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HYDROTECHNIC STRUCTURES ON THE POMERANIAN RIVERS – A REACTION TO EXTREME HYDROLOGIC PHENOMENA IN THE 19TH CENTURY (IN THE EXAMPLE OF THE UPPER WIEPRZA)

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Abstract: In the 19th century throughout Central Europe floods became increasingly intense; a similar situation pertained in the area of lake districts and the coastal zone. Maximum water levels recorded at the end of the 19th century (particularly in the years 1888-1892) to the present day on many water-gauge stations (particularly those located in rivers' lower courses) were the highest ever observed. Yet in the half on 19th century the need for regulation works became increasingly apparent. On the Pomeranian rivers these works began in 1860; they reached their greatest intensity in the first twenty years of 20th century.

Regulation activity was conducted which led to a distinct shortening of riverbeds; on longer sections of the river the reduction amounted from over 12 to 20 or more percent, in some places even 50%. It caused the aggravation of bottom erosion, and also lateral erosion, which was particularly apparent beneath the water power stations.

In the last few decades the ending of work that interferes with the riverbed has resulted in the gradual restoration of the primary character of Wieprza River bed. It is also worth mentioning that even when notable floods have appeared (for example, in 1980), which were comparable to those that appeared at the end of 19th century, they did not lead to any fundamental change to any section of the Wieprza River bed geosystem.

Key words: hydrotechnic structures, Wieprza river, flood, river bed response, reservoir, floodplain.

INTRODUCTION

In the middle of the 18th century large land improvement projects were initiated in the lake district of Pomerania. At that time, and also later, these were mostly drainage systems, which must have resulted in increased irregularities of flows (probably the 18th century engineers were not aware of this). In the 19th century, flooding increased in the whole of Central Europe, and also in the lake district and coastal areas. Maximum water levels were recorded at the end of the century (especially during the years 1888-1892), and at many stations, particularly those located on the lower parts of the rivers, they remain the highest ever recorded (Fig. 1). As early as the middle of the 19th century the floods generated pressure for river regulation works. On the Pomeranian rivers the works began in 1860, but most of the construction was carried out during the first two decades of the 20th century.

River training works included the deepening of river beds, the removal of boulders, trees, sandbars from the channels, but most

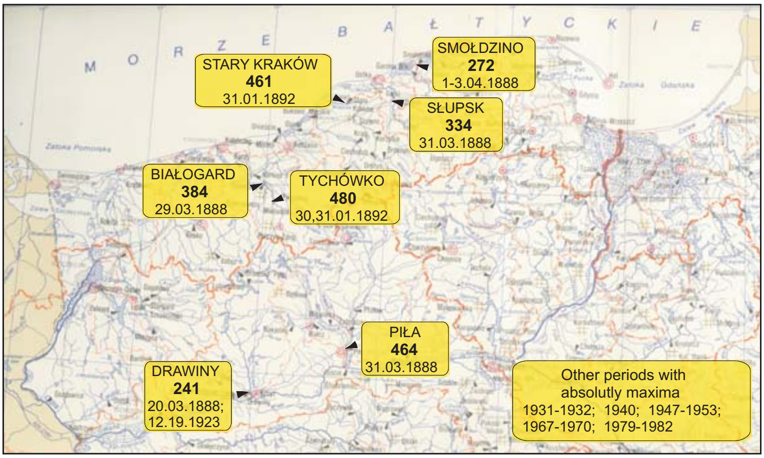

Figure 1. Division of Pomerania into watersheds and the location of water level gauges with maxima for the period 1888-1892.

of all the removal of river bends (meanders), the strengthening of river banks and the building of weirs, dams and reservoirs. At the turn of the 20th century, relatively large hydroenergy projects were initiated.

One consequence of these regulation activities was that river beds were significantly shortened; over longer stretches the reduction could be between a dozen and over twenty percent (Florek, Nadaczna 1986); locally it could be as much as 50% (Florek 1991). This resulted in the strengthening of bottom and bank erosion, especially below the power plants, due to the increased flow velocities generated by the increased slope of the river bed and by the insufficient dissipation of energy of the relatively sediment-free water below the power plant.

