DOI: 10.2478/jwld-2014-0023

JOURNAL OF WATER AND LAND DEVELOPMENT
J. Water Land Dev. 2014, No. 22 (VII–IX): 61–66
PL ISSN 1429–7426
Available (PDF): www.itp.edu.pl/wydawnictwo; http://www.degruyter.com/view/j/jwld

Received 29.01.2014
Reviewed 17.03.2014
Accepted 17.03.2014

A – study design
B – data collection
C – statistical analysis
D – data interpretation
E – manuscript preparation
F – literature search

The functioning of drainage canal near barrage "Brzeg Dolny" on the Odra River in 1971–2009

Beata OLSZEWSKA [ABCDEF], Leszek PŁYWACZYK [ABDEF], Wojciech ŁYCZKO [ABDE]

Wrocław University of Environmental and Life Sciences, Institute of Environmental Protection and Development, pl. Grunwaldzki 24, 50-363 Wrocław, Poland; tel. +48 71 320-55-96, e-mail: beata.olszewska@up.wroc.pl, wojciech.lyczko@up.wroc.pl

For citation: Olszewska B., Pływaczyk L., Łyczko W. 2014. The functioning of drainage canal near barrage "Brzeg Dolny" on the Odra River in 1971–2009. Journal of Water and Land Development. No. 22 p. 61–66.

Abstract

The paper analyses the amount of water flowing into the drainage canal in comparison to the levels of the Odra waters in the Brzeg Dolny – Wały cross section (upper water in the barrage). The results of the measurement of the flow intensity in the canal in 1971–2009 provided the basis for the evaluation.

The analysis led to the conclusion that with the same ordinate of damming in the barrage the average yearly flow in the canal in the Warzyna section decreased from 196 $m^3 \cdot s^{-1}$ to about 80 $dm^3 \cdot s^{-1}$ as the Odra's riverbed and the area between the embankments became tighter. The flow into the canal changes in time and depends on the difference between water levels in the Odra and in the canal. The paper presents the dynamics of changes in the water flow into the canal in relation to 1 m of difference between the level of water in the Odra and the drainage canal. It was shown that in a similar location, ground and water conditions as well as similar damming levels, the value of the drained water can be estimated to be about 35–40 $dm^3 \cdot s^{-1} \cdot km^{-1}$ for 1 meter of difference of the water level in the river and the canal.

Key words: *barrage, damming, drainage canal, percolating water, water flow*

INTRODUCTION

The building of the barrage in Brzeg Dolny in 1958 changed the Odra's character in relation to the adjoining areas, above the barrage the Odra became the infiltrating river [PŁYWACZYK 1988; 1997; SZYMAŃSKI, PŁYWACZYK 1988]. After the barrage was build, shallow draining ditches were dug, yet part of the area was still flooded and hence could not be used for agricultural purposes. Between 1958 and 1960 the Jeziorka River was regulated so as to drain the areas threatened with flooding. The water level in the Jeziorka decreased by about 1 meter, yet during summer the riverbed was overgrown by plants and the draining system didn't function properly [OLSZEWSKA 1988; PŁYWACZYK 1988]. In 1967 deep drainage canal was dug along the side dike of the reservoir. The paper presents the results of amount of water flowing into the drainage canal in the Warzyna section in relation to the level of water in the Odra River in upper water section in the Brzeg Dolny barrage.

Recognition of factors affecting the development of water relation forming in the river valley, in conditions of damming and free-flowing river, is essentials in designing, execution and exploitation of land-improvement systems [CHALFEN *et al*. 2005; 2010].

STUDY AREA

The barrage "Brzeg Dolny" is located on 281.77 km of the Odra River, about 21 km below the barrage "Rędzin" and about 3 km up the river from the town

Brzeg Dolny itself. According to regulations from the Minister for Environmental Protection, Natural Resources and Forestry Regulation of December 20, 1996 on technical conditions to which water management buildings and their location should adhere (OJL 2007, item 86, point 579), the main buildings of barrage "Brzeg Dolny" should be classified as hydrotechnical buildings of 2nd class of importance. The barrage closes the basin of the area of 263 811 km^2. It is controlled in the section Brzeg Dolny, situated about 500 m below the weir. The particular appliances of the barrage have the following discharge capacity [MOKWA 2002]:

