http://dx.doi.org/10.16926/zc.2016.42.10

Joanna KARLIKOWSKA, Igor JATULEWICZ, Cezary GĘBICKI
Akademia im. Jana Długosza w Częstochowie[1]

Management and planning of the river basins landscape with using water reservoirs in abandoned excavations

Introduction

The natural landscape is characterized by irregular shapes, so-called organic[2], and composed of line, point and area elements, which form a harmonious whole. Ores exploitation destroys this spatial order, but interposes some new elements[3]. The residues of the exploited resources are abandoned mines, quarries, clay pit ponds, gravel pits etc., which all comprise so-called anthropogenic habitats[4]. The concepts of using the objects like abandoned excavations are widely disccussed[2,5,6,7].

[1] Joanna Karlikowska, Igor Jatulewicz, Cezary Gębicki, Jan Długosz University in Czestochowa, Faculty of Mathematics and Natural Sciences, Institute of Chemistry, Environmental Protection and Biotechnology, al. Armii Krajowej 13/15, 42-200 Czestochowa; e-mail: j.karlikowska @ajd.czest.pl, i.jatulewicz@ajd.czest.pl, cgeb@ajd.czest.pl.

[2] Janeczko E., 2008, *Możliwości kształtowania krajobrazu leśnego w kontekście potrzeb i oczekiwań społeczeństwa.* Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej R. 10. Zeszyt 3 (19). 130–137.

[3] Nita J., 2010, *Kamieniołom w krajobrazie i geoturystyce.* Krajobraz a turystyka. Prace Komisji Krajobrazu Kulturowego Nr 14 Komisja Krajobrazu Kulturowego PTG, Sosnowiec, 221–229.

[4] Molenda T., 2013, *Problematyka ochrony środowisk antropogenicznych w Polsce*. JEcolHealth, vol. 17, nr 2, 76–70.

[5] Pietrzyk-Sokulska E., Kulczycka J., Cholewa M., Henclik A., Koneczna R., Lelek Ł., 2013, *Master Plan for post-mining water reservoirs "Górka" and "Balaton" – synthesis*. Sigma for Water. 57.

[6] Pietrzyk-Sokulska E., 2010, *Zbiorniki wodne w wyrobiskach pogórniczych – nowy element atrakcyjności krajobrazu miasta.* Krajobraz a Turystyka. Prace Komisji Krajobrazu Kulturowego Nr 14. Komisja Krajobrazu Kulturowego PTG, Sosnowiec, 264–272.

[7] Pietrzyk-Sokulska E. (red.), 2008, *Tereny pogórnicze szansą rozwoju obszarów ich występowania Studium na przykładzie Wyżyny Krakowsko-Częstochowskiej.* Wyd. Instytutu GSMiE PAN, Kraków. 190.

The Silesian Voivodeship serves as an example in this paper[3]. It is rich in natural resources, what is related to complicated geological background and multi-aged rocks occurence. Middle Jurrasic iron ore beds and rock resources like Upper Jurassic limestones are the most important in the northern part of the area (Częstochowa and Woźniki-Wieluńuplands)[8,9].

Some of the abandoned excavations fulfills with rain- and groundwater after the cease of mining. The examples of using these types of excavations for tourism are commonly known[3]. Moreover, water reservoirs can have recreational, agricultural[10] and retention functions in a land surface water deficit[11].

The existence of reservoirs in abandoned excavations can be used for improving the water basin balance. Application of the sump (a space where water is allowed to collect at the bottom of a shaft or quarry) can be an example here. Additionally, water reservoirs can be also a relatively cheap way of the restoration and management of the excavation extant after the cease of exploitation of mineral and rock resources[5].

Management and planning of the river basin landscape should be conducted with regard to natural and anthropogenic forms as well. Both approaches follow a legal citation, which exists in the Polish low of **nature conservation**[12] **and concerns the landscape protection necessity (…*to preserve the characters of a particular landscape*…).**

Additional aspects of the management and planning of the river basin landscape are its attractiveness and esthetic values, both the most threatened[13]. The criteria of the landscape attractiveness proposed by Janeczko[1] and Sklenička&Kašparová[12] are adopted in this work.

