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Ecological Flood Protection in the Oder Catchment Area, with Emphasis on the Model Region 'Lower Oder Valley'



The Oder – an ecologically important Border River

Action needed for nature-friendly Flood Protection

The Oder is one of the last near-natural and free-flowing rivers in Europe and the only large, central European river which flows over 500 km with no barrages from the river mouth. Surrounded by softwood alluvial forests, the river is an important habitat for migratory fish such as sturgeon (*Acipenser oxyrinchus*) and maraena (*Coregonus maraena*), and its oxbows and transitional biotopes also provide a habitat for priority protected species. At the Lower and Middle Oder is the "Lower Oder Valley Cross-Border Protected Area Complex" with the only German wetland National Park and the Polish Międzyodrze wetland, left to develop naturally for 70 years, as well as the Warta River-Mouth and Wolin National Parks, landscape parks and large-scale EU Natura 2000 sites.

With the signing of the bilateral waterway agreement in the German-Polish border area of April 27, 2015 and the associated Concept for Regulation (CfR), the flood discharge at the Border Oder will be optimized and stable traffic conditions will be ensured in future for 90 percent of the year below and at 80 percent above the Warta River confluence, at a mean depth of 1.80 m. This is particularly relevant for the German-Polish icebreaker fleet.

Closely related to the agreement and the Concept for Regulation is the Polish "Odra-Vistula Flood Management Project", which has been running at the World Bank since 2015 and is co-financed by the EU. There is intended modernization work for the restoration of the fairway at the Border Oder, measures planned at the Middle Oder from Malczyce to the mouth of the Nysa Łużycka/Lusatian Neisse River to upgrade the free-flowing river to waterway class III and to re-use the over 70 years largely untouched Międzyodrze wetland, the core zone of the Lower Oder Valley Cross-Border Protected Area Complex, under the pretense of flood protection. A resolution by the Polish Council of Ministers even calls for the development of the Oder River for shipping, to at least waterway class IV.

Together with many Polish environmental organizations which have formed the coalition "Save the Rivers" (Koalicja Ratujmy Rzeki), the German environmental and nature conservation organizations BUND, NABU, DUH, WWF, Heinz Sielmann Foundation and the Association of Friends of the German-Polish European Union National Park Lower Oder Valley under the umbrella of the German League for Nature and Environment (DNR) in a project funded by the German Environmental Foundation (DBU) support ecological flood protection on the Oder River.

The aim is both to optimize cross-border flood protection with the planned projects and to bring them into line with EU environmental legislation. In order to advance and ground the discussion on future Oder River flood protection in facts, the organizations involved have had two reports drawn up: (1) "Effectiveness of the Międzyodrze Polder and the Concept for Regulation for the Lower Oder"ⁱ and (2) "Delineation of key zones for water retention enhancement in the Polish part of the Oder catchment: Analysis of potential water retention in land reclamation systems and its possible role in mitigating winter low flows of Oder".ⁱⁱ

Report Critique of current Oder Flood Protection Concepts

The experts come to the following conclusions in their investigations:

1. The Concept for Regulation and the use of Międzyodrze wetland as a controlled flood polder makes a positive effect in terms of flood protection doubtful.
2. The holistic approaches required in a large river system are lacking, as seen in measures such as the improvement of water retention in the Oder catchment area, the use of alternative icebreakers and ice breaking methods, and sustainable sediment management and coastal development in the Baltic Sea.
3. The challenges posed by climate change and rising Baltic Sea water levels call for comprehensive and multinational Oder flood risk management. The problems, which are addressed by the Concept for Regulation and the upgrade of the Międzyodrze wetland to a controlled polder, make up only a small part. These partial problems are not reduced by the planned measures, let alone solved.