- water power plant: 4 x 60 = 240 m$^3\cdot$s^{-1};
- fish ladder: 4.30 m$^3\cdot$s^{-1};
- canal lock during locking: 21.66 m$^3\cdot$s^{-1};
- weir when water is flowing above the gates and damming elevation up to 108,00 m a.s.l. (normal water level): 330 m$^3\cdot$s^{-1};
- weir when the water is flowing under the gate valves and damming elevation up to 108.00 m a.s.l. (normal water level) when the valve is raised to: 1.5 m – 710 m$^3\cdot$s^{-1}; 2.0 m – 865 m$^3\cdot$s^{-1}; 3.0 m – 1120 m$^3\cdot$s^{-1}; 4.0 m – 1300 m$^3\cdot$s^{-1}; 5.0 m – 1420 m$^3\cdot$s^{-1} (all spans in operation).

After building the barrage in Brzeg Dolny the Regional Board of Water Management in Wrocław established the elevation on the weir on 107.00 m a.s.l. In 1980 this elevation was raised to 108.00 m a.s.l. Between 1995–1996 Regional Board of Water Management in Wrocław decided to lower the elevation to 107,50 m a.s.l. and such value is valid until today [AR Wroc. 1971–2012]. The measurements of water levels in the Odra above the barrage are conducted in upper part of the barrage.

The damming by the barrage Brzeg Dolny by about 5.8 m changed the way in which the river affects the adjoining areas. Building of the barrage changed the Odra's character in relation to the adjoining areas – above the barrage it became infiltrating river, below the barrage Odra is still draining river [OLSZEWSKA *et al.* 2012].

The leakage from the water reservoir began to infiltrate into the left bank areas and the raising of groundwater table made it difficult to keep the existing way of using the area. The water and ground conditions in this part of the Odra valley foster the infiltration to adjoining areas. Under the shallow layer of alluvial soils, consisting of clays, there are easily permeable layers of sands, gravel and sand and gravel mix, constituting the water bearing layer. The infiltration coefficient is between $1.0\cdot10^{-3}$ to about $1.6\cdot10^{-1}$ cm$\cdot$s^{-1} [PŁYWACZYK 1988].

After the barrage "Brzeg Dolny" was built, when the level of water in the Odra was high enough, the water began to infiltrate the valley, the groundwater table rose and pressure conditions were created in part of the area. The flooding and swamping of the agricultural grounds were unacceptable, therefore the actions aiming at draining the area between the Odra and the Jeziorka were undertaken. The first attempt to protect the left-bank areas was the project from 1955–1959, which relied on strengthening the embankment from the water side and designing shallow banding ditches, which were supposed to catch the excess water. This solution proved to be ineffective [HAMADI 1989; LENCZEWSKI 1982].

The next attempt was regulating the Jeziorka stream, which was finished in 1960, and which was supposed to catch the percolating waters. The riverbed was broadened and deepened. After this, the level of water in the Jeziorka decreased by about 1 m. Yet the improvement was only temporary, because during the vegetation period the riverbed was overgrown by the water plants and the attempts to control it were ineffective in the long run. Later there were many ideas of how to channel the percolating waters, but they were not accepted for various reasons such as difficulties in introducing them, high costs and little effectiveness. The project of channeling the percolating waters by gravity below the barrage in Brzeg Dolny using deep drainage canal was the first one which seemed to offer the possibility of success. In 1967 the drainage canal of the following parameters was put into operation:

- length: 5.5 km,
- average depth: 2.2 m,
- the bottom width: 0.5–2.5 m,
- elongated slope: 0.4‰,
- average distance from left bank embankments: 80 m.

Reference sketch of the construction is presented in Figure 1.

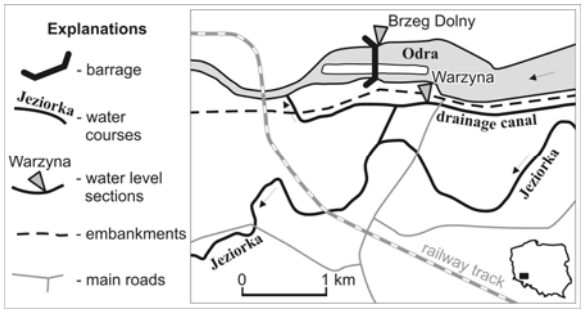

Fig. 1. Scheme of researched object; source: own elaboration

The researches conducted directly after digging the canal showed that the water flow into it depends mostly on the hydrogeological conditions, the elevation of water in the Odra and technical parameters of this canal [NAWALANY, PŁYWACZYK 1988a, b; PŁYWACZYK 1997; PŁYWACZYK *et al.* 1992].