The completion of some of the projects, such as on the middle Słupia River, caused a radical restructuring of the drainage system, and changed the rhythm and range of the water flow below the hydropower plants (W. Florek 1991, E. Florek 2001). With regard to erosion, sediment transport and accumulation, especially of the coarser grains, the dams and weirs divided the channels of many rivers into autonomous stretches (Rachocki 1974).

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HYDROLOGICAL PROPERTIES OF THE UPPER WIEPRZA CATCHMENT AREA

The slope of the Wieprza decreases gradually though rather irregularly along the river course. Where the river cuts through the glacial outwash of the Pomeranian ice-marginal valley (below Bożanka), the decrease of the river slope is especially visible. Above it, on some stretches the Wieprza the decline even exceeds 5‰. The average flow velocity on the upper Wieprza is 0.5 m/s.

According to Dębski (1978), the hydrological regime of the rivers of the northern slope of Pomerania, including that of Wieprza, is a typical example of an oceanic snow-rain system, and Dynowska (1971) defined it as a soil-snow rain system with a balanced distribution of flows. It is a two-seasonal regime, with a shallow summer low and a rather low winter/spring flood.

Low water levels occur on the Wieprza during the summer, most often in July. The high waters are not very high; they are recorded in March, January or December, and they are of the same order of magnitude (Mikulski 1963).

Physiographical (the diverse relief of the terrain, with numerous undrained hollows, and a high percentage of forest cover) and climatic conditions facilitate a significant equalization of flow-off from the upper part of the Wieprza catchment area. This is reflected by the relatively small differences of water levels both in the Wieprza river channel (profile Kwisno at km 102.4 – 0.6 m, profile Broczyno at km 84.1 – 1.2 m) and in the Studnica river channel (profile Ciecholub at km 2.2 – 1.12 m) (Table 1). The maximum discharge occurs in the upper Wieprza during the first months of the year, mainly in January and March. At the profile at Kwisno a minimum discharge was recorded during nearly all months of the year except the first three, while at the station Broczyna they occurred most often in June, July and September. It is worth noting that the difference between dry and wet years mainly relates to

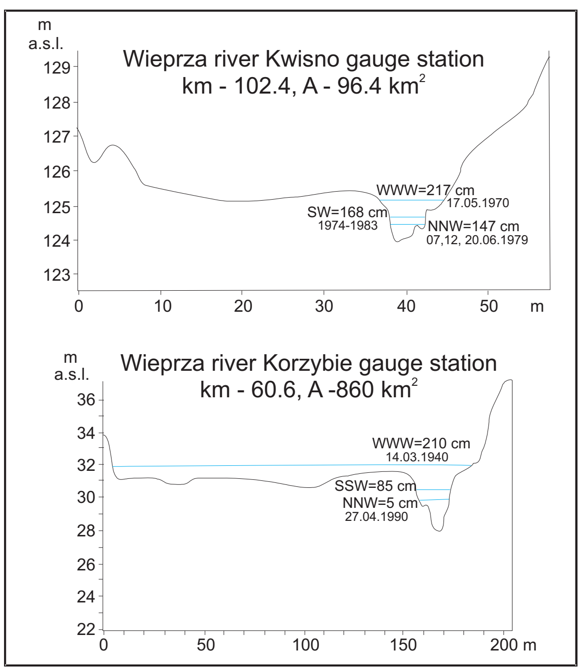

Figure 2. Transverse profiles of the upper Wieprza river bed at Kwisno and Korzybie; the reach of extreme water levels and the average water level in the decade 1974-1983.

Table 1. Average and extreme water levels and flow in the Wieprza and Studnica rivers (Rocznik Hydrologiczny Wód Powierzchniowych...).

Station	km	Catchment area [km²]	Water level (cm)			Flow (m³/s)			$Q_{max}:Q_{mean}:Q_{min}$	$Q_{max}:Q_{min}$
			Absolute maximum	Absolute minimum	Mean for 1956-1975	Absolute maximum	Absolute minimum	Mean for 1951-1975		
Kwisno	102.4	96.4	217 17 IV 1970	157 27 VI 1966	170 (1966-1975)	2.68 1 IV 1979	0.31 4-14 IX 1976	0.86	3.11:1.0:0.38	8.87
Broczyna	84.1	381	150 7,8 II 1963	32 16,17 V 1959	51 (1961-1975)	15.8 19 IV 1970	2.02 18 VII 1982	4.29 (1961-1975)	3.68:1.0:0.47	7.8
Korzybie	60.6	860	210 14 III 1940	10 10,11 X 1969	68 (1966-1975)	24.7 18 IV 1970	2.76 10,11 X 1969	8.95 (1961-1975)	2.76:1.0:0.30	8.9
Ciecholub (Studnica)			200 18 I 1982	88 2-4, 7 VI 1978	120 (1974-1983)	12.7 5 I 1982	2.25 10 VII, 15 VIII, 3 IX 1975	3.89	3.26:1.0:0.58	5.49