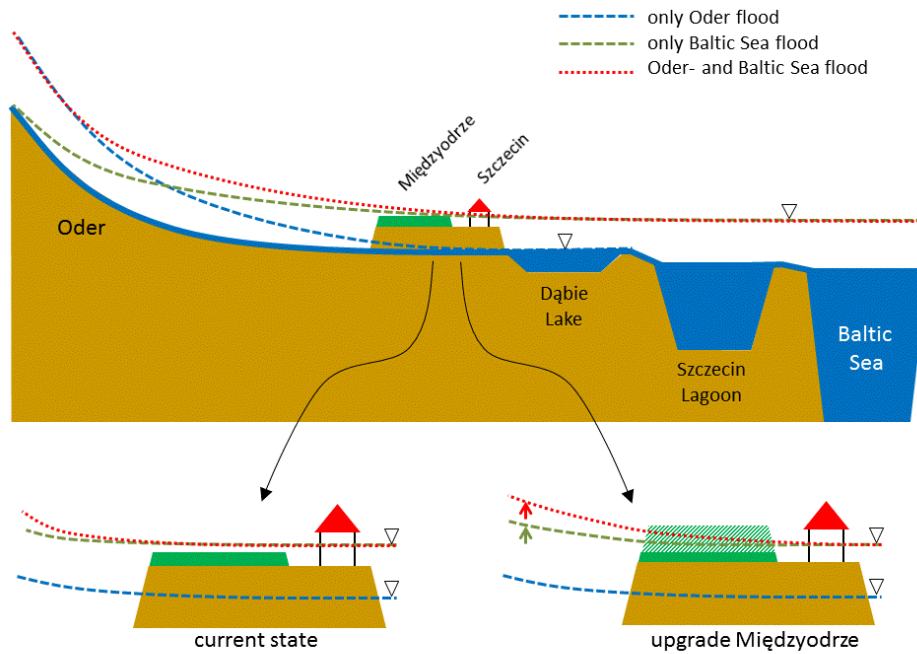
Assessment of the Flood Protection Concept by Means of an Upgrade to the Międzyodrze Wetland

The Międzyodrze wetland currently functions, that is, without further measures, as a natural retention area from Widuchowa until just before Szczecin. Floodwater flows here in a manner similar to an open retention polder (Fließpolder). Another strategy is being pursued with the planned development to the controlled flood polder. Namely the targeted capping of flood wave peaks in the Oder.ⁱⁱⁱ

In the "Odra-Vistula Flood Management Project", the total usable volume of the Międzyodrze polder at a depth of 1.0 m, is given as 1.0 billion m³. This information is grossly inaccurate and must be adjusted to reflect the correct values; 54.27 million m³ with a polder area of 54.27 km² and a computational mean depth of 1.0 m. The polder volume at 1.0 m depth corresponds to only 5.4 % of the value given by The World Bank.

The hydraulic conditions in the planned Międzyodrze polder are not only dependent on the outflow in the Oder, but also on the water level in the Dąbie Lake. This in turn is determined by the conditions in the Szczecin Lagoon and the Baltic Sea. Conversely, the influence of wind and surge hardly plays a role in the Dąbie Lake and the Oder. The proposed Międzyodrze polder is much too small to have any influence on water levels in the Dąbie Lake, which are determined by the Baltic Sea and Szczecin Lagoon.

The best point to fill the planned polder would be at the Widuchowa reference level. This would cut the peak of an upstream flood wave. At this point, the wave is already very long and has been considerably flattened out. Even an optimally controlled operation, utilizing the entire polder volume as a flood polder, would therefore only minimize the flood wave peak capping between Widuchowa and Szczecin by a few centimeters. At the same time, the currently increased state of the natural retention function of the Międzyodrze wetland would be lost during floods. Unlike the historical and agricultural polder, the planned flood polder for controlled filling would have to be equipped with higher, separating dikes which cannot be overflowed. The resulting backwater would increase the flood risk for inhabitants in the upper areas, reaching as far as Cedynia and the Oderbruch.