MATERIAL AND METHODS

The aim of this paper is to analyze the amount of water flowing into the drainage canal in the Warzyna section in relation to the level of water in the Odra in upper water section in the Brzeg Dolny barrage. A number of periods were analyzed: 1971–1972

[SZYMAŃSKI, PŁYWACZYK 1988], 1981–1982 [SZYMAŃSKI, PŁYWACZYK 1988], 1987–1988 [HAMADI 1989], 1995–1996 [OLSZEWSKA 1998], 2003–2004 [OLSZEWSKA, PŁYWACZYK 2007] as well as the results of research conducted by the authors directly after the flood of 1997 (between 1998–1999) and 2007–2009. The observations and field measurements from 1971–2009 [AR Wroc. 1971–2009] provided the basis for the analysis. The paper is based on:

– daily observations of water level in the Odra in the Brzeg Dolny section – upper water in barrage,
– daily observations of water levels in drainage canal in the Warzyna section,
– regular (on average, twice a month) measurements of flow rate of water in the drainage canal in the Warzyna section and in the junction connecting the canal with the Jeziorka stream. The details concerning the junction of the drainage canal with the Jeziorka are shown in Figure 2.

The measurements and observations of everyday water levels provide the basis to draw the appropriate flow rate curves. Using the curves drawn for every year, as well as the water levels and the seasonal coefficient of level reduction (used because of plants overgrowing the canal) daily, average monthly and periodical flow rates were determined [AR Wroc. 1971–2009]. Since 2003 the flow rate measurements were conducted in the junction (situated about 400 m below the section in Warzyna) connecting the drainage canal with the ditch channeling water into the Jeziorka. When the water level in the Odra is high (and the reflexive valve in the embankment opening is closed) and with the appropriate steering of water gates in the junction, the water from the canal is channeled to the Jeziorka.

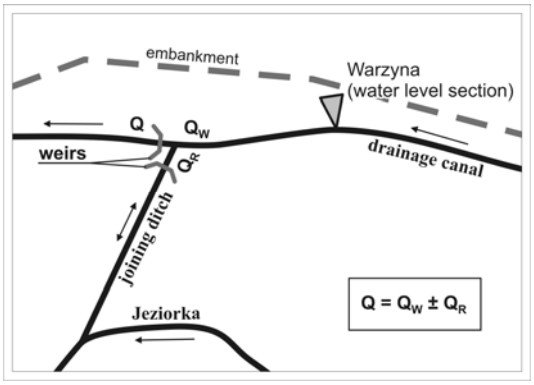

Fig. 2. Water junction – connection of drainage canal with the Jeziorka stream; source: own elaboration

The flow rate in drainage canal Q, depending of the direction of water flow in the ditch connecting drainage canal with the Jeziorka, was calculated according to the following formula: $Q = Q_W \pm Q_R$, where:

„+" – when the water is flowing to the Jeziorka,
„–" – the water from the Jeziorka flows into drainage canal,
Q_W – the flow rate in the canal in the junction,
Q_R – the flow rate in the ditch.

RESULTS AND DISCUSSION

Table 1 presents semiannual, annual and monthly average water levels in the Odra in upper water section in the barrage Brzeg Dolny in the analyzed periods, whereas Table 2 presents appropriate values of average monthly, semiannual and annual flow rates in drainage canal in the Warzyna section.

Table 1. Average monthly, semiannual and annual water levels (cm) in the Odra River on the barrage Brzeg Dolny – upper water on the barrage

Years	Months												Half-years, year		
	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X	XI–IV	V–X	XI–X
1971–1972	696	666	660	667	674	693	686	694	679	679	678	675	676	682	679
1981–1982	765	745	723	728	777	787	774	773	774	770	776	765	754	772	763
1986–1988	771	772	732	734	734	770	756	754	754	768	771	760	752	761	756
1995–1996	718	717	731	737	738	741	733	716	705	719	720	709	730	717	724
1998–1999	715	722	739	743	670	715	691	687	721	697	710	705	717	702	710
2003–2004	733	741	759	744	714	730	735	723	716	735	733	735	737	730	733
2007–2009	723	724	728	711	706	718	724	720	690	713	716	726	718	715	717

Source: own study.

