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FIGHTING FLOODS. ANTI-FLOOD MEASURES ON THE LOWER STYRIAN SAVINJA RIVER IN THE LONG 19TH CENTURY

BORBA PROTIV POPLAVA. PROTUPOPLAVNE MJERE NA DONJEM TOKU ŠTAJERSKE SAVINJE U DUGOM 19. STOLJEĆU

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Summary

Due to snowmelt and heavy rainfall, the Savinja River and its tributaries were historically prone to significant flooding. The Celje District Office dealt with the river and its tributaries from the beginning of the 19th century onwards. Until the mid-19th century, affected landowners were responsible for clearing the riverbed, building embankments, and reinforcing banks, while the district (later regional) engineer prepared the plans. However, work progressed slowly and was only of an emergency nature, thus not particularly effective during major floods. In the first half of the 19th century, Celje and the Savinja Valley were hit by the worst floods in 1814 and 1824, while in the second half of the century, the most severe flood occurred right at the beginning, in 1851. After this flood, efforts were made to approach the regulation of the "mountain" river more seriously, but until systematic regulation between Mozirje and Levec, works remained quite inconsistent and slow. With a thorough approach, the river was finally regulated and straightened over a relatively long section between 1876-93, suggesting that major floods would no longer occur. However, this significantly threatened Celje; all the material carried by the river accumulated in the city, and at the turn of the centuries, the most severe flooding occurred precisely there.

Keywords: Savinja River, Celje, Savinja Valley, floods, clearing, embankment construction, bank reinforcement, regulations

Ključne riječi: rijeka Savinja, Celje, Savinjska dolina, poplave, čišćenje korita, izgradnja nasipa, učvršćivanje obala, regulacije

INTRODUCTION[1]

The torrential Savinja River originates in the Kamnik-Savinja Alps and is over 100 km long. The river flows through the Upper and Lower Savinja Valley and empties into the Sava River near Zidani Most. It has a rain-snow regime, where flows are highest in autumn and spring due to precipitation and snowmelt, and lowest in summer due to higher temperatures and greater evapotranspiration. It has numerous tributaries, among the most important being the Ljubnica, Lučnica, Rečica, Dreta, Paka,

[1] * The research was conducted as part of research program No. P6–0280 *Economic, Social and Environmental History of Slovenia*, financed by the Slovenian Research and Innovation Agency (ARIS) from the state budget.

Bolska, Ložnica, and Voglajna. In Celje, the lowest point of the Lower Savinja Valley, it forms one of the largest confluences in Slovenia, as several smaller watercourses join the Savinja from the left side. In the past, due to snowmelt and downpours, the river frequently flooded, especially in its upper course, where it had a strong gradient, carving its way through gravel deposits with numerous meanders. Although efforts to regulate the Savinja began as early as the 17th century, they were more or less unsuccessful. The river constantly threatened inhabitants by shifting its riverbed, but flood reports for that period are scarce. More tangible data is available for the late 18th and early 19th centuries, when Celje and the wider Valley were affected by several (known) floods. The District Office began to deal with the Savinja and its tributaries more "seriously" from the beginning of the 19th century onwards. Clearing the riverbed, building embankments, and reinforcing banks had to be undertaken by the affected landowners until the mid-19th century, with plans drawn up by the district (later regional) engineer. However, works progressed slowly and were only of an emergency nature, so they were not particularly effective during major floods. Until the mid-19th century, floods were more severe in 1805, 1807, 1814, 1820, 1824, 1833, 1847, 1850, 1851, and 1852, and the inhabitants of the Savinja Valley faced their consequences almost daily. *Kmetijske in rokodelske novice* (Agricultural and Craft News) newspaper reported in the middle of the century that floods *"hit the city of Celje and its surroundings almost every year once or even twice, /.../ otherwise small and docile Savinja"* would *"swell mightily, overflow its banks and spread far and wide across the entire Valley."* Due to the river's unpredictability (and several stronger floods in the 1860s and 1870s), more extensive regulation was knocking at the door, which occurred between 1876-93. After the regulation, the river also became faster in its lower section and carried gravel all the way to the city by the Savinja, which then experienced severe flooding in 1895, 1898, 1900, 1901, 1906, and 1909.[2]

PRE-MARCH PERIOD

In the pre-March period, serious regulation cannot be discussed; instead, the river was managed as needed and for navigation. Although slightly larger maintenance measures in Celje began at the beginning of the 19th century, they were largely futile, as work was often disrupted by unfavorable floods (such as in 1814), causing frequent delays. Works remained quite local, with affected farmers and "technical" personnel having to deal with clearing the riverbed, digging embankments, and reinforcing banks (they were also criminally liable for neglecting these tasks). All this was, of course, necessary due to numerous floods. In the early 1820s, efforts were made to improve the river's flow, and for this purpose, temporary defensive embankments began to be built between Medlog and Levec, but in 1824, a severe flood once again affected the Valley.[3]

In the early 1830s, work continued, and bank reinforcement (mostly with fascines) began in Vrbje, Žalec, Dobriša vas, Petrovče, and Zgornje Roje. The plan included the construction of canals, meanders, and barrages to prevent floods and protect the surrounding area from the destructive effects of the Savinja. Works were delayed due to bad weather, a lack of wood, and high material prices, and then again by new floods. The April flood of 1833 caused extensive damage, as the river overflowed its banks due to snowmelt and abundant rainfall. The floods most severely affected the area above Celje, where the water destroyed embankments, bridges, and other infrastructure. The Savinja flooded again in September 1834, primarily affecting landowners near Levec, who warned of the unregulated riverbed; during high waters, the river primarily threatened the left bank and hampered rafting navigation. Despite existing plans, many were skeptical about the effectiveness of the hydraulic structures. Problems were already arising further up the Valley, so the Celje District Office concluded in the mid-1830s that the river needed to be regulated all the way downstream from Letuš. The responsible engineer Anton

[2] Cf. Janko Orožen, "Zgodovinski pregled regulacije Savinje in njenih pritokov," Kronika 4, No. 1 (1956): 16, 17. Matija Zorn, "Poplave – stalnica v Spodnji Savinjski dolini," Kronika 65, No. 3 (2017): 530-34. Blaž Pristovšek, "Regulacijski problemi Savinje," Kronika slovenskih mest 1, No. 3 (1934): 217, 218. Miran Trontelj, Kronika izrednih vremenskih dogodkov XX. stoletja (Ljubljana: Hidrometeorološki zavod Republike Slovenije, 1997), 109.

[3] Cf. Andreas Gubo, *Geschichte der Stadt Cilli vom Ursprung bis auf die Gegenwart* (Graz: Moser, 1909), 347.

Fig. 1 *Plan for reinforcing the banks of the Savinja in the district of Novo Celje, 1832.*
Source: *SI_ZAC/0008, Okrožni urad Celje, t. e. 83, 1833, 1834, Savinja Regulation, hydraulic structures, p. 83/605b.*

Brunader also warned that work must continue to prevent damage to surrounding properties, rehabilitate the banks, and regulate the river's navigability.[4]

Work often took place with the assistance of the army and the (interested or affected) local population. After the last flood, the river became dangerous for navigation near Petrovče, where banks had to be protected and flooding of riparian areas prevented. The construction directorate commission subsequently determined that regulation was needed between Latkova vas and Žalec. Despite the assured material, farmers from the surrounding villages refused to cooperate, causing delays in construction. Nevertheless, work finally began in March 1835, when the first piles were installed. After the next flood in 1836, plans for further measures were prepared, but nature was very unpredictable. Farmers complained about floods in Medlog, Šempeter, Zgornje and Spodnje Roje, and Vrbje. Although embankments were planned to protect these areas, floods continued to threaten properties and navigation. Despite some measures, the water overflowed its banks again in the summer of 1837 and inundated properties. In autumn, it was concluded that without further measures, rafting would soon become impossible. Therefore, the following year, efforts were made to continue reinforcing the banks and clearing the riverbed. After the March flood of 1838, additional corrections were needed, as water was inundating buildings along the river. Clearing of the riverbed began all the way downstream from Mozirje; the flood had deposited new material that hindered rafting traffic. The riverbed was damaged in several

[4] SI_ZAC/0008, Okrožni urad Celje, box 83, 1833, 1834, Savinja Regulation, hydraulic structures; box 85, 1835-1837, Savinja Regulation, hydraulic structures.