Experimental procedures

A case study is based on the water reservoirs, which fulfill the following requirements: 1) are located in the depressions formed as a result of mineral and

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[8] Molenda T., 2005, *Górnicze środowiska antropogeniczne - obiekty obserwacji procesów geomorfologiczno-biologicznych (na przykładzie województwa śląskiego)*. Prace Naukowe Instytutu Górnictwa Nr 111 Politechniki Wrocławskiej. Konferencje Nr 43, 177–196.

[9] Szuflicki M., Malon A., Tymiński M. [red.], 2013, *Bilans zasobów złóż kopalin w Polsce według stanu na 31.12.2012 r.,* Państwowy Instytut Geologiczny – Państwowy Instytut Badawczy, Warszawa.

[10] Pierzgalski K., Gębicki C., Cabała S., Zygmunt J., 2009, *Ekosystemy wodne Częstochowy*. Rękopis. 149.

[11] Śliwińska-Wyrzychowska A. red., 2013, *Kopalnia przywrócona naturze*. *Przewodnik po przyrodniczej ścieżce dydaktyczno-edukacyjnej na obszarze nieczynnej kopalni odkrywkowej „Lipówka" w Rudnikach koło Częstochowy*. Agencja Wydawnicza "ARGI" s.c., Wrocław. 112.

[12] Dz. U. 92 nr 770 z 2004 r. *Ustawa o ochronie przyrody z 17 maja 2004*, Dz. U. Nr 130, poz. 1379.

[13] Sklenička P., Kašparová I., 2007, *Restoration of visual values in a post-mining landscape*. Journal of Landscape Studies 1. 1–10.

rock resources exploitation, where water exists constantly and, 2) are located within the Warta River basin of the Częstochowa and Woźniki-Wieluń uplands.

The water reservoirs were catalogued in a few steps:

1) collecting of the available data on the past exploitation in the discussed area; the data were verified according to the current *'The balance of mineral resources deposits in Poland*[8] *to eliminate still operating mines;*
2) cataloguing of water reservoirs based on topographic maps in scale 1:25 000 and 1:10 000, as well orthophotomaps[14]; other authors use [for example[15]] soil-agricultural maps in scale 1:5 000,
3) estimating of the effectiveness of the water reservoirs in small water retention and a range of the technical operations based on a field validation and preparation of the photographical documentation.

Two examples with a potential importance for the retention improvement in the part of the Warta River basin of the Częstochowa and Woźniki-Wieluń uplands are presented in this work.

Results

History of the mineral and rock resources exploitation

The exploitation of the silt, iron ores and Upper Jurassic limestones within the area of the Częstochowa and Woźniki-Wieluń Uplands has a long history. Silt deposits were used in numerous brick factories. For example, in Częstochowa city, several big existed a long time (Paweł, Michalina, Anna) and many smaller operated only temporary.

Medieval Jurassic castles, so-called '*Eagles Nest'* were built using local material, such as Upper Jurassic limestone. Cement factories, which production was also based on limestone, started to work in XIX century. The highest number of quarries can be found in the suuroundings of Działoszyn (Woźniki-Wieluń upland) and south-west of Wieluń (14 abandoned).

Sedimentary iron beds resources are not included into *'The balance of mineral resources deposits in Poland'*[8]*. There are 3 limestones quarries providing material for lime industry and 9 silt deposits ores connected with bricks production.*

Water reservoirs cataloguing in the abandoned excavations

The Middle Jurassic silts exploitation caused formation of the most numerous objects. Totally, 160 reservoirs (table 1) exist in the discussed area, but questionable cases were excluded from the list.

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[14] Galiński, Górnicki, Goc, 2005, *Projekt Programu małej retencji dla województwa śląskiego*. Śląski Zarząd Melioracji i Urządzeń Wodnych w Katowicach. 110.