Table 2. Average monthly, semiannual, annual values of the flow rates ($dm^3 \cdot s^{-1}$) in the drainage canal in the Warzyna section

Years	Months												Half-years, year		
	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X	XI–IV	V–X	XI–X
1971–1972	205	184	177	183	191	210	203	211	195	197	193	201	192	200	196
1981–1982	324	332	188	157	245	240	248	247	359	344	306	329	248	306	277
1986–1988	208	218	190	190	178	214	195	227	179	188	171	172	200	189	194
1995–1996	152	123	95	92	127	171	173	171	120	152	166	182	127	161	144
1998–1999	193	194	197	189	224	158	165	157	120	98	125	120	193	131	162
2003–2004	94	98	108	97	80	73	61	70	52	60	57	93	92	66	79
2007–2009	63	55	93	108	90	98	74	77	90	91	69	56	85	76	80

Source: own study.

The water levels in upper part of barrage in Brzeg Dolny during the analyzed periods varied, which was the effect of both different flow rates in the Odra, and also exploitation conditions of the barrage resulting from different elevation in subsequent periods. Average monthly elevation in upper water in the Odra between 1971–1972 (while elevation was established at 107.00 m a.s.l.) assumed values between 660–696 cm. After raising the elevation to 108 m a.s.l. in 1980 the average monthly water level in the Odra amounted to 723–772 cm between 1981–1982, and to 732–772 cm in 1986–1988. During next analyzed periods (after establishing the elevation at 107.50 m a.s.l.), the respective levels of upper water amounted to 705–741 cm between 1995–1996, 670–743 cm between 1998–1999, 714–759 cm between 2003–2004 and 690–728 cm between 2007–2009.

The flow of percolating waters from the reservoir into the drainage canal during the whole year is steady and depends mainly on the water levels in the Odra. After putting the canal into operation (1971–1972) the average monthly flow rates amounted to 177 to 211 $m^3 \cdot s^{-1}$, average annual flow rate was 196 $m^3 \cdot s^{-1}$. Until the flood in June 1997 the decreasing of percolating waters flow into the canal was observed. Between 1995–1997 the average monthly flow rates were between 92 to 182 $m^3 \cdot s^{-1}$. After the flood in 1997 in subsequent months of 1998 and between November 1998 and April 1999 the average monthly flow rates observed were higher, 142–231 $dm^3 \cdot s^{-1}$ and 142–276 $dm^3 \cdot s^{-1}$ respectively. The average yearly flow rate in 1998 amounted to 173 $dm^3 \cdot s^{-1}$ [OLSZEWSKA 1998; PŁYWACZYK 1997].

The average monthly flow rates in the canal in the Warzyna section between 2003–2004 fluctuated from 52 to 108 $dm^3 \cdot s^{-1}$, average annual flow rate was 71 $dm^3 \cdot s^{-1}$, and in the next analyzed period (2007–2009) it reached values ranging from 55 to 108 $dm^3 \cdot s^{-1}$.

Figure 3 presents the decreasing flow into the canal for different elevation levels in the barrage Brzeg Dolny. As the water level in the Odra is rising, the water flow into the drainage canal is rising too, however due to the process of the Odra's riverbed and the area between embankments becoming more impermeable it is observed that the percolation values are decreasing in subsequent periods at the same elevation in the weir.

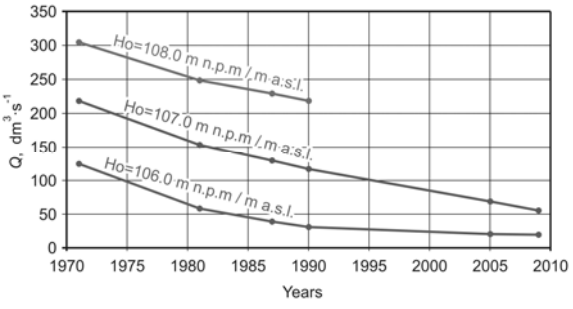

Fig. 3. Flow rate Q in the drainage canal in the Warzyna section with the different water levels H_O in the Odra in the Brzeg Dolny section; source: own elaboration

The data concerning daily flow rates in the drainage canal Q_K and water levels in the Odra in the Brzeg Dolny H_O section allowed to determine the relationship between those values.