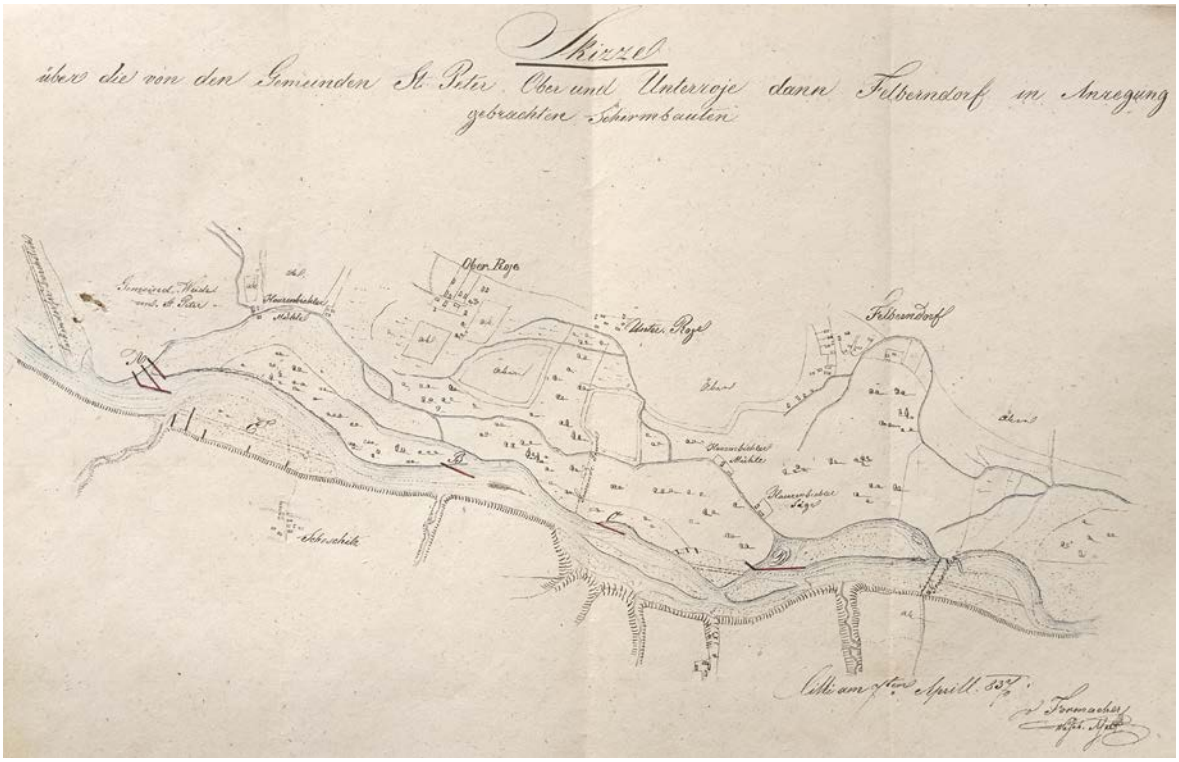

Fig. 2 *Savinja Riverbed near Šempeter, Roje, and Vrbje, and proposed embankments, 1837.*
Source: *SI_ZAC/0008, Okrožni urad Celje, t. e. 86, 1838-1840, Savinja Regulation, hydraulic structures, p. 86/611a.*

places, requiring bank repairs. In November, the commission inspected the works and found them to be relatively well done, but additional measures were needed.[5]

Despite these regulations, some landowners warned that the river still posed a great danger to people and the surrounding area during heavy rainfall and snowmelt, especially in Zgornje and Spodnje Roje and Vrbje. Therefore, in September 1839, plans were prepared for new river regulation, opting for the construction of a cut-off channel near Latkova vas to bypass river bends that caused water levels to rise and increased flood risk. Despite numerous measures, the Savinja caused extensive damage again in June 1840. A review of already completed works showed that they had been carried out according to plan, but this was evidently not enough to protect the area for some time and prevent more severe floods. After the flood, when the water overflowed its banks and inundated the area from Mozirje to Prebold, the river changed its course, damaged mills and sawmills, and buried water sources with gravel (the flooded area covered about 600 hectares of cultivated land). Due to delays by the authorities, residents of Braslovče, Polzela, and other smaller flood-affected places demanded rapid bank rehabilitation in March 1841, as the swollen river increasingly threatened their property. The district engineer concluded that it was essential to protect the banks to prevent further devastation of meadows and fields (as well as homesteads), which were crucial for local agriculture. Although smaller works on the river continued in the following years, they were mostly unsuccessful, as the river flooded again in November 1841 in the area of Latkova vas and Braslovče, overflowing its banks and inundating fields and meadows. Despite all efforts for more effective regulation, the Savinja continued to destroy everything in its path, so residents complained again that new embankments and cut-off channels should be built to protect agricultural land, mills, sawmills, and the surrounding population. Although several landowners from Braslovče began implementing certain remediation works in April 1842, the November flood, which also damaged the defensive embankment near Latkova vas and caused significant damage in Preserje,

[5] SI_ZAC/0008, Okrožni urad Celje, box 84, 1834, 1835, Savinja Regulation, hydraulic structures; 1835-1837, Savinja Regulation near Latkova vas; box 85, 1835-1837, Savinja Regulation, hydraulic structures.

again demonstrated the ineffectiveness of local measures. The January flood of 1843 also did not spare the surrounding population, causing extensive damage again, especially in Preserje and Podvin. Fields, meadows, and numerous mills were destroyed. Residents again appealed to decision-makers to enable remediation and protection of land from future floods (construction of embankments and cut-off channels to protect their properties).[6]

In the early 1840s, the Savinja also severely threatened the Žalec area. Floods threatened numerous mills, and rafting was almost impossible. Efforts were made to rehabilitate the banks with fascines, but it was soon realized that this measure was insufficient. Gravel had to be added to the left river bank to reinforce the embankment for several hundred meters. Due to groundwater, the area up to Dobriša vas and Petrovče flooded during high water. The situation was similar between Griže and the trotting bridge, so it was decided to reinforce the banks with embankments to ensure normal rafting.[7] Slightly upstream, on the other side of the river (near Prebold), construction of a dam on the Bolska tributary began at this time, financed by the Trieste merchant Gustav Adolf Uhlich, who planned to build a water-powered spinning and weaving mill. Farmers in the vicinity complained about the height of the built dam, as it increased the risk of floods during high water, while at lower water levels, some mills did not receive enough water to operate.[8]

Despite all efforts, the Savinja continued to flood, as there was no unified and effective approach. After 1843, reports on Savinja regulations and floods were scarcer, but we know that the river caused another extensive flood in the Savinja Valley in early September 1847. The flood also affected Celje, where the water threatened the newly built Southern Railway and railway embankments. However, other problems were already in the foreground at this time: poor harvests, drought, and famine caused growing discontent among the lower classes. The uncertain conditions certainly also affected the inhabitants of the Lower Savinja Valley, who apparently had less time to deal with the unpredictable river.[9]