[15] geoportal.gov.pl

Water rarely occurs in limestone quarries. During a field validation, constant water reservoirs were present in 3 excavations in the Woźniki-Wieluń upland: Wysoka near Łazy, Rudniki near Częstochowa and a small pond in Częstochowa-Aniołów.

Table 1. Results of the water reservoirs cataloguing

Mesoregion	Number of water reservoirs	Exploited rock
Częstochowa upland	3	limestone
	77	iron ore, silt
	5	other (sand, gravel, peat)
Woźniki-Wieluń upland	4	limestone
	66	iron ore, silt
	7	other (sand, gravel, peat)
sum	**162**	

As a result of the presence of the rock resources ores different than limestones, small reservoirs also occur in abandoned excavations. These are usually sand, gravel and peat pits and in such cases it is very difficult to estimate the origin of the reservoirs. For example, fire ponds can exist in depressions caused by the exploitation above-mentioned resources. However, opposite situation is also possible when sand or gravel is intentionally removed to form a such pond. These cases were not included into the list and 12 reservoirs of the mentioned origin were found during the field work.

Water reservoirs potentially important for retention conditions improvement – examples

Because of a high number of the reservoirs related to iron and silt ores exploitation in the discussed area, the validation concerned only selected locations. Water reservoirs are mainly reported in the region of Częstochowa and Kłobuck. Collected photographic documentation allowed to choose only these objects, which can be involved into the small retention program with the use of simple technical operations. Limestones quarries are often characterized by the lack of constant water reservoirs, those with permanent water were observed only in 7 locations.

Detailed characteristics are provided only for two locations: Częstochowa-Lisiniec Park – 3 reservoirs and Lipówka quarry in Rudniki near Częstochowa – 3 reservoirs.

Reservoirs named Bałtyk, Adriatyk and Pacyfik are located in Lisiniec Park in Częstochowa (Fig. 1).

The character, which distinguishes them from other silt pits, is that the first two are recharged by a watercourse, which debouches to the canal connecting

both reservoirs[16]. Although the Pacyfik is an endorheic type, it is located about 10 meters north-west of Bałtyk and about 60 meters north-east of a nameless stream.

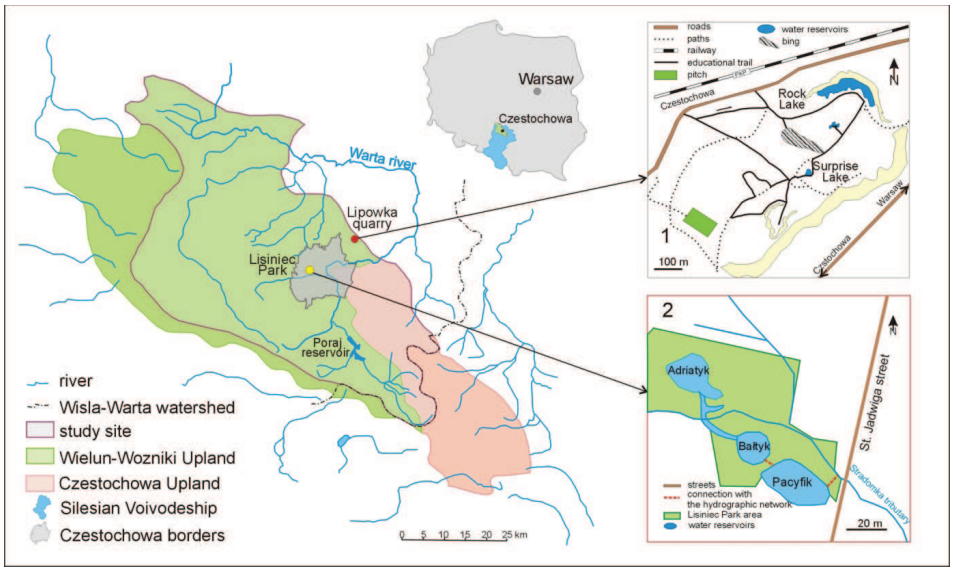

Fig. 1. Location of the discussed water reservoirs. 1 – Lipówka Quarry, 2 – Lisiniec Park in Częstochowa