Table 3 presents the collation of equations of relationship between the flow in the drainage canal and the water level in the Odra in the upper water section in the barrage. The critical value of correlation coefficient with the assumed significance level $\alpha = 0.01$ equaled 0.56. Figure 4 presents the determined linear correlation between flow rate in the drainage canal in the Warzyna section and upper water level in the Odra in the Brzeg Dolny barrage within the analyzed period between 1971 and 2009.

Table 3. Equations showing relationship between flow rate Q in the drainage canal in the Warzyna section and upper water levels H_O in the Odra in the Brzeg Dolny barrage

Years	Equation	Correlation coefficient	Number of samples
1971–1972	$Q = 92.800H_O - 9716$ $H_O \in (106.10 \div 108.00)$	0.99	4
1981–1982	$Q = 94.390H_O - 9948$ $H_O \in (106.18 \div 108.00)$	0.97	16
1987–1988	$Q = 94.270H_O - 9944$ $H_O \in (106.45 \div 108.00)$	0.89	44
1995–1996	$Q = 98.040H_O - 10370$ $H_O \in (106.50 \div 107.50)$	0.92	23
1998–1999	$Q = 72.544H_O - 7625$ $H_O \in (107.00 \div 107.60)$	0.70	16
2003–2004	$Q = 62.110H_O - 6590$ $H_O \in (106.50 \div 107.50)$	0.77	18
2007–2009	$Q = 48.926H_O - 5160$ $H_O \in (106.40 \div 107.50)$	0.81	20

Source: own study.

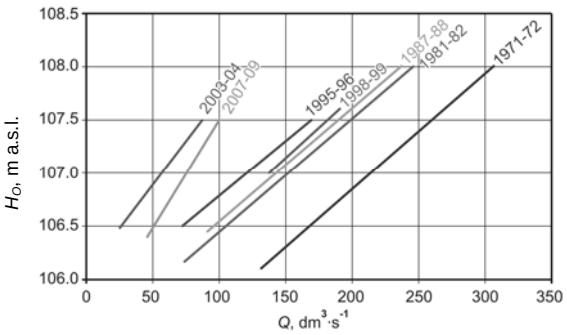

Fig. 4. Relationship between flow rate Q in the drainage canal in the Warzyna section and water elevation H_O in the Odra in upper water section in the Brzeg Dolny barrage between 1971–2009; source: own elaboration

During summer the drainage canal becomes overgrown with hydrophilic plants and is cleaned only sporadically. Therefore the values of percolation into the canal were presented in relation to the difference of dammed water elevation in the Odra H_O and water elevation in the canal H_K [OLSZEWSKA 1998; OLSZEWSKA, PŁYWACZYK 2010]. These values Q_P

were determined per 1 m of difference in water levels in the Odra and the canal ($H_O - H_K$). The results are presented in Table 4.

Table 4. Percolation of water Q_P to the drainage canal estimated per 1.0 m difference of water level in the Odra H_O and the canal H_K in the analyzed periods

Years	Q $dm^3 \cdot s^{-1}$	$H_O - H_K$ m	Q_P $dm^3 \cdot s^{-1} \cdot km^{-1}$
1971–1972	196	3.02	37
1981–1982	277	3.84	36
1987–1988	194	3.75	30
1995–1996	144	3.38	24
1998–1999	162	3.32	28
2003–2004	79	3.21	12
2007–2009	80	3.12	18

Source: own study.

The value of infiltration in the Odra valley direction in the initial years of canal exploitation (1971–1982) equaled between 36–37 $dm^3 \cdot s^{-1} \cdot km^{-1}$, after 10 years 1995–1999) between 24–30 $dm^3 \cdot s^{-1} \cdot km^{-1}$ and after 30 years of barrage exploitation (2003–2009) between 12–18 $dm^3 \cdot s^{-1} \cdot km^{-1}$.

CONCLUSIONS

1. The valley areas adjoining the damming, near the barrages on water routes should be equipped with appropriate draining systems in order to preserve proper water relationships for the given area usage.