late autumn and winter (November-March), with wet years having discharges decidedly higher than average.

A comparison of data on the variability of water level and discharge on the upper Wieprza with the cross-section at Kwisno (Fig. 2) shows that even during the highest water levels the water is contained in the river bed, and does not flow out onto the floodplain. The situation is different at Korzybie, where extreme water levels caused the inundation of the whole floodplain.

These data indicate that the occurrence of extreme 19th century flows and, connected with them, extensive inundations covering the whole floodplain, would at that time have caused concern for farmers engaged in extensive stock farming, and stimulated the initiation of land reclamation and river training projects, which aimed mainly to provide the rapid drainage of water from the river valley bottom during high water levels, i.e. generally in early spring. The implementation of these projects also coincided with the beginnings of hydropower expansion.

ECONOMICAL INGERENCE INTO RIVER BEDS AND VALLEY BOTTOMS AND ITS IMPACT

The main rivers of the upper Wieprza catchment (Wieprza and Studnica) have been used for various purposes for quite a long time. There is historical evidence that from at least 1562 they were used for floating timber, though this type of transport became popular in the 19th century (Fig. 3; Lindmajer 1997, 1999), and disappeared in the 1930s, after a dense network of surfaced roads was built. Especially in the 18th and 19th centuries, many plants powered by hydroenergy were built in junker estates, such as fulling mills, sawmills, and water mills.

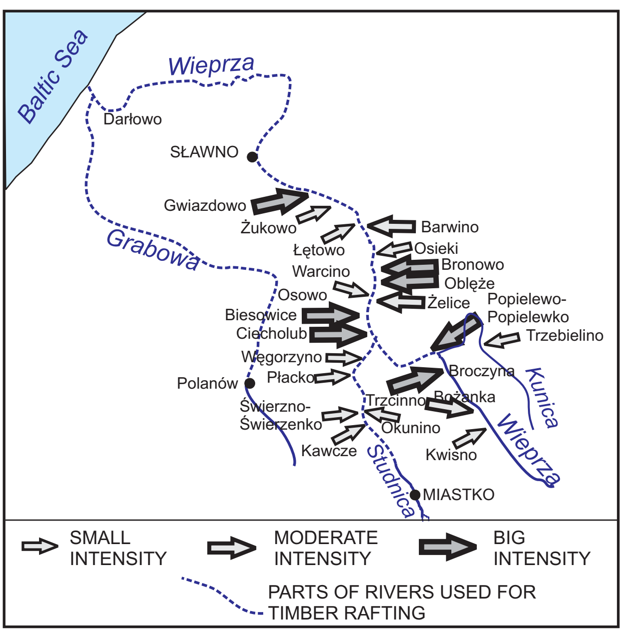

Figure 3. The geography of timber rafting on the Wieprza and Studnica in the third quarter of the 19th century (according to J. Lindmajer 1997).

These were generally located on valley stretches of glacial trough origin (because of the larger river slope). From the beginning of the second half of the 18th century, investment into land improvement steadily increased. From 1843 they were undertaken by water partnerships; these were replaced at the turn of the 20th century by land improvement offices. These offices developed systems (hillside and ridge) that irrigated the higher parts of the valleys and drained the lower parts. River training works began in 1860, i.e. after the floods; their impact and reach have not been documented by systematic observations. The land improvement and river training works in the Wieprza valley were carried out mainly along its glacial outwash stretch (below Bożanka). The hydroelectric power plant at Biesowice (km 80.88 of Wieprza) started operation in 1908 and is still working today (Fig. 4). The next hydroelectric power plants began to operate at Kępka (km 78.26) in 1913 and Kępice (km 73.6) in 1918. The construction of these power plants was connected with the partitioning of the river channel and valley bottom by earth dams and weirs, and the creation of reservoirs. At least since the first half of the 19th century (before 1849) there was a weir with a water mill at km 2.2 of Studnica valley. The water mill was later replaced by a power generator. The partitioning of Wieprza disturbed the flow of the coarser sediments, and consequently the effective part of the Biesowice reservoir became completely sanded up. This was also strongly facilitated by the removal of many hydrotechnic installations on the upper Wieprza and Studnica, as a result of the pre-emption policy of the central government in the 1950s and 1960s, which strengthened river channel processes. In effect, many erosion niches appeared, the river channel separated into branches because of numerous clumps, and a tendency emerged towards curving the formerly straightened