An endorheic type of a reservoir can be found in a limestones quarry "Lipówka" in Rudniki near Częstochowa. Lack of contact with other watercourses within the Warta River basin is observed here and the river flows about 350 meters north of the quarry. All 3 reservoirs in this excavation are of different origin.

The occurence of water during rainless periods suggests partly groundwater and rainwater recharges. The smallest reservoir called "SurpriseLake" is a sump, established at the beginning of the "Lipówka" quarry exploitation. Its depth is about 3 meters, but water table fluctuation are about 1 meter.

The biggest reservoir called "Rocky Lake" possess the surface area of 1 ha and maximum depth about 3 meters[17]. It originated at the end of exploitation (70's of XX century) as the protection for bedded Upper Jurassic exposure. Educational advantages of the limestones "wall" were the main purposes of its preservation. The third reservoir "Fire-bellied toad Lake" appeared independently, after finishing of the exploitation in 1976.

[16] Pierzgalski K., Gębicki C., Cabała S., Zygmunt J., 2009, *Ekosystemy wodne Częstochowy*. Rękopis. 149.

[17] Śliwińska-Wyrzychowska A., Gębicki C., red., 2012, *Sprawozdanie z waloryzacji przyrodniczej nieczynnego wyrobiska odkrywkowej kopalni wapienia „Lipówka" w Rudnikach*. Rękopis.

The range of adaptive operations

Restoration directions were determined for retention conditions improvement within the Warta River basin of the Częstochowa and Woźniki-Wieluń Uplands. For the water reservoirs in Lisiniec Park, partial contact with a nameless watercourse is an important factor. Discussed reservoirs discharge part of the Lisiniec district in Częstochowa city. Technical operations should consider the connection of Pacyfik reservoir with two others. Additionally, the canal between Bałtyk and Adriatyk should be controlled systematically to avoid its blockage.

The significance of the reservoirs in "Lipówka" quarry for the management and planning of the river basins landscape is limited to the abandoned excavation area. However, not only their retention function in the area with the water deficit is significant, but also the landscape values are of great importance. Incorporation of these reservoirs into a hydrographic network is inappropriate because of the financial and environmental reasons. Advanced stage of the succession in the reservoirs can be observed, taking into account the composition of flora and fauna, and this classifies the example in a non-technical category of the water resources management and planning methods, so-called landscape (habitat) retention[18].

Discussion of results

Cataloguing of the water reservoirs within Częstochowa and Wieluń uplands showed that small reservoirs have diverse contact with the hydrographic network and are mainly represented by the endorheic and flow-through types. The most important for the small retention, mentioning financial and environmental reasons, are the reservoirs, which possess connection with watercourses (Bałtyk and Adriatyk in Lisiniec Park). The endorheic reservoirs can be adapted to emergency application during high water periods. Establishment of the connections between watercourses, in some cases, does not require expensive operations.

In the case of the uncontrolled retention, the endorheic reservoirs in abandoned quarries play a role of the storage sink in the periods of water surplus and keeping it in soil, ground or in the surface of the land for a longer time[11].

Conclusions

Post-mining landscape, as a type of a cultural landscape[19], forms so-called athropogenic habitat[3]. The following factors are connected with the formation of a new water reservoir in devastated and dried-out present-day environment:

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[18] Mioduszewski W., 1997, *Mała retencja i polityka melioracyjna*. [w:] *Użytkowanie a ochrona zasobów wód powierzchniowych w Polsce.* Zeszyty Naukowe Nr 17. Kom. Nauk. Człowiek i Środowisko, PAN, Warszawa.