1850S AND 1860S

In early May 1851, the Savinja Valley, including Celje, experienced a catastrophic flood comparable to those in 1814 and 1824. Water inundated many parts of the city, literally destroying several city streets and interrupting the railway connection to Ljubljana and Maribor. The flood completely devastated Glazija, then destroyed the military hospital, affected the commercial buildings of the Hotel zur Krone, and damaged city infrastructure. Several corpses were even washed up in the mortuary. Several reports stated that the entire Valley was underwater, with only churches, some stronger trees that could withstand the raging river, and higher points remaining visible. It all resembled islands in wild waves.[10] The main cause for a catastrophe of such magnitude was cited by newspapers as primarily the logging of forests in the Upper Savinja Valley. The bare hills could no longer retain rain clouds and numerous streams, which caused the water to quickly inundate the area. Riverbeds became increasingly shallow due to sand and stones brought by torrents from the cleared uplands, meaning that even a minor downpour could cause a flood.[11]

The 1851 flood was not the only one in the early 1850s. In October 1850, after several days of rain, a flood destroyed numerous properties and affected the surrounding area. A similar situation occurred in October 1852, when torrents caused an exceptional rise in water levels and turned the Savinja Valley into a large lake, again causing immense damage to agricultural areas. The early 1850s were difficult

6 SI_ZAC/0008, Okrožni urad Celje, box 86, 1840, 1841, Savinja Regulation, hydraulic structures; 1841-1843, Savinja Regulation, hydraulic structures.

7 SI_ZAC/0008, Okrožni urad Celje, box 85, 1841-43, Savinja Regulation, hydraulic structures.

8 SI_ZAC/0012, Okrožni urad Celje, box 51, 1840-1846, Construction of the dam on the Bolska near Prebold.

9 Gubo, *Geschichte der Stadt Cilli*, 362. Cf. Filip Čuček, "Poplava 'mesto Celje z njegovo okolico skoraj vsako leto enkrat ali celo dvakrat zadene'," *Zgodovina za vse* 31, No. 1 (2024): 63-76.

10 Orožen, "Zgodovinski pregled," 16.

11 Cf. *Novice kmetijskih, rokodelnih in narodskih reči*, "Novičar iz slovenskih krajev," 14 May 1851, 95.

for the inhabitants of the Savinja Valley; severe floods had become an annual phenomenon. Although conditions improved somewhat in the following years, floods severely affected the area again in 1867, 1868, 1870, and twice in 1876, until the start of more thorough regulation of the Savinja upstream from Celje (in 1876).[12]

The Savinja Valley faced similar problems after the March Revolution as before it; solutions on the river were only temporary and insufficient to tame the raging nature or rising water. Despite numerous remediation "attempts," floods remained a constant threat. Even before the 1851 disaster, several landowners warned the Celje district administration about the endangerment of their properties and called for bank reinforcement and embankment construction. Water posed a great threat near Petrovče, and problems were caused by the dam (of the spinning and weaving mill) in Prebold, where landowners repeatedly reported floods of the Bolska tributary. Despite partial remediations (deepening of the riverbed, reinforcement of banks for several hundred meters, and promises from the owner to lower the dam), no major improvements occurred. Landowners and millers still suffered from destroyed land and insufficient water levels for mill operation.[13]

Floods in the Savinja Valley and Celje posed a significant challenge for residents, as they constantly had to contend with the swollen river. Celje district engineer Friderik Byloff, who drew up a topographical map of the city in 1847, marked the area between Ložnica, Sušnica, and Savinja to the west, and Vodna Glazija to the south, as the most pressing flood-prone areas, in addition to the confluence of the Voglajna and Savinja (to the east).[14] Celje was one of the largest confluences in the Slovene lands, where different types of floods combined, making it difficult to find effective solutions. Technological limitations of the 19th century and prolonged rainfalls often caused water to rise from the Savinja riverbed, making floods a constant in the Savinja Valley. The Voglajna, Hudinja, Sušnica, and Ložnica contributed significantly to this and (periodically) (co-)caused environmental disasters, as they additionally "filled" the Savinja, which already brought abundant water from its upper parts. The "eastern" Voglajna and Hudinja, during high water, often flooded the railway in addition to the city, while the Ložnica and Sušnica threatened riparian lands and the city from the western side.[15]

After the devastating flood of 1851, local authorities finally decided to approach problem-solving more holistically. Initially, they focused on regulating the (above-mentioned) smaller watercourses in Celje, while they began to deal with the Savinja more seriously somewhat later. The Voglajna, which had already been partially regulated for the construction of the Southern Railway, still caused numerous problems due to inadequate banks and embankments. As early as July 1850, landowners from Zavodna warned that the river often overflowed its banks and flooded the surrounding area. Complaints from the eastern Celje area subsequently multiplied. Despite efforts for flood protection, coordinated implementation of measures was ultimately lacking. Thus, the Celje abbot Matija Vodušek independently carried out some protective constructions on its left bank, which caused disputes with other landowners on the right bank, which was most severely flooded by the rising water in the continuation. Landowners tried to stop the numerous floods, but more or less in vain. The Voglajna, together with its tributaries (Hudinja with Koprivnica, then the "eastern" Ložnica), flooded the wider area of Zavodna, Gaberje, and Spodnja Hudinja during high waters, causing great difficulties for farmers.[16]

On the other side of Celje, in the early 1850s, more "serious" measures began on the Ložnica. Although the stream had been cleared and a drainage ditch dug near Medlog as early as 1841, major works only began after the devastating floods of 1851. Initially, a plan was made to clear the stream, reinforce the banks, and extend the drainage ditch. However, landowners delayed the works, so regula-

[12] Gubo, *Geschichte der Stadt Cilli*, 347. Zorn, "Poplave – stalnica," 532-35. Orožen, "Zgodovinski pregled," 16, 17.

[13] SI_ZAC/0012, Okrajno glavarstvo Celje, box 1, 1850, Prebold Spinning and Weaving Mill.

[14] Branko Goropevšek, "Prostorska širitev celjskega mesta do srede 19. stoletja," in *Iz zgodovine Celja 1780-1848* (Celje: Muzej novejše zgodovine, 1996), 71.

[15] Blaž Komac, Karel Natek and Matija Zorn, *Geografski vidiki poplav v Sloveniji* (Ljubljana: Geografski inštitut Antona Melika ZRC SAZU, 2008), 96, 101.

[16] SI_ZAC/0012, Okrajno glavarstvo Celje, box 1, 1853, Regulation of the stream on Lava. SI_ZAC/0014, Okrajni urad Celje (1854-1865), box 2, 1855, Bank protection structures, riverbed regulation due to floods, Voglajna (Celje).