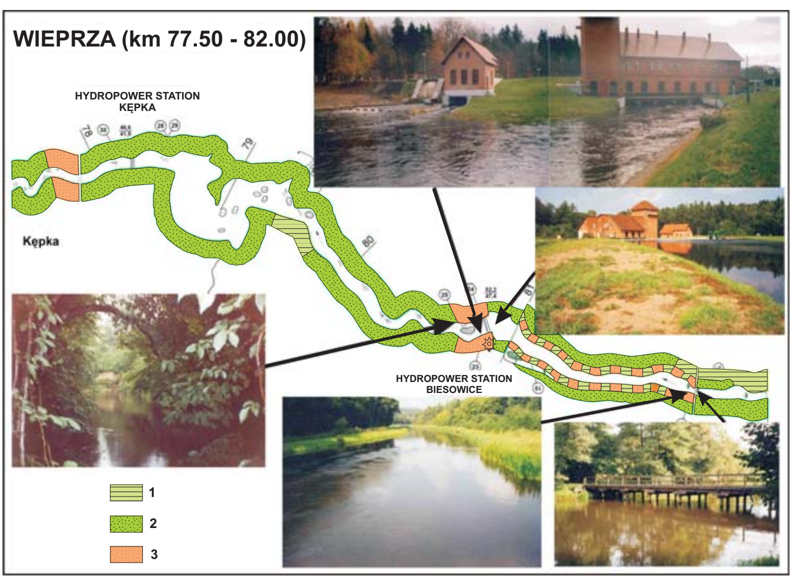

Figure 4. State of the Wieprza channel near the Biesowice and Kępka hydropower plants; 1- bank grown over with turf plants, 2 – bank grown over with bush abd trees, 3 – bank artificially strengthened.

stretches of the rivers. Generally, the Studnica channel is much more stabile than the upper Wieprza channel (Fig. 5).

THE PRESENT STATE OF THE UPPER WIEPRZA BED NEAR THE HYDROELECTRIC POWER PLANTS AT BIESOWICE AND KĘPKA

The Wieprza flows above the Studnica outlet (km 80.4) in a valley whose width ranges from 100-150 m to a maximum 250 m. The slopes of the valley are wooded and reach 20-40 m above the bottom of the valley. The average slope of the river is along this stretch is about 1‰. In the upper part of this stretch, the river continually meanders, easily eroding its sandy banks in the bends. According to information contained in the *Ekspertyza*... (1957), in the past local people protected the eroded banks by sinking along them felled trees. Furthermore, today many fallen trees lie in the river. The river channel width varies between 10-12 m, the average depth is 1.0-1.2 m. Along the river, alternatively on both sides, there are narrow wet meadows, grown over with sedge and alder trees. The ditches draining the floodplain were not cleaned for a long time and have now disappeared completely. On the edge of the meadows, at the foot of the slope bordering the bottom of the valley, there are quite numerous oxbow lakes, and also springs and seepages. Approaching the Studnica outlet, the Wieprza channel remains fairly compact, in spite of the many traces of erosion and local damming by fallen trees. At places where the river meanders have narrow necks, e.g. below km 88, the river is close to shortening its course. This has happened above km 87, though flow through the meander has not yet been stopped completely (the neck is 2 m wide).

