for a living planet®

Analysis of the conditions and economic effectiveness of developing the **Odra waterway**

AN OVERVIEW

Analysis of the conditions and economic effectiveness of developing the **Odra waterway**

AN OVERVIEW

The present analysis is a recapitulation of results of two studies commissioned by WWF Poland:

The Odra Waterway: Potential and Perspectives. Economic analysis taking into account external ecological consequences, Warsaw, October 2007

Authors/Project Team: prof. dr hab. Tomasz Żylicz, dr Agnieszka Markowska, mgr Mikołaj Czajkowski, mgr Jakub Rak

and

Hydrological and morphological context and consequences of developing the Odra waterway, Warsaw, Sosnowiec, December 2007

Authors/Project Team: dr inż. Jan Brański, dr Agnieszka Czajka, mgr Andrzej Kadłubowski, mgr inż. Ewa Maciążek, dr inż. Małgorzata Mierkiewicz, mgr inż. Marianna Sasim, dr Bartłomiej Szypuła, dr inż. Janusz Żelaziński.

Photographs and drawings:
Artur Adamski (cover, page 13); Grzegorz Bobrowicz (page 10); Marek Czasnojć (page 3); Piotr Nieznański (pages 2, 10, 16, 18)

Warsaw, February 2010

© WWF Polska

Graphic design, typesetting, print:
P.R.U. NAJ

Printed on environmentally friendly paper

Contents:

Introduction

A series of investment projects aimed at improving navigation conditions on the Odra River is planned in Poland. These projects are part of the Programme for the Odra 2006 (Program dla Odry 2006).

Investments necessary to ensure relevant parameters of a waterway constitute a great technical challenge and require immense financial expenses, for both implementation and the waterway's subsequent maintenance. Therefore, the following questions should be answered before a decision is made to implement the navigation projects:

- Is the scenario of developing the Odra Waterway, and its inclusion in the European waterways network, feasible under present hydromorphological conditions?
- Will the investments necessary to implement this scenario be economically effective?

Two independent teams of experts were commissioned by WWF Polska to find the answers to these questions. The experts' tasks are as follows:

- **an analysis of hydrologic and morphometric conditions**[1] of developing the Odra Waterway, i.e. examination of whether navigation on the Odra is possible, how long during a year the Odra is navigable and to what extent this period can be extended by an additional supply of water from reservoirs and whether the shape of the riverbed and processes occurring within it allow for efficient navigation.
- **a social and economic analysis**[2], i.e. examination, whether the benefits for the society caused by improving navigation conditions on the Odra justify the costs the society would have to incur.

Comparing the Odra Waterway to a motorway, the mentioned analyses will evaluate the existing road's (i.e. waterway's) width and surface condition, i.e. its adaptation to a particular size and capacity of vehicles, number of connections to other waterways, difficulties related to further development of the waterway and the possibility to ensure a relevant quantity of materials for this purpose, as well as for an evaluation on whether the development-related benefits will compensate the investment's costs and environmental damage.

This information will be used to start an important discussion on the direction of development of the Odra Waterway and further implementation of the Programme for the Odra 2006

Further in the document, the results of the work of the teams of experts are presented, including their assumptions, modelling methods and conclusions concerning the potential of development of the Odra Waterway as a transport corridor on a country, as well as European, scale.

---

1 A. Czajka, M. Mierkiewicz, J. Brański, A. Kadłubowski, E. Maciążek, M. Sasim, B. Szypuła, J. Żelaziński "Hydrologiczne i morfologiczne uwarunkowania oraz skutki rozwoju Odrzańskiej Drogi Wodnej. Zadanie 1: Hydrologiczne uwarunkowania rozwoju ODW na odcinku od Brzegu Dolnego do ujścia Nysy Łużyckiej. Zadanie 2: Analiza morfometryczna koryta Odry na odcinku od Chałupek do ujścia Warty", Sosnowiec 2007.

2 T. Żylicz, A. Markowska, M. Czajkowski, J. Rak "Odrzańska Droga Wodna: potencjał i perspektywy. Analiza ekonomiczna z uwzględnieniem ekologicznych efektów zewnętrznych," Warsaw 2007.

Development of inland waterway transport in programming documents

An analysis of the main programming documents in Poland has led to the conclusion that developing inland navigation and adapting the Odra River for the purposes of navigation are not regarded as priorities. Both the Water Management Strategy (Strategia Gospodarki Wodnej)[3] and the National Transport Policy indicate modernisation and development of inland waterways among their goals, but neither document includes defined targets or actions in this field.

Little attention was paid to inland navigation in the main documents that stipulate the priorities of EU funds allocation between 2007 and 2012 both on the national and voivodeship level. EU and national funds for improving inland navigation conditions are designated in the Operational Programme “Infrastructure and Environment” within the “Environmentally friendly transport” priority. However, the programme’s goal in this area is defined as preventing further regression of inland navigation and not its development. This goal is reflected by the amount assigned for this issue. While the amount of EUR 7.5 billion was planned for the entire priority axis between 2007 and 2012, only 1% of these funds was assigned to investments involving inland waterways.