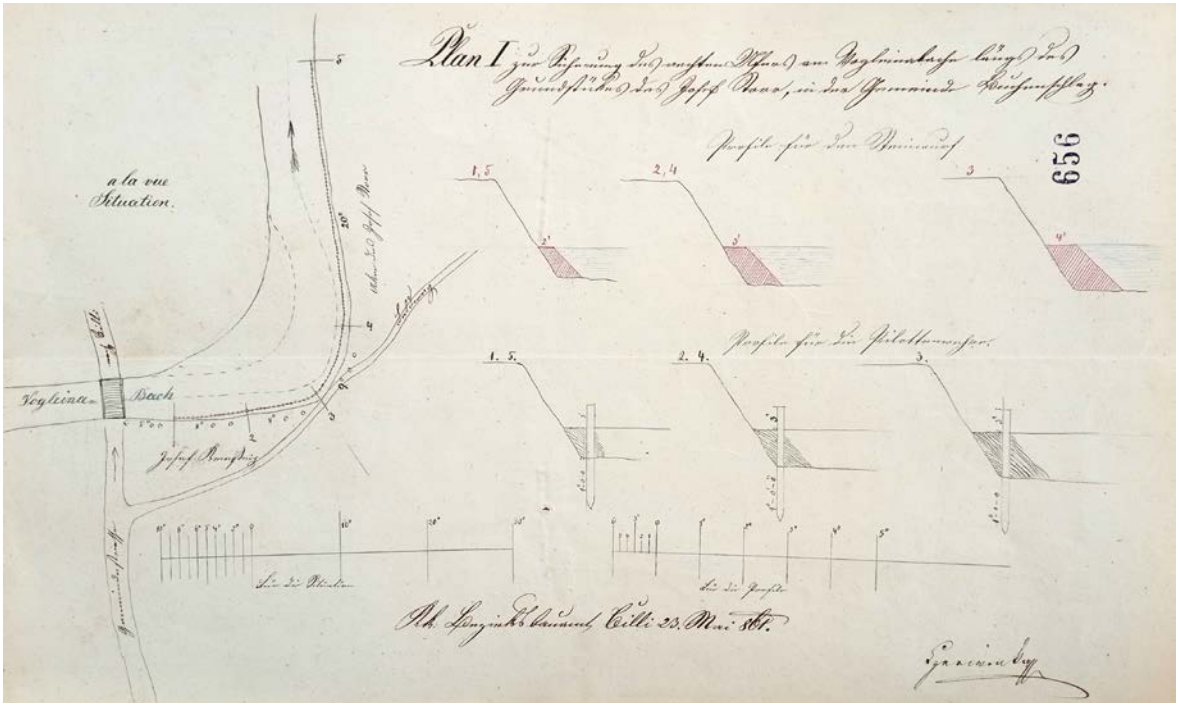

Fig. 3 *Plan for reinforcing the right bank of the Voglajna, 1861.*
Source: *SI_ZAC/0014, Okrajni urad Celje (1854-1865), t. e. 2, 1855, Bank protection structures, riverbed regulation due to floods, Voglajna, 656, f. 39, p. 29a.*

tion only began in 1856 (it was completed in 1862, but did not prevent floods). At the end of May 1853, the citizens of Celje – landowners – conducted a commission inspection of the nearby Sušnica, where they determined that the stream needed to be regulated, as stagnant water during floods threatened the health of residents (which was also confirmed by doctors Adalbert Cyppl and Štefan Kočevar). They decided to deepen and widen the stream and reinforce the banks to provide permanent flood protection and improve sanitary conditions.[17]

In the 1850s, Celje and its wider surroundings were heavily burdened with solving flood problems, where various measures often faced inadequate implementation and ongoing destructive floods. During the regulation of the Hudinja, landowners faced numerous difficulties and delays. The Hudinja flooded surrounding properties and threatened the Trieste road above Celje. In 1851, anti-flood embankments began to be built on its left bank in Škofja vas, but floods in the same year severely damaged or even destroyed them. After the initial works, which included clearing the riverbed and minor regulation, the autumn floods of 1852 again damaged the measures already implemented. Despite the embankments, which landowners mostly built themselves, the protections did not provide a permanent solution. Therefore, additional local measures had to be implemented in several places, but these often encountered obstacles, as the works were repeatedly postponed or inadequately carried out. In April 1854, landowners demanded additional protections, as the Hudinja had created new meanders that threatened the surrounding lands. A cut-off channel was planned to eliminate them; some work was nevertheless carried out in August 1854, when the probability of floods was smallest. Similar problems arose in the mid-1850s on the Voglajna, where poorly executed solutions caused further overflowing of the river. Here too, landowners often had to deal with problems themselves and erect protective barriers bypassing the authorities. In July 1854, a special commission finally inspected the area and proposed a new cut-off channel between its confluence with the Hudinja and the railway station. They also proposed additional

[17] SI_ZAC/0025, Okrajni urad Celje (1850-1935), box 22, 1852/1870, Ložnica Regulation. SI_ZAC/0012, Okrajno glavarstvo Celje, box 1, 1853, Regulation of the stream on Lava.

reinforcement of the left bank with gravel and the construction of three dams on the right bank. Despite the measures being approved, nothing had been implemented by February 1856, so some landowners proactively erected some barriers. Works were partially carried out in April and May 1856, but just a month later, water again threatened the riverbanks.[18]

The constructions carried out on the Voglajna generally proved ineffective, as they did not satisfactorily prevent flood danger, the procedures for completing the planned works took (too) long, and furthermore, coordination between affected landowners and authorities was lacking. Despite the partial protections implemented, the river continued to flood. After numerous complaints, the Celje district office only confirmed the continuation of works in 1860 (the protection on the left bank needed to be extended and the meander rehabilitated). It became clear that more thoughtful and permanent flood protection measures were needed. In Bukovžlak, landowners complained about the damage the river was causing to their properties. In May 1861, they decided to reinforce the right bank using piles, but this did not bring about a long-term solution. The flow of the Voglajna improved somewhat with the clearing of the river and the removal of stones, wood, and bushes along the river, but plans for a larger regulation met with opposition from those whose property would be taken by the intervention. In Zavodna, for example, the Celje merchant Andreas Zorzini undertook the extension of the cut-off channel and the construction of a dam, but he met with opposition from other landowners.[19] Similar conditions prevailed along the Hudinja. The left river bank, which was more threatened due to the new meander, caused disputes between residents on both sides. The new plan envisioned a cut-off channel, reinforced with piles, that would shorten the riverbed and increase flow. After lengthy negotiations, the riparian landowners had to agree to the proposed plan, and the work was mostly self-financed.[20]

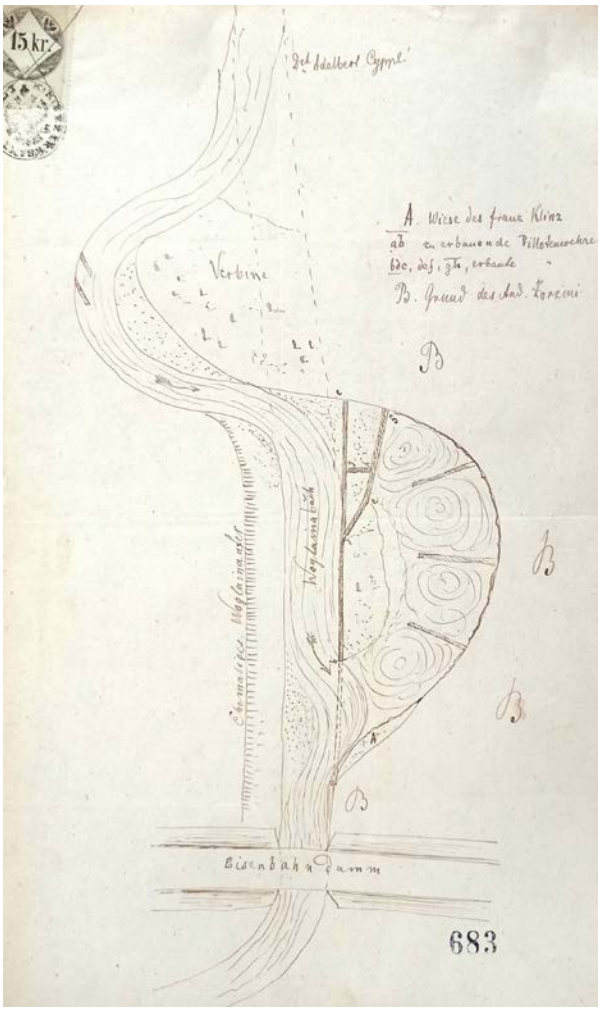

Fig. 4 *Plan of the cut-off channel and extension of the dam in Zavodna, 1862.*
Source: *SI_ZAC/0014, Okrajni urad Celje (1854-1865), t. e. 2, 1855, Bank protection structures, riverbed regulation due to floods, Voglajna, 683, f. 39, p. 29a.*