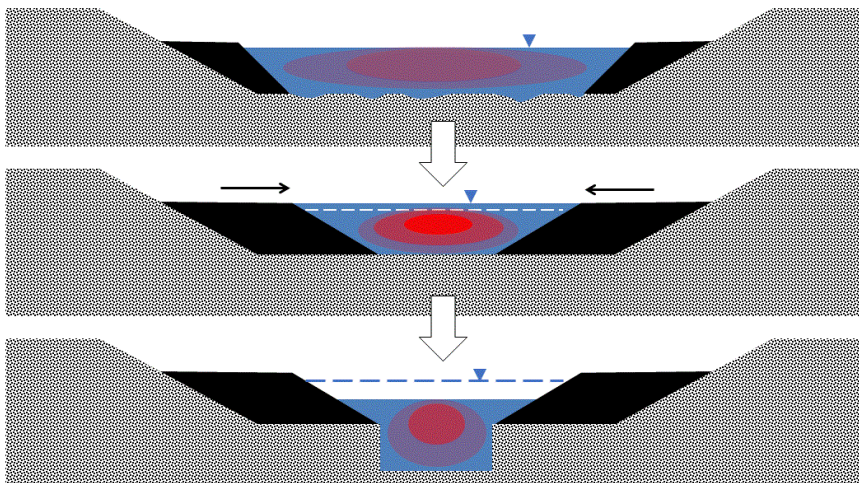


Oder Valley longitudinal section: current state and Międzyodrze polder upgrade

Even with ice floods, flood protection would deteriorate because of the rebuilding of separating dikes. These dikes cause an increase in ice loads, especially in the Eastern Oder and thus increase the risk of ice jams, at bridges as well as other points. In conclusion, the flood situation on the Lower Oder would worsen because of the flood polder upgrade and the necessary separating dikes.

Assessment of the Concept for Regulation

According to the thesis agreed upon between the German and Polish waterway administrations, a minimum water depth in the Oder is necessary to ensure the use of an icebreaker fleet. In the Concept for Regulation the icebreaker ship design is set for the Oder river engineering upgrade target. However, there are low water phases in Winter. During which, despite measures from the Concept for Regulation, a mean water depth of 1.80 m cannot be ensured.



Upgrade of groins with increasing flow velocity, deepening of the mean river bed position and decreasing of the water level

The model of the Federal Waterways Engineering and Research Institute (BAW) only calculates the temporal and spatial average of the river bed position. It cannot factor in dunes or dune heights. However, dune heights are relevant and not the mean river bed position for icebreaker operations. The current Concept for Regulation measures lead to an increase in the attack of currents flowing in certain sections. They also lead to an increase in mean water depth due to erosion. At the same time, the height of the dune may increase. However, this is not reflected in the Concept for Regulation. Thus, for inland navigation the effect of the Concept for Regulation measures would be nullified.

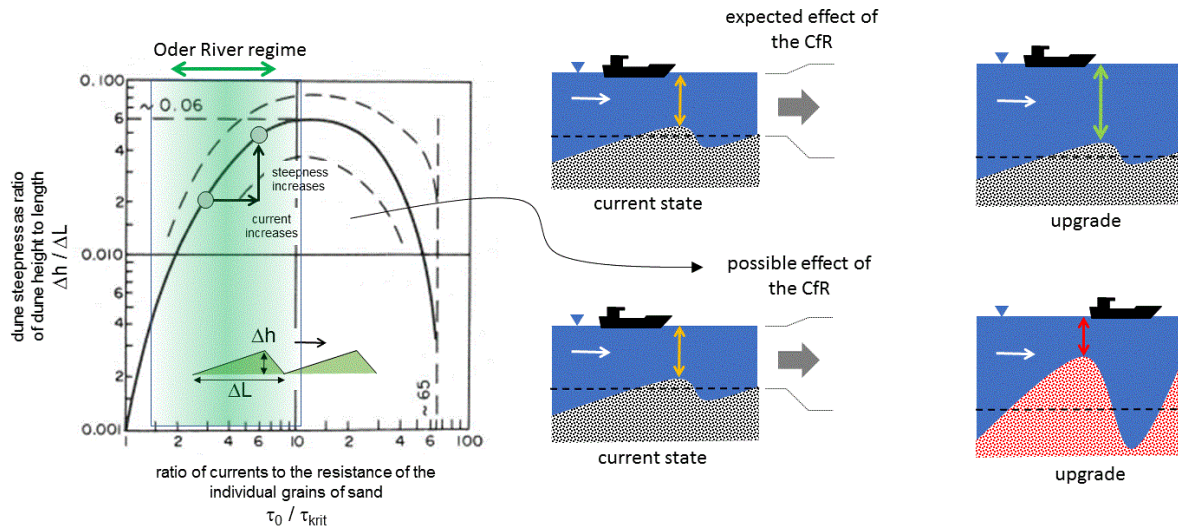
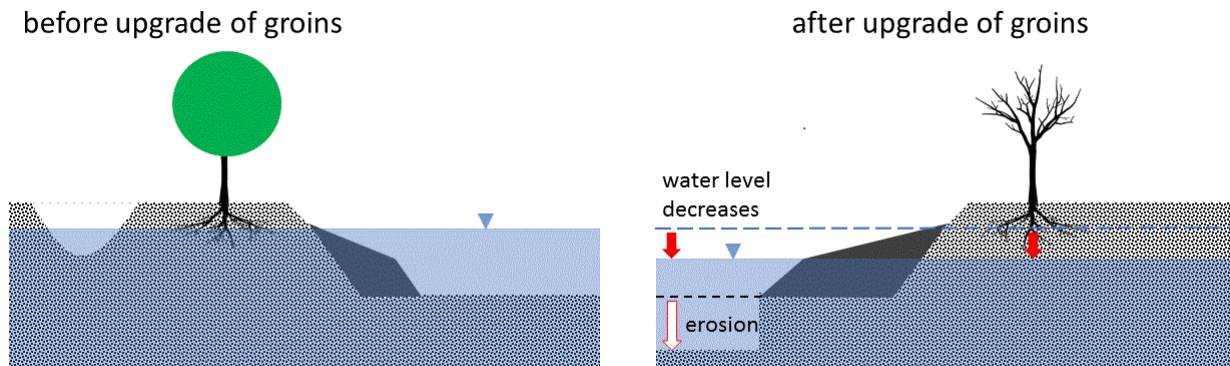