Beginning from km 87, the river does not curve so much as in the section above it, but its tendency to erode the banks is still

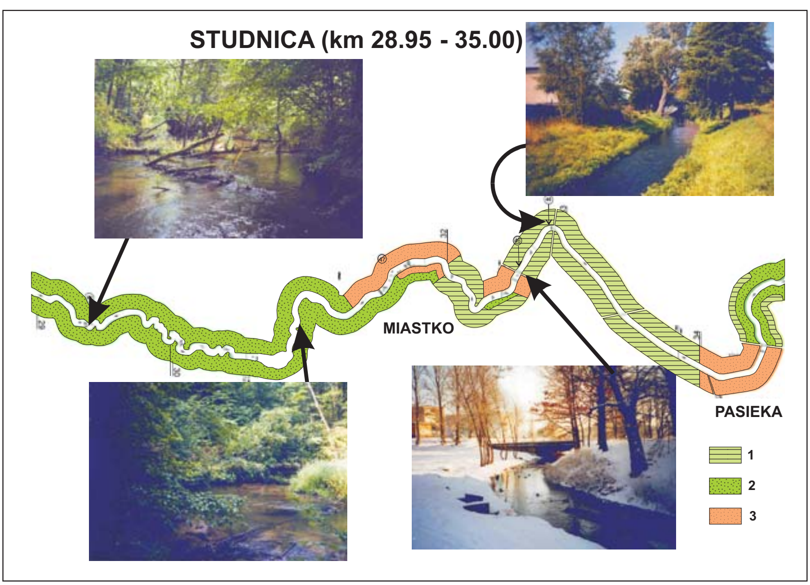

Figure 5. State of the Studnica channel near Miastko; explanation as in Fig. 4.

present. In the past, the Wieprza meandered at this point intensely, as is shown by two rather large oxbow lakes on the right bank (at km 86 and above km 85). On a Prussian map that dates from the end of the 19th century they are shown as connected with the river channel. Low lying parts of the meadows are boggy, because the drainage ditches have not been maintained. Above the connection with Studnica there is an island which divides the river channel into two branches. On the bottom of the bed grow watercress *(Nasturtium officinale R.Br.)* and white water-buttercup *(Ranunculus aquatilis L.)*; and closer to Studnica also grow spiny waterstarwort *(Callitriche verna L. em. Loennr.)* (a plant typical for Studnica).

On this stretch the Wieprza changes its direction from west to north-west, and with that change, near the Darnowskie Lake, it leaves the distal valley and flows into the bottom of a sub-glacial trough (Sylwestrzak 1977).

From the connection with Studnica onwards, the Wieprza increases its cross-section attaining, on the stretch to the hydropower plant at Biesowice (except on a part of the old reservoir), a channel width 12-15 m and mean depth of 1.2 m (which is dependent on its distance from damming structures). The slope of the river is very gradual. Meadows on both sides are slightly inundated by dammed up water. Bulrush *(Typha latifolia* and *T. angustifolia)* and reed grow in the river channel. The banks are low, and willows grow on them (Fig.4). Above km 83 the river flows under a reinforced concrete arch bridge on the Biesowiczki-Przyjezierze road. The backwater of the Biesowice reservoir reaches about 350 m below the bridge (*Operat wodno-prawny elektrowni wodnej w Biesowicach* [Water-legal documentation for the hydroelectric power plant at Biesowice]), i.e. to the place where the water surface is at the ordinate 52.40 m above s.l. The valley slopes above the meadows are used for agriculture. There are some small copses. Below the bridge at Biesowiczki the valley becomes narrower, the height of the valley slopes, which are covered by leafy trees, is about a dozen metres. The hydropower plant reservoir, below the timber bridge, previously took up nearly the whole width of the valley bottom. After reconstruction in 2002, a part of the floodplain was left outside the dykes bordering the reservoir (Fig. 4). Because of the intense accumulation of sediments the reservoir required systematic dredging. At present, the dredged spoil is used for the building up of dykes and for increasing the height of parts of the foodplain outside the dykes.

Late 19th century Prussian topographic maps show that above the bridge at Biesowice there was a water mill on the right bank of the river. It was probably built between 1780 and 1789 (Florek, Nadaczna 1986), a conclusion drawn from a comparison of maps made by Gilly (published in 1789) and Schmettau (from the years 1770-80).