SAVINJA REGULATION 1876-93 AND EFFORTS UNTIL THE WAR

In the mid-1860s, the "priority" finally shifted from the tributaries to the Savinja River itself. The Styrian Provincial Diet repeatedly called for the urgent regulation of the main waterway in the Savinja Valley, but all correspondence somehow "stalled" between the Provincial Diet and the government in

[18] SI_ZAC/0014, Okrajni urad Celje (1854-1865), box 11, 1861 (1850), Hydraulic structures (embankments, regulation).
[19] SI_ZAC/0014, Okrajni urad Celje (1854-1865), box 2, 1855, Bank protection structures, riverbed regulation due to floods, Voglajna.
[20] SI_ZAC/0014, Okrajni urad Celje (1854-1865), box 11, Hydraulic structures (embankments, regulation).

the following years. After numerous efforts (and several severe floods), systematic regulation finally began in 1876 between Prihova (near Mozirje) and Levec (near Žalec); the last May flood (1876)[21] also showed that the devastation of the wide area of the Upper and Middle Savinja Valley, as well as the city of Celje, was repeatedly too severe.[22]

Plans were prepared by the Provincial Building Office in Graz and the District Building Office in Celje. In June 1876, the relevant law was finally sanctioned, stipulating a ten-year period for the execution of works (1877-87), and a special commission was established. This commission assessed the damage suffered by individual districts (Gornji Grad, Šoštanj, Vransko, Celje) and (cadastral) municipalities (in Gornji Grad district: Prihova, Mozirje, Loke, and Libija; in Šoštanj district: Rečica; in Vransko district: Letuš, Male Braslovče, Spodnje Gorče, Orla vas, Podvin, and Polzela; and in Celje district: Latkova vas, St. Lovrenc, Šempeter, Žalec, Zabukovica, Kasaze, Petrovče, Levec, Medlog, Lisce, and Celje) due to floods and identified the most threatened areas (Celje (municipalities of Šempeter, Žalec, Petrovče, Latkova vas, Medlog) and Vransko (municipalities of Letuš, Male Braslovče, Polzela, Orla vas)). The following year, the commission divided the area into five zones (from the confluence of the Dreta to Soteska (near Mozirje), from Soteska to the confluence of the Paka into the Savinja, from the confluence of the Paka to the bridge on the Trieste road, from the latter to the trotting bridge above Celje, from the trotting bridge to the Capuchin bridge in Celje). Regulation began above Celje in 1877.[23] However, the September flood already interrupted the works and caused extensive damage (especially in Celje). The commenced regulation was greatly jeopardized, as the flood caused enormous devastation. The dam above Celje was destroyed, the practically new city park was completely submerged, numerous houses were damaged, and firewood was destroyed. Roads, bridges, dams, and numerous mills and sawmills were damaged or destroyed. Two days of continuous rain intensified the floods in the Savinja Valley, which naturally slowed down the plans.[24]

Public criticism of the poor efficiency and slow execution of works, which stalled due to floods, grew. The embankments were also made of poor material that could barely "withstand" the rising water. The November flood of 1878, comparable even to that of 1851, exposed all the weaknesses, destroying bridges, buildings, and supplies in several places.[25] In Luče, Levec, Griže, and Žalec, the water destroyed bridges; in Mozirje, the dam; in Male Braslovče, several stables were washed away; and in numerous places, dwellings were damaged, and grain and wood supplies destroyed.[26] After several appeals, works were finally somewhat accelerated, but floods still presented a challenge. Gravel deposits accumulated in Celje, and road infrastructure was eroded by water. In May and October 1879, the water in Celje again reached two and a half meters above normal,[27] while in the autumn of 1880, it approached three meters.[28] Despite some regulatory works carried out, the results were poor. Provincial assembly deputies criticized the implementation and called for faster measures and increased funding.[29] They decided to accelerate and improve the matter, and shorten the working period. In 1881, the results were better, but in August, it flooded again and damaged some already regulated sections. The Provincial Diet therefore decided to conclude the first phase at the end of 1884. In December 1881, a new law was thus sanctioned, shortening the working period by two years, setting a new one (1885-89), and increasing funds. Due to floods that continued to threaten the area, faster action was needed.[30]

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21 *Slovenski gospodar*, "Razne stvari," 18 May 1876, 205.

22 Cf. Filip Čuček, "Ako bi tekla Savinja ali Voglajna blizu Gradca, bili bi že davno z deželnim denarjem regulirani," *Prispevki za novejšo zgodovino* 60, No. 1 (2024): 284-97.

23 Orožen, "Zgodovinski pregled," 17. *Die Landesvertretung von Steiermark, IV. Theil, 1878-1884* (ed. by Landes-Ausschusse des Herzogthums Steiermark) (Graz: Leykam, 1885), 201, 202.

24 *Cillier Zeitung*, "Regengüsse und Hochwasser," 27 September 1877, 2.

25 *Slovenski narod*, "Iz celjske okolice," 1 December 1878, 2.

26 *Cillier Zeitung*, "Hochwasser," 21 November 1878, 2.

27 *Cillier Zeitung*, "Hochwasser," 8 May 1879, 2.

28 SI_ZAC/0024, Mestna občina Celje (1850-1918), box 52, List of maximum water levels at the Celje water gauge from 1870 to 1901.

29 *Die Landesvertretung von Steiermark, IV. Theil,* 202, 203.

30 Orožen, "Zgodovinski pregled," 17. Ibidem, 204, 205.

Meanwhile, local conditions on the ground did not change significantly. In 1882 and 1883, floods caused major damage. The river periodically flooded and partially damaged the cut-off channels near Male Braslovče and Polzela.[31] Slovenian provincial assembly deputies protested in early 1883, claiming that the provincial assembly did nothing for the regulation of the Savinja and Drava, while money was always found for the Mura near Graz.[32] The report for 1883 also showed that funds would not be enough even for half of the planned works. Regulation was assessed as successful only in areas where the embankments were well executed (in the first working period, 10 km of the river between Mozirje and Celje were regulated, and in the second, more was certainly expected). After the floods in November 1885, when the water in Celje reached almost three and a half meters above normal and again relativized the already completed works, works on the Mozirje-Ljubija and Letuš-Polzela sections nevertheless continued. But they could not get rid of repeated floods. In September 1887, the water in Celje again reached three and a half meters above normal.[33] The flood also affected the Upper Savinja Valley (it damaged the regulation works near Polzela the most).[34] The Celje municipal council finally reacted to the recurring floods and concluded that regulation of the Savinja and its tributaries was needed in the city, as the last flood had shown numerous weaknesses in Celje.[35] However, funds were scarce, which naturally affected the planned works, but by 1888, they had still "processed" 23 km of the river. But the very next flood at the end of 1888 again showed all the shortcomings of the work done, which increased skepticism among the population about the success of the project.[36]