Illustration of the relationship between dune height and bed shear stress in two-dimensional dunes and possible effects on the Oder River after implementation of the Conception for Regulation.

There are so many uncertainties in the modeling that it causes doubts about the model concept and the databases of the BAW investigations. They are insufficient for a reliable decimeter range verification as well as a 40-year prognosis period.

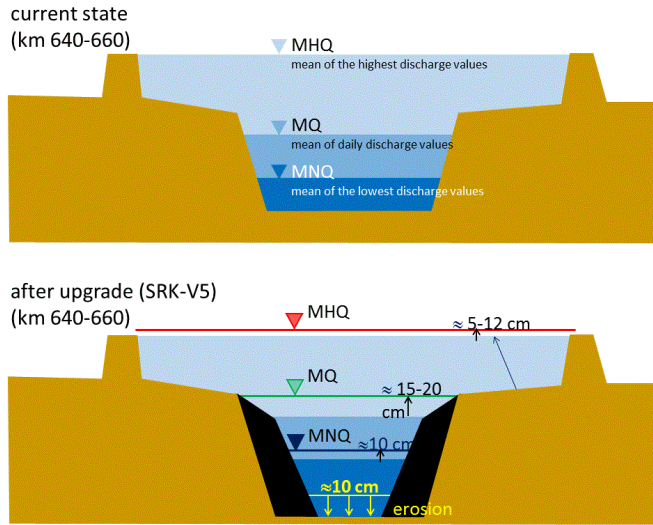
Experience from other major rivers teaches us that the water level will adapt to the eroded river bed position, after the upgrade of groins, in the long term. Because of this, there was also no gain in water depth. Floodplain habitats are particularly negatively affected by the sinking of mean water levels, in particular the low water level, and consequently the sinking of the groundwater level.



Influence of the groin upgrade on sole erosion, water levels in the river and in the groundwater

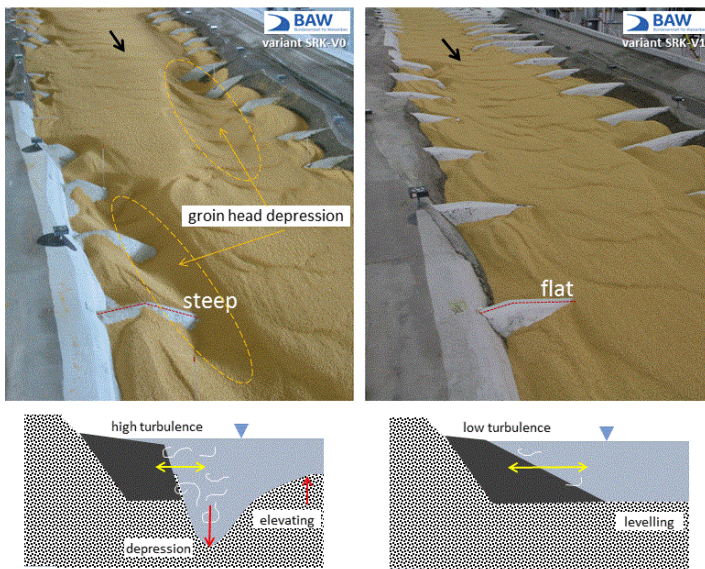
Feared long term impact: sinking of the water level especially at low water

In addition, the optimal groin upgrade variant selected in the Concept for Regulation causes an increase of 12 cm in the water level during high flood, in particular at river km 661. This is a danger spot due to the sharp river bend ("Krummer Ort") near Hohenwutzen. A dike breach and a flood of the Oderbruch were barely prevented in 1997.