The damming structures of the Biesowice hydropower plant are located at km 80.88 (Fig. 4). The power plant was built in the period 1906-1908. The upper water level comes to 52.0 m, and the lower water level is 47.4 m a.s.l. The river flows from the power plant in three branches – the left and right pass through the turbines (Fig. 4), the central branch goes through a weir, which is opened when needed. Directly below the branches connect into one channel. The banks are artificially strengthened: the right with a concrete structure, further down with fascine, the left with stones. Several dozen metres below the power plant, there are small holms fixed by alder trees, and an island formed by a division of the river, which previously flowed only through the right branch. The island is about 70 m long and 30 m wide, with beech trees growing on it.

Until the backwater of the Kępka hydroelectric power plant's reservoir the generally steep river banks are naturally strengthened by the trees that grow there (mainly beech, although further away there are some pine trees), except the 3 m high stretch of river bank by the aforementioned island, where traces of sliding due to side erosion are visible. Along the whole stretch the river bed is often dammed by fallen trees. The river slope is significant, the river channel width is 10-16 m, and has a depth 0.5-1.2 m, and the bottom is stony. Higher terraces of the valley are covered mainly by pine forests.

Water velocity becomes much smaller at km 80 because of the backwater of the Kępka reservoir. This is a 2 km long stretch of the river. The reduction in velocity is also related to the increased water depth. However, in places where parts of the floodplain have become inundated, the water is shallow, and willows and shallow water plants grow abundantly. The average depth of the reservoir is 1.36 m, and the maximum depth close to the dam is 3.6 m. The ordinate of the water surface at the dam is 46.6 m a.s.l. Generally the banks are high (being the edges of higher terrace levels) and are covered by pines. At km 79 a left tributary flows into a reservoir – the Modła. Towards the hydropower plant, the left bank becomes lower, and the width of the reservoir narrows from 100-200 m to about 50 m. The Kępka hydropower plant is located at km 78.26. It was built in 1913 to supply power to the paper-mill at Kępice. It operated until 1945, and again began to operate in 1998. Above the power plant the left bank is strengthened by a concrete structure and the right bank is naturally protected by bushes.

Below the power plant at Kępka (the lower water surface comes to 41.39 m a.s.l.), the river bed has been artificially strengthened: the bottom and the right bank are supported with concrete, the left bank with stones. There is a timber bridge at km 77.96. From here the river flows in a curving channel 12-15 m in width and 1.5 m in depth, with a till bottom. There are many fallen trees in the river. Very occasionally small meadows also occur. The level of bank erosion is small.

THE STATE OF THE STUDNICA CHANNEL NEAR MIASTKO

The beginning of the Studnica is in a chain of lakes, the first of which is Lake Słosineckie Małe; there then follow the lakes Sitno Duże, Sitno Małe and Studzieniczno. The outflow from the last lake is considered to be the proper starting point of the Studnica. About 50 m from the lake there is a concrete weir that was constructed in 1974 to manage water levels and to guarantee the water supply to the fish farm at Pasieka near Miastko. A similar weir was built at the same time near Świerzenko. Both weirs lift the water level by 1.5 m. The water level in the lake is permanently lifted by 0.7 m, which ensures a stable flow of 350-450 l/s (previously it was 120-600 l/s). Additionally, on a stretch that measures 750 m the river channel was deepened, and now the depth is 0.6-0.8 m, the width is 3-4 m and the river slope is small (below 2‰). In the past the river channel was regulated, which is indicated by the remains of piles at the banks; today, though, the river is irregular. The channel is covered by the reed *Phragmites communis)* and the bulrush *(Typha latifolia* and *T. angustifolia)*, but there is no underwater vegetation. There can often be found in the river fallen trees, and blockages caused by vegetation and large rocks. This locally lifts the water level even up to the edge of the bank, which also serves to increase the wetness of the valley bottom, which in addition to this has many springs and other ground water outflows. Most of the valley bottom is covered by wet meadows with sedge and moss; the direct neighbourhood of the river is covered by alders and osiers. The remains of a damming timber structure which was once a water mill are located at the end of this 750 m long stretch, and on the bank are the stone foundations of the mill.

From the point of the remains of the mill (km 35.94) the slope of the river increases to over 5‰, and along a 1 km long stretch the river flows in a curving channel through a narrow valley with steep slopes. The Studnica at this point is 4-5 m wide, its depth is only 0.1-0.2 m, and the river bed is gravelly with many stones, and is often jammed by fallen trees. The banks are densely grown over with alders. On the left, steep slope of the valley are boggy meadows with sedge, moss, horsetail, and sometimes reed. Numerous springs occur over the whole area of the meadows.