After the conclusion of the second working period (1889), there was a minor stagnation in the implementation of regulation, so the mayor of Celje, Josef Neckermann, called for the continuation of works. He emphasized that floods in Celje had become more violent due to the faster entry of high water from the Upper Savinja Valley.[37] Meanwhile, the provincial assembly nevertheless confirmed the continuation of regulation. In the last phase (1891-93), constructions took place near Mozirje, Ljubija, Preska, Podvin (bridge in Polzela), Šešče, Vrbje, Griže, Kasaze, and Levec, where they finally stopped. In total, between 1877–93, over 40 km of cut-off channels, dams, and dikes were constructed along the route, costing approximately half a million gulden. Under the leadership of the Provincial Building Office in Graz (supervised on the ground by the District Building Office Celje (initially under the direction of Eng. Wilhelm Hallada, then Eng. Wilhelm Butta)), the waterway was successfully shortened and secured (despite numerous concerns of the local population), obstacles to rafting were removed, the inundation area controlled, and approximately 200 hectares of new arable land gained. The riverbed was straightened and deepened, thereby greatly accelerating the flow. However, some undesirable (or side) effects also appeared. In the upper part of the Valley, the river eroded into marl layers, the groundwater level dropped, and consequently, springs began to dry up. The consequences were quite unfavorable for Celje, as the material carried by the water accumulated in the Celje bend, raising the groundwater and water levels, and creating greater possibilities for floods. Between 1887 and 1910, numerous extensive floods affected the city on the Savinja (more severely in 1887, 1888, 1895, 1899, 1900, 1901, 1905, 1906, and 1909).[38]

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31 *Cillier Zeitung*, "Hochwasser," 31 August 1882, 4.

32 *Slovenski narod*, "Ugovorne obravnave 'Slovenskega naroda'," 8 March 1883, 4.

33 Cf. *Slovenski narod*, "O povodnji," 4 November 1885, 3. *Deutsche Wacht*, "Hochwasser," 3 November 1887, 4.

34 *Deutsche Wacht*, "Die Arbeiten der Sannregulirung," 10 November 1887, 4.

35 *Deutsche Wacht*, "Cillier Gemeinderath," 6 November 1887, 3. *Deutsche Wacht*, "Die Regulirung der Sann," 10 November 1887, 1.

36 *Die Landesvertretung von Steiermark, IV. Theil*, 203, 204. *Die Landesvertretung von Steiermark, V. Theil*, 1885-1890 (ed. by Landes-Ausschusse des Herzogthums Steiermark) (Graz: Leykam, 1891), 309-13.

37 *Deutsche Wacht*, "Steiermärkischer Landtag," 1 November 1890, 2.

38 Orožen, however, incorrectly states 1910. – Orožen, 18. Cf. Zorn, "Poplave – stalnica," 534, 535. *Die Landesvertretung von Steiermark, V. Theil*, 313-15. *Die Landesvertretung von Steiermark, Sechster Theil – Erste Abtheilung, 1891-1896* (ed. by Landes-Ausschusses des Herzogthums Steiermark) (Graz: Verlag des Landes-Ausschusses des Herzogthums Steiermark, 1898), 178-80.

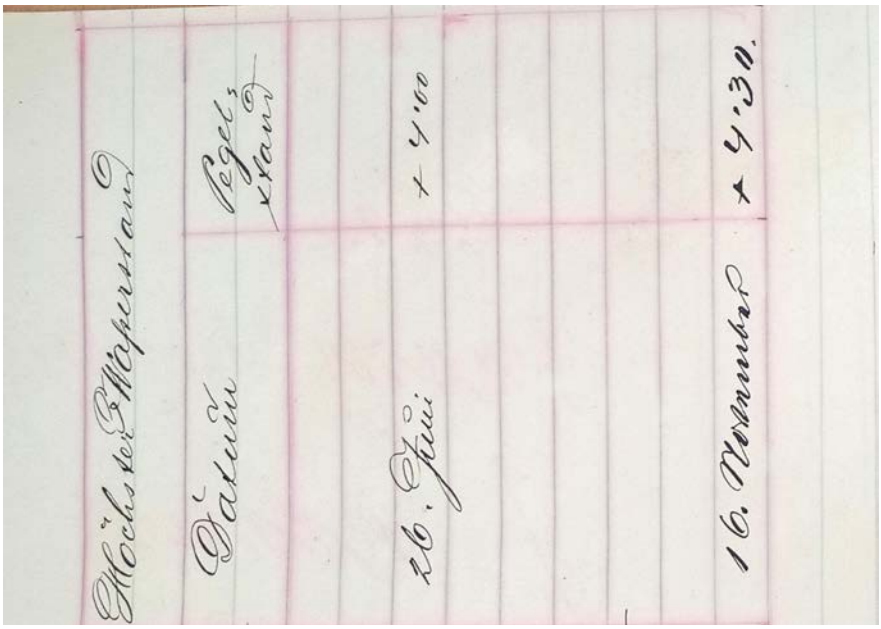

Fig. 5 *Water level in Celje during the floods of 1900 and 1901.*
Source: *SI_ZAC/0024, Mestna občina Celje (1850-1918), t. e. 52, fasc. 1901, List of maximum water levels at the Celje water gauge from 1870 to 1901, document Verzeichnis der Hochwasser-Maximalwasserstände am Cillier Pegel vom Jahre 1870 bis 1901.*

Shortly after the completed regulation, the Styrian Deputy Guido Kübeck inspected the Celje problem, as floods increasingly threatened the city.[39] Slovenian provincial assembly deputies also repeatedly called for the clearing of the Savinja riverbed above Celje, since the regulation in the city did not yield the desired results.[40] The worst floods affected Celje at the turn of the centuries and convinced even the biggest doubters of the necessity of continuing the Savinja regulation. After the severe floods in 1900 and 1901,[41] a special commission assessed the situation and identified the necessary rehabilitation measures. But many believed that this would not be enough and that broader regulation was needed.[42]

Another visit by the Styrian Deputy (Manfred Clary-Aldringen) brought some more hope.[43] There were also increasing calls for additional regulation in the provincial assembly.[44] Therefore, a comprehensive rehabilitation plan was drawn up in April 1903, which also included the regulation of tributaries and the area below the Celje bend. In July 1903, a study for extensive renovation works was prepared, but floods affected the area again in the same month.[45] Slovenian deputies demanded an immediate start of works in Celje at the end of the year[46] (and again at the end of the following year),[47] which indeed bore some fruit higher up in the Savinja Valley (by 1908, the Mozirje dam was lowered, the canal near Šempeter renovated, and the riverbed somewhat deepened), but not in the city, where floods continued to devastate the area.[48] Although a technical report was prepared in December 1905, which precisely

[39] Janez Cvirn, "Thomas Fürstbauer: Kronika mesta Celja 1892–1907, I. del," in *Celjski zbornik* (Celje: Skupščina občine Celje, 1990), 231, 232.

[40] E.g. *Stenographisches Protokoll über die 9. Sitzung des steiermärkischen Landtages*, VIII. Landtags-Periode, I. Session, 8 February 1897, 82. *Stenographisches Protokoll über die 12. Sitzung des steiermärkischen Landtages*, VIII. Landtags-Periode, I. Session, 12 February 1897, 105, 106.

[41] Cf. *Slovenski narod*, "Povodnji," 28 June 1900, 4. *Deutsche Wacht*, "Die Hochwasserkatastrophe," 21 November 1901, 2, 3.

[42] *Deutsche Wacht*, "Zur Sannregulierung," 1 December 1901, 1, 2.

[43] Janez Cvirn, "Thomas Fürstbauer: Kronika mesta Celja 1892–1907, II. del," in *Celjski zbornik* (Celje: Skupščina občine Celje, 1991), 213, 214.

[44] E.g. *Stenographisches Protokoll über die 28. Sitzung des steiermärkischen Landtages*, VIII. Landtags-Periode, VI. Session, 23 July 1902, 486.