Medium-term effect after 40 years according to Concept for Regulation: Rising of the water level even at flood – 12 cm at sharp river bend “Krummer Ort” near Hohenwutzen (km 661)

According to the EU Water Framework Directive (WFD), at least for Germany, the entire Border Oder is classified as a natural rather than a heavily modified water body. For this purpose, at least, a good ecological status must be achieved and maintained.



Influence of the groin shape on turbulence, sole structure and formation of local depressions. SRK-V1 is positive in the nautical sense (BAW), but leads to a loss of structural diversity compared to the current state (SRK-V0). This is ecologically negative.

The optimal variant SRK-V5 of the current Concept for Regulation is a modification of the basic variant SRK-V1 and causes the same destruction of the structural diversity

Recommendations and Alternatives

Alternatives to breaking Ice with Icebreakers

It is not proven that icebreakers encounter any problems at shallow depths. But should this be the case, alternative methods of ice breaking offer a way without necessitating an intervention in the Oder: There are effective alternatives for icebreakers, such as Amphibex excavators. These are used to break ice in Canadian rivers with low water. They can easily free themselves, should they become stuck. These excavators can work alone or in combination with conventional icebreakers. A disadvantage of the excavators, compared to conventional icebreakers, is lower ship speed. Therefore, a mobility concept combining the use of Amphibex excavators with conventional icebreakers is important. The use of satellite imagery and forecasts of the ice situation can contribute significantly to a targeted and effective operation. The ice-breaking from upriver Dąbie Lake to the Oder can thus continue as before. In places where icebreakers cannot get any further, Amphibex excavators can either break the ice on their own or clear the way for the icebreakers.



Ice breaking in North America with Amphibex excavator (Normrock Industries Inc.)

Handling and Problems regarding local Shallows

Commercial inland navigation and icebreaker use would be improved if the mean water depth could be increased to 1.80 m in shallow water conditions. For this reason, water retention possibilities based on nature-based solutions in the Polish Oder basin were analyzed. By damming drainage ditches down to the surface of the terrain, the amount of water in certain parts of the catchment area can be increased, if the water level is well controlled. For instance, in Gozdowice it can be increased by up to 22 cm for a few weeks.

Even if the identified shallows of the Border Oder were to be a problem, in total they amount to a flow path of only a few kilometers. Therefore, there is no justification for a continuous groin repair along the Border Oder with an additional section-wise upgrade.

Even if the average depth of water in the shallows is less than 1.80 m, it is often possible to find continuous fairways with water depths greater than 1.80 m within these shallows, which permit ship passage. The passage of boat hulls is not considerably impeded by potential local minima along this route due to dune crests. Even the Concept for Regulation mentions the possibility of a skillful, permanently successful dredging of shoals.

Dike Relocation at Święta

The risk of flooding in Szczecin is mainly due to increased water levels in the Baltic Sea and thus in the Szczecin Lagoon and Dąbie Lake. Furthermore, water levels which have already been increased can be further expanded in Szczecin by an upstream parallel running flood wave. Most of the existing water level difference between Szczecin and the Szczecin Lagoon, which is caused by an upstream flood wave, is reduced along the flow path of the Oder at Święta. By widening the discharge cross-section at Święta, it seems possible, in principle, to lower the water level for Szczecin and thus contribute to flood protection in this area. This would be possible, for example, through a dike relocation using ring dikes around individually protected goods.