[19] Nita J., Myga-Piątek U., 2006, *Krajobrazowe kierunki w zagospodarowaniu terenów pogórniczych*. Przegląd Geologiczny, 54, 256–262.

— raising of landscape values of a water basin,
— increasing of environmental values,
— emphasizing educational benefits,
— causing partial restoration of the retention capacity in the water basin.

Small water reservoirs in natural conditions rarely occur separately so the creation of many small rather than one large is more beneficial[20]. One of the planned item in the water restoration of the abandoned excavations is river basins landscape management and planning. In other cases, the occurrence of water in holes, depressions and excavations is unintentional and restoration is partially caused by natural succession. The usage of existing water reservoirs can reduce the costs of improvements of retention conditions in the water basin. The new values of the water reservoirs can lead to the protection of anthropogenic habitat under a form of nature reserve, documentary site or SSSI (Site of the Special Scientifically Interest), like in Great Britain[3].

The necessity of the landscape management and planning should be applied to water reservoirs in the abandoned excavations. Planned and organized actions beneficial to the space harmony[18] are discussed in Polish legislation[12]. Examples presented in this work show that anthropogenically transformed places can comprise valuable elements for water basin landscape, even without human activity.

The research was carried out with the financial support from the Department Zoology and Animal Ecology of the Jan Długosz University in Częstochowa.

References

Dz. U. 92 nr 770 z 2004 r. *Ustawa o ochronie przyrody z 17 maja 2004*, Dz. U. Nr 130, poz. 1379.

Galiński, Górnicki, Goc, 2005, *Projekt Programu małej retencji dla województwa śląskiego*. Śląski Zarząd Melioracji i Urządzeń Wodnych w Katowicach. 110.

Geoportal.gov.pl

Janeczko E., 2008, *Możliwości kształtowania krajobrazu leśnego w kontekście potrzeb i oczekiwań społeczeństwa.* Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej R. 10. Zeszyt 3 (19). 130–137.

Mioduszewski W.,1997, *Mała retencja i polityka melioracyjna*. [w:] *Użytkowanie a ochrona zasobów wód powierzchniowych w Polsce*. Zeszyty Naukowe Nr 17. Kom. Nauk. Człowiek i Środowisko, PAN, Warszawa.

Mioduszewski W., 2007, *Mała retencja w lasach elementem kształtowania i ochrony zasobów wodnych.* Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej R. 10. Zeszyt 2 (17). 33–47.

[20] Ożgo M., 2010, *Rola małych zbiorników wodnych w ochronie bioróżnorodności.* Parki Narodowe i Rezerwaty Przyrody 29 (3). 117–124.

Molenda T., 2005, *Górnicze środowiska antropogeniczne - obiekty obserwacji procesów geomorfologiczno-biologicznych (na przykładzie województwa śląskiego)*. Prace Naukowe Instytutu Górnictwa Nr 111 Politechniki Wrocławskiej. Konferencje Nr 43, 177–196.

Molenda T., 2013, *Problematyka ochrony środowisk antropogenicznych w Polsce*. JEcolHealth, vol. 17, nr 2, 76–70.

Nita J., 2010, *Kamieniołom w krajobrazie i geoturystyce.* Krajobraz a turystyka. Prace Komisji Krajobrazu Kulturowego Nr 14 Komisja Krajobrazu Kulturowego PTG, Sosnowiec, 221–229.

Nita J., Myga-Piątek U., 2006, *Krajobrazowe kierunki w zagospodarowaniu terenów pogórniczych*. Przegląd Geologiczny, 54, 256–262.

Ożgo M., 2010, *Rola małych zbiorników wodnych w ochronie bioróżnorodności.* Parki Narodowe i Rezerwaty Przyrody 29 (3). 117–124.

Pierzgalski K., Gębicki C., Cabała S., Zygmunt J., 2009, *Ekosystemy wodne Częstochowy.* Rękopis. 149.