2. The analysis of flow rates in the drainage canal in the areas adjoining to the Brzeg Dolny barrage and functioning within pressure conditions between 1971–2009 showed that the flow rate in the canal depends on the difference between water elevation in dammed river and draining device and it decreases with time as a result of water bearing system becoming more impermeable.

3. Direct, lasting over 35 years, measurement of flow rates show that in the similar water and ground conditions as well as similar location and differences between dammed water level and water level in the canal, the percolating waters flow rate between 35–40 $dm^3 \cdot s^{-1} \cdot km^{-1}$ per 1 m difference in water level in the Odra and in the canal. These values can be used as the basis for calculating the dimensions for basic draining devices.

REFERENCES

AR Wroc. 1971–2012. Wpływ projektowanego spiętrzenia Odry stopniem Malczyce na stosunki wodne terenów przyległych [Studies on the effect of damming the Odra River by Malczyce barrage on water relations in adjacent areas]. Manuscript. Wrocław.

HAMADI M. 1989. Wpływ spiętrzenia Odry w Brzegu Dolnym i wykonanych urządzeń odwadniających na stosunki wodno-melioracyjne terenów przyległych [The effect of damming the Odra River by barrage in Brzeg Dolny and drainage devices on water relations in adjacent areas]. AR Wrocław. Manuscript. pp. 86.

CHALFEN M., KOWALSKI J., MOLSKI T. 2005. Skuteczność rozwiązań technicznych chroniących tereny przyległe do stopni wodnych na przykładzie rejonu Malczyc [The efficiency of technical facilities protecting areas adjacent to dams exemplified by Malczyce region]. Woda-Środowisko-Obszary Wiejskie. T. 5. Z. 1(13) p. 41–56.

CHALFEN M., KOWALSKI J., MOLSKI T. 2010. Wpływ spiętrzenia Odry stopniem Brzeg Dolny na przyległe prawobrzeżne tereny w rejonie Rakowa [The effect of damming the Odra River by barrage in Brzeg Dolny on adjacent right bank areas near Raków]. Woda-Środowisko-Obszary Wiejskie. T. 10. Z. 3(31) p. 59–69.

LENCZEWSKI W. 1982. Filtracja ze spiętrzonych rzek na tereny przyległe [Filtration from dammed rivers on the adjacent areas]. Wiadomości Melioracyjne i Łąkarskie. Nr 2 p. 55–57.

MOKWA M. 2002. Sterowanie procesami fluwialnymi w korytach rzek przekształconych antropogenicznie [Fluvial processes control in anthropogenically modified river beds]. Zeszyty Naukowe AR Wrocław. Nr 439. Rozprawy 189. ISSN 0867-7964 pp. 135.

NAWALANY M., PŁYWACZYK L. 1988a. Computer aided analysis of a combined drainage system. Part I. Transient states of the natural system. Archiwum Hydrotechniki. T. 30. Z. 3–4 p. 375–391.

NAWALANY M., PŁYWACZYK L. 1988b. Computer aided analysis of a combined drainage system. Part II. Steady state analysis of the designed system. Archiwum Hydrotechniki. T. 35. Z. 3–4 p. 393–404.

OLSZEWSKA B. 1998. Wpływ budowli piętrzącej na warunki wodne oraz wybrane elementy środowiska przyrodniczego w dolinie na przykładzie Odry w rejonie Brzegu Dolnego [The influence of damming by barrage on water conditions and selected element of natural environment in the valley – case study of Brzeg Dolny on the Odra River]. Zeszyty Naukowe AR Wrocław. Inżynieria Środowiska. 10. Nr 349 p. 107–132.

OLSZEWSKA B., PŁYWACZYK L. 2007. Kształtowanie się przepływów w kanale odwadniającym w rejonie stopnia wodnego w Brzegu Dolnym w latach 1971–2004 [Forming of flow intensity in the drainage canal in the region of the Brzeg Dolny barrage in 197–2004]. Acta Scientiarium Polonorum. Ser. Architektura. Nr 6(2) p. 3–11.

OLSZEWSKA B., PŁYWACZYK L. 2010. Wpływ stanów wody w Odrze w przekroju Brzeg Dolny na natężenie przepływu w kanale odwadniającym [The influence of the water levels in the Odra River in the Brzeg Dolny section on flow intensity in the drainage canal]. Zeszyty Problemowe Postępów Nauk Rolniczych. Z. 548. Cz. II p. 403–408.

