

Niebieszczański, J., Kołaczek, P., Karpińska-Kołaczek, M., Hildebrandt-Radke, I., Gałka, M., Kneisel, J. (2023). Consequences of lake expansion and disappearance for the complex of Bronze and Iron Age settlements at Bruszczewo (Western Poland, Central Europe). *Environmental Archaeology*, *29*(6), 543–561.

Nowacki, J. (1950). *Liber beneficiorum dioecesis posnaniensis anni 1510.* Poznań: Poznańskie Towarzystwo Przyjaciół Nauk.

Pietrzak, J. (2013). *Nowożytne budownictwo przemysłowe w dobrach biskupich na Mazowszu*. Łódź: Instytut Archeologii Uniwersytetu Łódzkiego.

Pietrzak, R., Rączkowski, W. (2009). Od przybytku głowa… boli. O kontekście i konsekwencjach odkrycia pierwszej lokacji Szamotuł. In I. Skierska (ed.), *Szamotuły. Karty z dziejów miasta*, t. 2 (p. 9–26). Szamotuły: Muzeum Zamek Górków.

Podgórski, Z. (2004). *Wpływ budowy i funkcjonowania młynów wodnych na rzeźbę terenu i wody powierzchniowe Pojezierza Chełmińskiego i przyległych Dolin Wisły i Drwęcy*. Toruń: Wydawnictwo Uniwersytetu Mikołaja Kopernika.

Podgórski, Z. (2009). Młyny wodne w krajobrazie pojezierza chełmińskiego. *Prace i Studia Geograficzne*, *41*, 151–161.

Prarat, M. (2023). *Młyny wodne, wiatraki i kieraty w XIX i 1. Połowie XX w. na terenie Pomorza (w granicach dawnych Prus Zachodnich): Technika i architektura*. Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika.

Roymans, N., Gerritsen, F., van der Heijden, C., Bosma, K., Kolen, J. (2009). Landscape biography as research strategy: the case of the South Netherlands Project. *Landscape Research*, *34*(3), 337–359.

Silska, P. (2012). *Wczesnobrązowa osada obronna w Bruszczewie. Badania 1964–1968*. Poznań: Muzeum Archeologiczne w Poznaniu.

Szurowa, B. (2015). *Młynarstwo między Wisłą a Pilicą od połowy XVIII do XX wieku*. Kielce: Muzeum Wsi Kieleckiej.

Urbańczyk, P. (1986). Formowanie się układów stratyfikacyjnych jako proces źródłoznawczy. In W. Hensel, G. Donato, S. Tabaczyński (eds.), *Teoria i praktyka badań archeologicznych*, t. 1: *Przesłanki metodologiczne* (p. 184–245). Wrocław: Zakład Narodowy im. Ossolińskich.

Wesołowska, H. (1969). *Młynarstwo wiejskie Opolszczyzny od XVIII do XX wieku*. Opole: Instytut Śląski w Opolu.

Wilson D. R. (2000). *Air Photo Interpretation for Archaeologists*. Stroud: Tempus.

Wiślański. T. (1984). Podstawowe cechy krajobrazu Ziemi Kościańskiej. In S. Jasnosz, Z. Kurnatowska, T. Wiślanski (eds.), *Z najdawniejszych dziejów Ziemi Kościańskiej* (p. 7–9). Kościan: Muzeum Regionalne.

INTERNET SOURCES

Jurek, T., Prinke, S. *Słownik Historyczno-Geograficzny ziem polskich w średniowieczu. Edycja elektroniczna*. Pobrano z: http://www.slownik.ihpan.edu.pl/index.php (accessed: 16 April 2026).

Mapster, *Mapy archiwalne Polski i Europy Środkowej*. http://igrek.amzp.pl/ [accessed: 16 April 2026].

Geoportal.gov.pl. https://www.geoportal.gov.pl/ (accessed: 16 April 2026).

NID – Portal mapowy. https://mapy.zabytek.gov.pl/nid/ (accessed: 16 April 2026).

ARCHIVAL SOURCES

Akta starostwa powiatowego w Śmiglu dotyczące cechu młynarskiego w Śmiglu, jednostka 34/5/0/4/279, p. 210–211, Archiwum Państwowe w Lesznie.

Bildplan/Bildskize, 1:25,000 (1942). Mapster: Wydziałowe Archiwum Kartograficzne/Biblioteka Collegium Geographicum. Wydział Nauk Geograficznych Uniwersytetu im. Adama Mickiewicza w Poznaniu. Arkusz 3965. http://maps.mapywig.org/m/German_maps/series/025K_Bildplan/600dpi/3965_(2197)_Kosten_Bildplanwerk25_1942.jpg (dostęp: 1.03.2026).

Gebäudesteuerrolle des Gemeindebezirk Alt Boyen (1862–1867), Urząd Katastralny w Kościanie, jednostka 53/432/0/-/655, Archiwum Państwowe w Poznaniu.

Karte von Südpreußen von Gilly und Cron, *1:50,000* (1793), SBB IIIC Kart N 14431, arkusz 25. Staatsbibliothek zu Berlin Kartenabtailung.

Mapa Taktyczna Polski, 1:100,000 (1924). Mapster: The Library of Congress, Washington, DC, USA. Pas 40, słup 23 (A40 B 23), http://maps.mapywig.org/m/WIG_maps/series/100K/A40_B23_(324)_Koscian_1924_LoC_G6520_s100_.P6.jpg (accessed: 24 January 2026).

Mapa Szczegółowa Polski, 1:25,000 (1933). Mapster: Udostępnione ze zbiorów Instytutu Geografii Uniwersytetu Pedagogicznego w Krakowie. Arkusz P 40 S 23 H (4023 H). http://maps.mapywig.org/m/WIG_maps/series/025K/P40-S23-H_SMIGIEL_1933.jpg (accessed: 4 November 2025).

Preußische Urmesstischblätter, 1:25,000 (1824), SBB IIIC Kart N 729, arkusz 2267, *Staatsbibliothek* zu Berlin Kartenabtailung.

Preußische Urmesstischblätter, 1:25,000 (1826), SBB IIIC Kart N 729, arkusz 2197, *Staatsbibliothek* zu Berlin Kartenabtailung.

Topographische Karte (Messtischblatt), 1:25,000, Mapster: Udostępnione ze zbiorów Archiwum Państwowego w Poznaniu. Sygn. 25-xxxx, Arkusz 2197. Mapa z 1892 r. http://maps.mapywig.org/m/German_maps/series/025K_TK25/3965_(2197)_Kosten_1892_APP_Sygn._M.top.25-1130.jpg (accessed: 4 November 2025).

Statut der Muller Innung zu Schmiegel. Akta starostwa powiatowego w Śmiglu dotyczące cechu młynarskiego w Śmiglu, jednostka 34/5/0/4/279, p. 40. Archiwum Państwowe w Lesznie.

Stamm-Rolle der Muller Innung zu Schmiegel. Muzeum Regionalne w Kościanie.

Verhandlungen über die Vermessung und Einschätzung Gut Alt Boyen (1862–1867). Urząd Katastralny w Kościanie, jednostka 53/432/0/-/124. Archiwum Państwowe w Poznaniu.

Verhandlungen über die Vermessung und Einschätzung Gemeinde Alt Boyen (1862–1867). Urząd Katastralny w Kościanie, jednostka 53/432/0/-/125. Archiwum Państwowe w Poznaniu.