Along the fish farm at Pasieka the river slope declines to 3-3.5‰. The width of the channel also becomes smaller, locally to as little as 2 m, and the depth increases (up to 0.5 m). In the past the river was regulated along this stretch, but has now returned almost completely to its former, natural state. Meadows lie along the banks covered by alders and osiers. There are numerous springs (at the foot of slopes and near the river channel). The ditches draining water from them have been destroyed and no longer serve their original purpose. To a large extent the area is being taken over by alder bushes; gradually the meadows and pasture land are being replaced by alder forest habitats.

Above Miastko, at Pasieka, there are fish ponds on the Studnica, which use the whole water flow of the river. Water intake is ensured by a concrete weir which lifts the water surface by 2 m. The fish are raised in two tanks, which also serve as settling tanks. From this point, until the inoperative water mill in Miastko, the river is regulated for 1800 m, and the land along it has a land improvement system that is in operation (Fig. 5). The last river training and land improvement works were carried out in the years 1990-95. This is the only stretch with these attributes along the whole river length. The average width of the river channel is 3.5 m, and the water depth is 0.3-0.45 m. The bottom is sandy or stony. Directly below the fish ponds the Studnica receives a left tributary, the Pląsy stream, which is regulated on its lower part. A further tributary, this time on the right, joins the river 200 m below the ponds. It is an unnamed stream, regulated along the whole of its length. The river below the timber bridge was in the past within reach of the backwater of the water mill in Miastko, and because of that it was protected on both sides by low dykes, which are still in place and have remained unchanged. At the back of the dykes there are, parallel to the river, the main ditches of the system that drains the meadows through which the river flows. These ditches are connected above the town with the river channel by a water trap, through which water is led to the lower level water at the water mill in Miastko. In the town, the Studnica passes under several bridges. The first is a reinforced concrete road bridge on the Mistko-Bytów road. This is the first time water vegetation appears in the river: duckweed *(Lemna minor L.)*, hornwort *(Ceratophyllum demersum L.)* and white water-buttercup *(Ranunculus aquatilis L.*. Probably this is connected with the higher fertility of the water caused by the discharge of waste water from the town area. The second reinforced concrete bridge is on the Miastko-Słupsk road, and 10 m further down is the inoperative water mill. At present it functions as a weir, lifting the water surface by 1.8 m. 40 m below the weir the river flows under a concrete bridge on the previous road to Słupsk, and about a dozen metres further ends the regulated urban stretch of the Studnica (Fig. 5).

Until the destroyed railway bridge, on the dismantled Miastko-Bytów railway line, the Studnica flows through a once regulated, and now no longer maintained, channel of 3.5-7 m width and 0.1-0.5 depth, with a varying declining gradient (0.5-3‰). Still within the town limits, there is a short, fast stretch in a shallow ravine, below which the fall gradually becomes smaller and the average depth increases. The river channel is more compact at this point, the bottom is sandy and muddy, and is covered by vegetation. In several places traces of bottom and bank erosion are visible. In some places on the bank there are reed *(Phragmites communis)* and bulrush *(Typha latifolia* and *T. angustifolia)*. On the left bank, between the town area and the river are rather wet meadows, which in this area are boggy due to spring waters. Below the meadow complex, there is a timber bridge, and below it the river slope increases. The river flows through a ravine with very steep, often undercut banks, grown over with alder, willow and osier. There are numerous springs in the lower part of the slopes. Many obstacles, in the form of tree trunks, and piles of branches are present in the channel, which serve to slow down the water flow. About 400 m below the timber bridge in the river channel there is a nearly destroyed stage of fall (km 31.65). Below, towards the railway bridge, the river flows in a widening and an increasingly shallow bed of natural character, which in some places inundates the bottom of the valley. Sandbars often appear both under and above the water, which are strengthened by turf, blocks caused by plants, and traces of flow outside the river channel. In the past a water mill named "Młyn Lipowy" [Linden Water Mill] was located on this stretch. Its remnants are a relatively well preserved concrete bridge and a destroyed concrete weir. Below, the river slightly reduces its slope and flows through boggy and overgrown areas with bushes, which replaced the small wet meadows that had previously grown here. A small unnamed left tributary flows into the Studnica, and below is an object defined as the "stone rapid Gatka-Łodzierz". In the past there was a textile factory in this location, but no trace of it remains today. Below the rapids, the water is dammed up by a mound of rubble which came from a railway bridge that was blown up during the war (km 30.52). The river floods over onto the banks, which are covered by alders, reed and bulrush *(Typha latifolia* and *T. angustifolia)*. The river channel on this stretch is overgrown; the steeply sloping right-bank meadows are boggy due to numerous springs and are overgrown with sedge and moss. On the dry left bank there are pastures.