[45] SI_ZAC/0024, Mestna občina Celje (1850-1918), box 98, Sannregulierung. *Slovenski narod*, "Iz Celja," 1 August 1903, 3.

[46] *Stenographisches Protokoll über die 11. Sitzung des steiermärkischen Landtages*, IX. Landtags-Periode, I. Session, 6 October 1903, 234, 244. *Stenographisches Protokoll über die 14. Sitzung des steiermärkischen Landtages*, IX. Landtags-Periode, I. Session, 13 October 1903, 306, 307.

[47] *Stenographisches Protokoll über die 28. Sitzung des steiermärkischen Landtages*, IX. Landtags-Periode, II. Session, 10 November 1904, 554–58.

[48] *Die Landesvertretung von Steiermark, Achter Theil, 1903-1908* (ed. by Landes-Ausschusses des Herzogthums Steiermark) (Graz:

described the necessary measures for the regulation of the Savinja and its tributaries in Celje (protection of the city, deepening of the riverbed, construction of dams and protective drainage facilities),[49] the start of works was again postponed, primarily due to lack of funds and political will. In early 1909, a special commission again inspected the river and its tributaries and made proposals for much-needed regulation. But everything progressed too slowly. During all this time, the Savinja flooded Celje and its surroundings several times. In January 1910, Member of Parliament Richard Marckhl called for an immediate start of regulation, as there was no more room for delay. In the same year, a decision was finally made for a multi-year regulation of the Savinja and its tributaries in Celje (worth two and a half million crowns). Nevertheless, only minor repairs to the dams (in Braslovče and Mozirje) and some corrections were carried out, while the main regulation was still awaited (and the Savinja continued to flood periodically).[50] However, with the outbreak of war in 1914, all regulation plans were postponed. Austrian works on the river thus definitively ended.

INSTEAD OF A CONCLUSION

Engineers soon realized that solving urban flood problems would only be possible once they systematically approached the regulation of the river below the city, primarily due to the problems caused by the Celje bend. In 1873, some rocks above Grenadirjeva brv (Grenadiers' Footbridge), which were considered the biggest obstacle to water flow towards Laško, were blasted, but further floods quickly showed that the problem was broader.

In the 1880s, experts began planning systematic river regulation up to Tremerje. By 1880, a plan, budget, and proposal were prepared, but only a part was implemented, which secured the left river bank below Grenadirjeva brv, while the section to Tremerje remained unresolved, as regulation works focused primarily on the area above Celje.

In 1902, Professor Philipp Forchheimer[51] reviewed the situation on the ground and supported the local experts in shortening the Celje bend with a cut-off channel and relocating the railway to the left river bank. Between 1906 and 1911, a detailed regulation plan was prepared in Graz, worth about two million crowns. However, despite the plans, works lagged due to delays and/or financial difficulties. Thus, actual realization did not occur. The plans were interrupted by the outbreak of war, which meant the end of hope for solving the problems in this regard.[52]

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49 SI_ZAC/0024, Mestna občina Celje (1850-1918), box 52, Technical report for the regulation of the Savinja and its tributaries near Celje.

50 *Deutsche Wacht*, "Zur Sannregulierung," 15 January 1910, 8. SI_ZAC/0024, Mestna občina Celje (1850-1918), box 52, Technical report for the regulation of the Savinja and its tributaries near Celje. SI_AS 186, C. kr. kmetijsko ministrstvo, Dunaj, box 85, Sann-Regulierung Prassberg-Cilli.

51 For more, see *Deutsche Biographie - Forchheimer, Philipp*, accessed May 22, 2025, https://www.deutsche-biographie.de/sfz23307.html#ndbcontent.

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SUMMARY

The torrential Savinja has a pluvio-nival regime; due to higher precipitation and reduced evapotranspiration, the first peak flows occur in the autumn months, and the second peak due to snowmelt in the spring months. Consequently, it was quite prone to flooding in the past. In its upper course, it had a strong gradient, which diminished in the Valley. The river, with numerous meanders, carved its way through gravel deposits. For the 17th and 18th centuries, we have reports that the Savinja caused numerous problems by shifting its riverbed. At the end of the 18th and in the first half of the 19th century, Celje (and the wider Valley) were affected by more severe floods. The Celje District Office seriously dealt with the Savinja and its tributaries from the beginning of the 19th century. Until the mid-19th century, affected landowners had to undertake riverbed clearing, embankment construction, and bank reinforcement, while plans were drawn up by the district (later regional) engineer. However, the work progressed slowly, and the measures were only temporary, thus not particularly effective during major floods.

In the first half of the 19th century, Celje and the Savinja Valley were hit by the worst floods in 1814 and 1824, while in the second half of the century, the most severe flooding occurred right at the beginning, in 1851. After this flood, a more serious approach to regulating the "mountain" river was attempted. However, it seems that in the 1850s, more attention was paid to the tributaries of the Savinja in Celje than to the river itself above the city; reports on regulation works mostly mention the Voglajna, Hudinja, Ložnica, and Sušnica, while serious regulation of the Savinja only began in the 1860s. Nevertheless, the works were still quite inconsistent and slow. The Celje area was, in fact, always one of the largest confluence points in the Slovene lands. Here, various types of floods combined with the aforementioned rivers and streams, which naturally complicated the search for appropriate flood protection, and in the mid-19th century, technology was not yet capable of keeping up with rising water.

In the mid-1860s, the Savinja finally "came into focus," yet it remained merely a dead letter on paper for more than ten years. In the second half of the 1860s, rivers and streams repeatedly overflowed their banks. Three severe floods spurred engineers to prepare numerous surveys and plans, but the regulation between Mozirje (Prihovo) and Levec near Žalec only began in the mid-1870s (in 1876, when the area was again affected by a major flood). The plans were prepared by the provincial construction office in Graz and the district construction office in Celje. In June 1876, the relevant provincial law was finally sanctioned, stipulating a ten-year working period (1877-87). Regulation initially commenced (in 1877) between the trotting bridge and Kristina's Castle just above Celje. However, the river surprised again at the end of summer 1877, heavily flooding Celje and areas above the city. It reached more than three meters above normal again in autumn 1878. The provincial assembly did not rate the regulation works highly, so in June, deputies resolved to accelerate and improve the matter, and shorten the working period by two years (until the end of 1884). The law also stipulated a new working period (1885-89).

Local conditions on the ground, meanwhile, did not significantly change. Slovenian deputies in Graz protested in early 1883, complaining that the provincial assembly did nothing for the regulation of the Savinja and Drava, while money was always found for the Mur near Graz. The flood in early November 1885 (in Celje, 3.4 meters above normal) again relativized the work already completed. Regardless, work proceeded on the Mozirje-Ljubija and Letuš-Polzela sections. Due to frequently high water, several channels and cut-off channels were built. However, intermittent floods considerably slowed down the work. The Celje municipal council finally reacted and concluded that regulation of the Savinja as well as its tributaries in the city was necessary, as the last flood had revealed numerous weaknesses in Celje. By 1888, 23 km of the Savinja downstream from Mozirje had been regulated (and deepened).