Pietrzyk-Sokulska E. (red.),: 2008, *Tereny pogórnicze szansą rozwoju obszarów ich występowania Studium na przykładzie Wyżyny Krakowsko-Częstochowskiej.* Wyd. Instytutu GSMiE PAN, Kraków. 190.

Pietrzyk-Sokulska E., 2010, *Zbiorniki wodne w wyrobiskach pogórniczych – nowy element atrakcyjności krajobrazu miasta.* Krajobraz a Turystyka. Prace Komisji Krajobrazu Kulturowego Nr 14. Komisja Krajobrazu Kulturowego PTG, Sosnowiec, 264–272.

Pietrzyk-Sokulska E., Kulczycka J., Cholewa M., Henclik A., Koneczna R., Lelek Ł., 2013, *Master Plan for post-mining water reservoirs "Górka" and "Balaton" – synthesis*. Sigma for Water. 57.

Sklenička P. Kašparová I., 2007, *Restoration of visual values in a post-mining landscape*. Journal of LandscapeStudies 1. 1–10.

Szuflicki M., Malon A., Tymiński M. [red.], 2013, *Bilans zasobów złóż kopalin w Polsce według stanu na 31.12.2012 r.,* Państwowy Instytut Geologiczny - Państwowy Instytut Badawczy, Warszawa.

Śliwińska-Wyrzychowska A. red., 2013, *Kopalnia przywrócona naturze*. *Przewodnik po przyrodniczej ścieżce dydaktyczno-edukacyjnej na obszarze nieczynnej kopalni odkrywkowej ,,Lipówka" w Rudnikach koło Częstochowy*. Agencja Wydawnicza "ARGI" s.c., Wrocław. 112.

Śliwińska-Wyrzychowska A., Gębicki C., red., 2012, *Sprawozdanie z waloryzacji przyrodniczej nieczynnego wyrobiska odkrywkowej kopalni wapienia „Lipówka" w Rudnikach*. Rękopis.

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Summary

Water reservoirs can be a side-effect of the ore exploitation in the anthropogenically changed river basins. The new value of the quarry is revealed at the end of mining operation when it starts to exist in the harmony with the surroundings. The concept of the usage of the water reservoirs in the abandoned excavations for small water retention is presented in this work. Reservoirs located within the Warta River basin of the Częstochowa and Woźniki-Wielń Uplands originated as a result of multi-aged beds exploitation, i.e. iron ores from Middle Jurassic silts and Upper Jurassic limestones. Water reservoirs in the abandoned excavations canincrease attractiveness of the river basin landscape and improve water conditions.

Keywords: water reservoir, landscape attractiveness, post-mining area, abandoned quarry, Częstochowa upland, Woźniki-Wieluńupland.

Kształtowanie krajobrazu zlewni z wykorzystaniem zbiorników wodnych w nieczynnych wyrobiskach

Streszczenie

W zlewniach przekształcanych antropogenicznie jednym z elementów powstających jako skutek uboczny eksploatacji złóż mogą być zbiorniki wodne. Nowa wartość wyrobiska pojawia się od momentu, gdy przestaje być czynnym zakładem górniczym i zaczyna funkcjonować w harmonii z otaczającym krajobrazem. W pracy przedstawiono koncepcję wykorzystania zbiorników wodnych w powstałych nieczynnych wyrobiskach do celów małej retencji. Omówiono przykłady obiektów zlokalizowanych w obrębie Wyżyn Częstochowskiej i Wieluńskiej w granicach zlewni Warty, których powstanie spowodowała wielowiekowa eksploatacja rud żelaza ze środkowo jurajskich iłów oraz górno jurajskich wapieni. Istniejące w nieczynnych zbiorniki wodne mogą stanowić element podnoszący atrakcyjność krajobrazu zlewni.

Słowa kluczowe: zbiornik wodny, atrakcyjność krajobrazu, obszar poeksploatacyjny, nieczynny kamieniołom, Wyżyna Częstochowska, Wyżyna Woźnicko-Wieluńska.