CONCLUSIONS

Data obtained from the mapping of the channels of both the investigated rivers indicate that they are in a stage of dynamic equilibrium, and that they have adapted to the conditions which arose as a result of 19^{th} and 20^{th}-century hydrotechnic ingerence. This state is not disturbed even by almost extreme hydrological events, such as those recorded in the19^{th} century (e.g. February 2005). Lately, the most intense side erosion has been observed on the Wieprza above and below the outlet of Broczynka, below the connection with Pokrzywna, below the destroyed reinforced concrete weir at Bożanka, and on the stretch between km 108 and Grądki Dolne (formerly Flisów), and also below the dams at Biesowice (Fig. 5) and Kępice. Also on the Studnica there are only a few, rather short stretches on which side erosion can be observed. Besides the maladjustment of the material forming the river banks (mostly non-cohesive sand) to the present hydrodynamic conditions, the main reason for the erosion is the reduction of the sediment load, which accumulates in the reservoirs of the hydropower plants, and in the local increase of the river slope as a result of the regulating (straightening) of the river at the beginning of the 20th century. Lower order causes, which have a local impact, may be considered, such as the presence of various obstacles in the river channel, mainly fallen trees, which change the local conditions of the water flow.

It is also worth noting that besides the stretches where the water level is increased by weirs and dams, the accumulation of mostly coarse material can be observed at the outlets of all the larger tributaries into the Wieprza River (and also the Studnica).

A greater, more extensive influence on the functioning of the river channels of the upper Wieprza and Studnica was, and still is, exerted by the reservoirs of hydropower plants. Their influence manifests itself in the following ways:

– reducing the water velocity above the damming facilities, and its strong differentiation within the reservoirs,
– the increasing the accumulation of coarse material (bed load material), and in zones where flow velocities are significantly reduced the accumulation of suspended matter (including material that originated in sewers) can also be observed. This results in the fermentation of sediments, a disturbance of oxygen management and the eutrophication of the reservoirs,
– in the Biesowice plant's reservoir, over the course of several decades of normal accumulation of the sand and gravel fraction, a classic "Gilbert" type delta was formed, which now reaches nearly over the whole of the reservoir, including the part leading directly to the turbine inlet. The bottom surface, on top of which coarse fractions are transported, has now been lifted nearly to the level of the turbine intake. In effect, functionally, the part of the reservoir closest to the dam has changed from a zone of accumulation to a transit zone,
– inundating those areas close to the reservoirs (fragments of the floodplain).

For several decades there have been no works that have interfered with the river channel (except short stretches at the dams and weirs, in settlements and by bridges; e.g. the re-commissioning of the weir at Kępka, the filling of washouts at Kępice in 1977, the cleaning of banks such as at Korzybie in 2002), and as a consequence of this the bed of the Wieprza is returning to its original character. Adaptation processes manifest themselves in various ways, including relatively strong lateral erosion (the rate of side displacement of concave banks of meanders in the years 1838-1938 was locally 4 m/year) and by the gradual lifting of the bottom, especially on the stretch between Korzybie and Sławno. However, it should be noted that there are only a few stretches with intense bank erosion and their length is small, except the stretches below the hydropower plants at Biesowice, Kępka and Kępice. At the same time, the banks are gradually becoming overgrown and the river channel is becoming increasingly blocked by fallen trees.

Taking into account that the stretch between Biesowice and Korzybie is within the Protected Landscape Park "Lake Łętowskie and Kępice Area", and that along its whole length the Wieprza valley fulfils the function of an ecological corridor, and also because there are plans to create a Landscape Park, "the Wieprza and Studnica Valley", the present state can be considered to be both advantageous and desirable.

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