Nothing happened after the conclusion of the second working period. In the interim, there was significant flooding again in July 1889. The provincial assembly, by August 1891 when it was sanctioned, finally adopted a new provincial law (valid until 1893). In the final phase, constructions took place near Mozirje, Ljubija, Preska, Podvin (bridge in Polzela), Šešče, Vrbje, Griže, Kasaze, and Levec. In some places, there was less riverbed excavation, but more protective bank work and repairs, and elsewhere the opposite. In the interim, there were several calls for the regulation of tributaries in Celje, and then also

more criticism of the regulation itself, claiming that it had not brought any great, noteworthy success. Nevertheless, a total of over 40 km of cut-off channels, dams, and flood defenses were built between 1877 and 1893, worth approximately half a million gulden. In 1893, work stopped above the confluence of the Ložnica near Levec. With the regulation, the watercourse (despite numerous concerns of the local population) was successfully shortened and secured, obstacles to rafting were removed, the flood-prone area was controlled, and approximately 200 hectares of new arable land were gained. The riverbed was straightened and deepened, thereby significantly accelerating the flow. However, the regulation also had some undesirable effects. In the upper part of the Valley, the river eroded into marl layers, the groundwater level dropped, and consequently, springs began to dry up. The consequences were quite unfavorable for Celje, as the material carried by the water accumulated in the Celje bend, raised the groundwater and water levels, and created greater possibilities for floods (which most severely affected the city at the turn of the centuries).

SAŽETAK

Bujična Savinja ima pluvio-nivalni režim; zbog veće količine oborina i smanjene evapotranspiracije prvi vršni protoci javljaju se u jesenskim mjesecima, a drugi vrhunac, uzrokovan topljenjem snijega, u proljetnim mjesecima. Posljedično, u prošlosti je bila izrazito sklona poplavama. U gornjem toku imala je velik pad, koji se u dolini smanjivao. Rijeka je, s brojnim meandrima, urezivala svoje korito u šljunkovite nanose. Za 17. i 18. stoljeće postoje izvješća da je Savinja stvarala brojne probleme pomicanjem svojega riječnog korita. Krajem 18. i u prvoj polovini 19. stoljeća Celje (i šira dolina) bili su pogođeni težim poplavama. Kotarski ured u Celju ozbiljno se bavio Savinjom i njezinim pritocima od početka 19. stoljeća. Do sredine 19. stoljeća pogođeni zemljoposjednici morali su provoditi čišćenje riječnog korita, izgradnju nasipa i učvršćivanje obala, dok je planove izrađivao kotarski (kasnije okružni) inženjer. Radovi su, međutim, napredovali sporo, a mjere su bile tek privremene, pa tijekom velikih poplava nisu bile osobito učinkovite.

U prvoj polovini 19. stoljeća Celje i Savinjska dolina pogođeni su najtežim poplavama 1814. i 1824. godine, dok se u drugoj polovini stoljeća najrazornija poplava dogodila već na samom početku, 1851. godine. Nakon te poplave pokušalo se ozbiljnije pristupiti regulaciji ove »planinske« rijeke. Ipak, čini se da se u 1850-im godinama više pozornosti posvećivalo pritocima Savinje u Celju nego samoj rijeci uzvodno od grada; izvješća o regulacijskim radovima uglavnom spominju Voglajnu, Hudinju, Ložnicu i Sušnicu, dok je ozbiljna regulacija Savinje započela tek 1860-ih godina. Unatoč tome, radovi su i dalje bili prilično nedosljedni i spori. Područje Celja zapravo je oduvijek bilo jedno od najvećih ušća na slovenskim zemljama. Ovdje su se kombinirale različite vrste poplava s navedenim rijekama i potocima, što je prirodno otežavalo pronalaženje odgovarajuće zaštite od poplava, a sredinom 19. stoljeća tehnologija još nije bila u stanju pratiti porast vodostaja.

Sredinom 1860-ih godina Savinja je napokon »došla u fokus«, no više od deset godina to je ostalo tek mrtvo slovo na papiru. U drugoj polovini 1860-ih rijeke i potoci više su puta izlijevali iz svojih korita. Tri teške poplave potaknule su inženjere na izradu brojnih izmjera i planova, ali regulacija između Mozirja (Prihovo) i Levca kod Žalca započela je tek sredinom 1870-ih (1876. godine, kada je područje ponovno pogodila velika poplava). Planove su izradili zemaljski građevinski ured u Grazu i kotarski građevinski ured u Celju. U lipnju 1876. konačno je sankcioniran odgovarajući zemaljski zakon, kojim je određen desetogodišnji rok radova (1877.–1887.). Regulacija je isprva započela (1877.) između Trkačkog mosta i Kristininog dvorca neposredno iznad Celja. Međutim, rijeka je ponovno iznenadila krajem ljeta 1877., kada je snažno poplavila Celje i područja iznad grada. U jesen 1878. vodostaj je ponovno dosegnuo više od tri metra iznad normale. Zemaljski sabor nije visoko ocijenio regulacijske radove pa su zastupnici u lipnju odlučili ubrzati i poboljšati zahvate te skratiti rok radova za dvije godine (do kraja 1884.). Zakon je istodobno odredio i novo razdoblje radova (1885.–1889.).

Lokalni uvjeti na terenu u međuvremenu se nisu bitno promijenili. Slovenski zastupnici u Grazu početkom 1883. godine prosvjedovali su, žaleći se da zemaljski sabor ne čini ništa za regulaciju Savinje

i Drave, dok se za Muru kod Graza uvijek nalazio novac. Poplava početkom studenoga 1885. (u Celju 3,4 metra iznad normale) ponovno je relativizirala već obavljene radove. Unatoč tome, radovi su se nastavili na dionicama Mozirje–Ljubija i Letuš–Polzela. Zbog čestih visokih voda izgrađeni su brojni kanali i presječeni rukavci. Ipak, povremene poplave znatno su usporavale radove. Gradsko vijeće Celja konačno je reagiralo i zaključilo da je nužna regulacija Savinje, kao i njezinih pritoka u gradu, jer je posljednja poplava razotkrila brojne slabosti Celja. Do 1888. godine regulirano je (i produbljeno) 23 km Savinje nizvodno od Mozirja.

Nakon završetka drugog razdoblja radova nije se dogodilo ništa. U međuvremenu je u srpnju 1889. ponovno došlo do znatnih poplava. Zemaljski sabor konačno je, u kolovozu 1891., kada je zakon sankcioniran, usvojio novi zemaljski zakon (na snazi do 1893.). U završnoj fazi gradnje su se odvijale kod Mozirja, Ljubije, Preske, Podvina (most u Polzeli), Šešča, Vrbja, Griža, Kasaza i Levca. Na nekim mjestima bilo je manje iskopa korita, ali više zaštitnih radova na obalama i popravaka, dok je drugdje bilo obrnuto. U međuvremenu je bilo više poziva na regulaciju pritoka u Celju, kao i sve više kritika same regulacije, uz tvrdnje da ona nije donijela nikakav velik, zamjetan uspjeh. Ipak, između 1877. i 1893. izgrađeno je ukupno više od 40 km presječnih kanala, nasipa i poplavnih obrana, u vrijednosti od približno pola milijuna guldena. Godine 1893. radovi su zaustavljeni iznad ušća Ložnice kod Levca. Regulacijom je, unatoč brojnim zabrinutostima lokalnog stanovništva, vodotok uspješno skraćen i osiguran, uklonjene su prepreke za splavarenje, poplavno ugroženo područje stavljeno je pod nadzor, a dobiveno je oko 200 hektara novog obradivog zemljišta. Riječno je korito ispravljeno i produbljeno, čime je protok znatno ubrzan. Međutim, regulacija je imala i neke neželjene učinke. U gornjem dijelu doline rijeka se usjekla u laporne slojeve, razina podzemnih voda se snizila, a izvori su se posljedično počeli isušivati. Posljedice su bile osobito nepovoljne za Celje, jer se materijal koji je voda nosila taložio u celjskom zavoju, podizao razinu podzemnih voda i vodostaj te stvarao veće mogućnosti za poplave, koje su najteže pogodile grad na prijelazu stoljeća.

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Plan for reinforcing the banks of the Savinja in the district of Novo Celje, 1832.

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