On the Community level, the European Commission promotes intermodal, or combined transport, which uses rail and water transport to a greater extent (both inland and sea navigation) in order to reduce the negative impact of road transport, which is regarded as more harmful to the environment due to noise and emissions into the air. However, support for inland navigation is recommended only if hydrologic and economic conditions are encouraging and beneficial.

The main strategic document concerning development of the Odra River is the Programme for the Odra 2006.

Programme for the Odra 2006

Established after the extreme flood in 1997 and currently implemented, the Programme for the Odra 2006 is aimed at implementing a comprehensive system of integrated water management in the Odra river basin. Detailed goals include environmental protection and restoration of ecosystems, as well as development of inland navigation and using rivers for energy generation. However, these goals are often contradictory.

The programme aims to achieve parameters of at least Class III of a waterway in the entire course of the river from Koźle to the confluence with the Szczecin Lagoon. The programme includes a number of investments aimed at modernising the existing infrastructure, training of the Odra River that flows freely from Koźle to the confluence of Lusatian Neisse (Nysa Łużycka) and the construction of two barrages at Malczyce and Lubiąż.

The predicted expenses for implementing the entire programme between 2002 and 2016 are PLN 9 billion with 2001 as a reference year. Public funds shall provide PLN 8 billion, that includes European funds, loans from state-owned financial institutions, and funds provided by environmental fees.

Among the programme’s components, there is no separate component related to improving the navigation conditions on the Odra. Investments contributing to improving these conditions are included mainly in the following components: “River-control structures” and “Reconstruction and modernisation of embankments.”

So far, the state budget has been the most important and reliable source of funding for the programme and its share is much larger than initially expected. The other significant source of funding is national environmental protection funds. Their share is also larger than assumed. At the same time, the involvement of non-budgetary sources of funding (i.e. international institutions, EU funds and investors’ own resources) is much lower than expected.

The majority of investments in the Programme for the Odra 2006 (including those related to navigation) are delayed. The total amount spent on improving navigation conditions on the Odra between 2002 and 2005 was PLN 208 million, i.e. more than PLN 50 million per year. Considering that total expenses in this period amounted to PLN 460 million, these expenses constitute about 38% of all expenses incurred in the programme. These are significant amounts.

---

[3] Although the Strategy was approved by the Council of Ministers in 2005, it was never subjected to a strategic evaluation of its environmental impact so, formally, it is only a draft.

COMPONENT	Planned investment in the entire financing period [million PLN]	Planned investment in the entire financing period [million Euro*]	Percentage
1. Forests	298.5	74.62	3.3
2. Sewage treatment plants	3 565.6	891.4	39.4
3. River-control structures	1 042.9	260.72	11.5
4. Flood-protection structures	3 098.5	774.62	34.2
5. Spatial management	35.4	8.85	0.4
6. Environmental protection	241.6	60.4	2.7
7. Flood monitoring	401.8	100.45	4.4
8. Reconstruction and modernisation of embankments	364.5	91.12	4.1
TOTAL	**9 048.8**	**2 262.2**	**100.0**

* 1 Euro – 4 PLN

Table 1: Programme for the Odra 2006: Allocation of financial means for particular components of the programme between 2002 and 2016. Investments improving the navigation conditions are included mainly in the following components: "River-control structures" and "Reconstruction and modernisation of embankments."