OLSZEWSKA B., PŁYWACZYK L., ŁYCZKO W. 2012. Oddziaływanie spiętrzenia Odry stopniem wodnym w Brzegu Dolnym na przepływy w cieku Jeziorka w latach 1971–2010 [The impact of damming the Odra River in Brzeg Dolny on flows in the Jeziorka stream in the years 1971–2010]. Woda-Środowisko-Obszary Wiejskie. T. 12. Z. 3 (39) p. 161–170.

PŁYWACZYK L. 1988. Oddziaływanie Odry na stosunki wodnomelioracyjne doliny w rejonie Brzeg Dolny – Malczyce [The influence of the Odra River on water-improvement relations in the river valley in the region Brzeg Dolny – Malczyce]. Zeszyty Naukowe AR Wrocław. Rozprawy Habilitacyjne. Nr 68. ISSN 0209-1321 pp. 74.

PŁYWACZYK L. 1997. Oddziaływanie spiętrzenia rzeki na dolinę na przykładzie Brzegu Dolnego [Impact of river impoundment on a valley on an example of Brzeg Dolny]. Zeszyty Naukowe AR Wrocław. Nr 311. Monografie 11. ISBN 83-85582-08-8 pp. 47.

PŁYWACZYK L., NAWALANY M., GĄSIOREK E. 1992. Matematyczne modelowanie zasilania kanału odwadniającego w warunkach przepływu naporowego [Mathematical modelling of the drainage canal recharge for the confined flow conditions]. Zeszyty Naukowe AR Wrocław. Nr 211 p. 207–225.

SZYMAŃSKI J., PŁYWACZYK L. 1988. Wpływ zmian stanów wody w Odrze na stosunki hydrologiczne zlewni potoku Jeziorka i Nowy Rów, położonych w dolinie tej rzeki [The influence of the changes of the water levels in the Odra River on hydrological conditions in the Jeziorka and Nowy Rów drainage areas, located in the river valley]. Roczniki Nauk Rolniczych. Ser. F. T. 81. Z. 3 p. 151–163.

Beata OLSZEWSKA, Leszek PŁYWACZYK, Wojciech ŁYCZKO

Funkcjonowanie kanału odwadniającego w rejonie stopnia wodnego na Odrze w Brzegu Dolnym w latach 1971–2009

STRESZCZENIE

Słowa kluczowe: *kanał odwadniający, piętrzenie, przepływ, stopień wodny, wody przesiąkowe*

W pracy dokonano analizy ilości wody dopływającej do kanału odwadniającego na tle stanów wody w Odrze w przekroju Brzeg Dolny – Wały (górna woda na stopniu). Podstawę oceny stanowiły prowadzone przez Instytut Kształtowania i Ochrony Środowiska Uniwersytetu Przyrodniczego we Wrocławiu bezpośrednie pomiary natężenia przepływu w kanale w przekroju Warzyna w okresie 1971–2009. Analiza wyników, na tle stanów wody w Odrze, wykazała, że z upływem czasu, w warunkach tej samej rzędnej piętrzenia na jazie, obserwuje się coraz mniejsze wartości natężenia przepływu w kanale. Jest to spowodowane procesami uszczelniania się koryta Odry i terenów międzywala. W latach 1971–2009 średnie roczne natężenie przepływu w kanale w przekroju Warzyna zmniejszyło się ze 196 $dm^3 \cdot s^{-1}$·do około 80 $dm^3 \cdot s^{-1}$. Badania wykazały, że ilość wody dopływającej do kanału jest zmienna w czasie i zależy od różnicy rzędnych zwierciadła wody w Odrze spiętrzonej i w kanale. W pracy przedstawiono dynamikę zmian dopływu wody do kanału w przeliczeniu na metr różnicy poziomów zwierciadła wody w Odrze i kanale odwadniającym. Na podstawie przeprowadzonych analiz wykazano, że w podobnych warunkach lokalizacyjnych, gruntowo-wodnych i zbliżonych wysokościach piętrzenia do określania parametrów podstawowych urządzeń odwadniających można przyjmować dopływ wód przesiąkowych około 35–40 $dm^3 \cdot s^{-1} \cdot km^{-1}$ na metr różnicy między poziomem wody w rzece spiętrzonej i kanale.