Principle Recommendations for Sealing and Soil Condition

Rainfall-runoff modeling (SCS method) was used to analyze the permeability of soil and sealing in the Polish Oder basin. The municipalities of Chojnów, Człuchów, Ksawerów, Lubań, Piekary Śląskie, Świdnica, Zgorzelec, Brzeg, Dzierżoniów, Głogów and Inowrocław have the highest flood generation potential. The waters (Integrated Surface Water Bodies) Czadeczka, Dopytyw z wyrobiska Turossów, Wrocławia Odra w granicach, Kanał Młyński and Śłęza od Małej Śłęzy do Odry contribute most significantly to flood generation. The listed areas should be the considered first when actions are planned concerning catchment-scale planning of runoff retention and water accumulation.

Conclusions from the Perspective of the Organizations involved

Currently, the Oder has barely any significance for freight traffic in Germany. As such, it is outside the core network of the German 2030 Federal Transport Infrastructure Plan. Accordingly, the Oder is foreseen as a secondary waterway for the construction of a national biotope network. The 2017 adopted German federal program Blue Ribbon states the following: "Secondary waterways are of paramount importance for the development of biodiversity and [...] should in future fulfill new social tasks."

Instead of expanding the no longer needed infrastructure of the Oder, a sustainable development concept for the entire Oder River should be developed across borders, governments and ministries. This should delineate how to protect and further develop the ecological potential of the Oder.

The Polish environmental organizations and experts in the "Save the Rivers" coalition see no need for Poland to expand the Oder either, pointing out that transport problems could be solved by using the railway. Rail traffic is faster and more accessible, due to the existing developed network. It functions independently of external factors. On the other hand, shipping requires considerable intervention in the river environments, with the risk of transport interruptions caused by ice, water shortage and flooding.^{iv}

Therefore, at least one Strategic Environmental Assessment (SEA) and, at project level, a large Environmental Impact Assessment (EIA) is necessary. These require participation from the public and environmental organizations and must be carried out to assess whether the planned projects are compatible with the EU Water Framework Directive, the Natura 2000 Directives and other environmental standards. So far, it has only been possible to distinguish initial participation processes involving environmental and business associations, but not with the general public - although the discussion on development amongst authorities has been ongoing since 2001. Public participation is an essential element under the EU Water Framework Directive.

Currently, measures such as the current Concept for Regulation and the planned flood polder in the Międzyzdrze wetland will contribute to the worsening of flood protection. The current deepening of the deep-sea shipping route to Szczecin, will furthermore increase the impact of flooding from the Baltic Sea in the Szczecin region. However, to protect Szczecin from rising floods caused by the Baltic Sea the natural flood protection of the Baltic Sea coast must be optimally preserved.^v

From the standpoint of the organizations involved, any project that further reduces one of the few semi-natural Central European rivers and thus degrades its ecology and ecologically diverse habitats must be avoided – especially if these initiatives do not produce a demonstrable advantage and instead leave a negative impact on flood protection. Rather, it is necessary to develop concepts that strengthen flood protection and harmonize regional development, tourism, nature conservation and navigation.

i Gerstgraser, Ch., Schnauder, I. & Domagalski, B. (2018): *Wirksamkeit des Międzyzdrze-Polders und der Stromregelungskonzeption für die Untere Oder* [Effectiveness of the Międzyzdrze Polder and the Concept for Regulation for the Lower Oder], report.

ii Grygoruk, M., Osuch, P. & Trandziuk, P. (2018): *Delineation of key zones for water retention enhancement in the Polish part of the Oder catchment. Analysis of potential water retention in land reclamation systems and its possible role in mitigating winter low flows of Oder*, report.

iii The World Bank (2015): *Poland - Odra-Vistula Flood Management Project*, Project Appraisal Document.

iv Koalicji Ratujmy Rzeki (2017): *Stanowisko Koalicji Ratujmy Rzeki w sprawie planów przekształcania polskich rzek w kanały żeglowne* [Position of the Coalition Save the Rivers about the plans on the plans to turn Polish rivers into navigable channels], <http://www.ratujmyrzeki.pl/o-koalicji/stanowiska>.

v Buchholz describes because of the deepening of the sea shipping route the influence of higher floods from the Baltic Sea for the Międzyzdrze wetland. The Międzyzdrze wetland is already upstream of Szczecin and therefore also the Szczecin area is affected. Buchholz, W. (2007): *Warunki Hydrologiczne Estuarium Odry. Hydrological conditions of the Odra estuary*, [Conference papers: Regional problems of water management and hydrotechnics], http://kbw.zut.edu.pl/Publikacje/Publikacje_Konferencja_2007/Buchholz2.pdf.

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