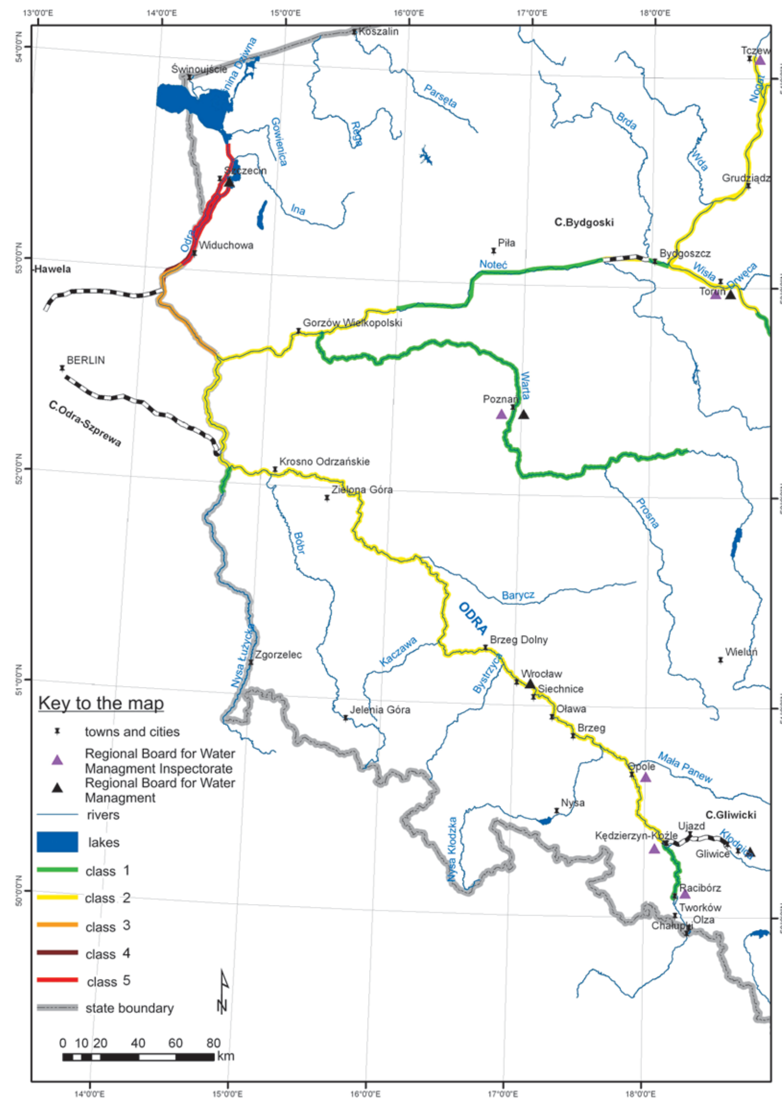
In the long-term, it is planned to connect the Odra to the European waterway network, which would require achieving parameters corresponding to Class IV. The programme does not stipulate in detail how the parameters of an internationally important waterway should be achieved or what the extent and cost of the works would be.

The Odra as a waterway in the past and nowadays

Previous regulation works on the Odra

The Odra was initially a river with many meanders, shifting its course within the valley. The first works aimed at taming the river were undertaken as early as in the 13th century, when ***embankments*** were built. To ensure a faster outflow of water, construction of ***short cuts*** started in order to shorten or straighten the river's course. To prevent washing away of the banks, ***groynes*** were applied within the faster flow (transverse river-control structures reaching from the banks to the middle of the riverbed). These solutions stretched on the Odra to the confluence of Warta. Next, the reaches of the Odra from Koźle to the confluence of Kłodzko Neisse (Nysa Kłodzka) and in Wrocław were ***canalised*** and partly dammed by river barrages. ***Reservoirs*** were built too in order to prevent floods and supply the Odra with additional flow during low water stages. The biggest investment currently underway in the Odra river basin is the construction of the river barrage in Malczyce.

As a result of river-training and canalisation, the length of the Odra on the territory of Poland nowadays is 742 km, which is 20% shorter than its original length. The entire course of the river within the Polish territory is fixed by regulation works implemented in previous centuries. And yet, the Odra was not successfully transformed into a navigable waterway of international or regional significance. Disastrous floods, such as the one in 1997, have not been prevented either.



The Odra is a navigable waterway

A river, just like a road or railway, has to meet specific requirements to be considered a transport route. Minimum parameters for a navigable waterway (including width, depth, meander radius on the route and clearance beneath bridges) are indicated in the national Regulation of the Council of Ministers of 7th May 2002 on the classification of inland waterways (Journal of Laws No. 77, item 695). According to the Regulation, these parameters have to be met for at least 240 days in an average year of a multiannual period.

According to the Regulation:

- the reach of the Odra between Racibórz and Kędzierzyn-Koźle is in Class Ia,
- the reach of the Odra between Kędzierzyn-Koźle and Brzeg Dolny is in Class III,
- the reaches of the Odra from Brzeg Dolny to the confluence of Lusatian Neisse and from the confluence of Lusatian Neisse to the confluence of Warta are in Class II.

Table 2:
Minimum parameters of a navigable waterway.
Regulation of the Council of Ministers of 7th May 2002

	WATERWAY CLASS						
PARAMETER [m]	**Ia**	**Ib**	**II**	**III**	**IV**	**Va**	**Vb**
Width of the navigable route*	15	20	30	40		50	
Transit depth	1.2	1.6	1.8		2.8		
Radius of the curvature of the route's axis	100	200	300	500	650		800
Minimum clearance beneath bridges over navigable high water	3			4	5.25 or 7.00		

* width of the navigable waterway on the level of the bottom of a ship of acceptable load capacity at complete draught

In reality, as indicated below, the section from Kędzierzyn-Koźle to Brzeg Dolny does not meet the requirements concerning Class III. In addition, to be considered a navigable waterway of regional significance, a river must meet the requirements of Class III through its entire course, and in the case of an internationally significant waterway, it is required to achieve the parameters typical of at least Class IV according to the national Regulation of the Council of Ministers of 7th May 2002.

Potential of the Odra as a waterway of Classes III and IV

Hydrologic analysis

This is where the first question is investigated: Considering the existing hydrologic conditions, and especially the flow rate (volume of water flowing through a particular transverse section of the river within a time unit [m^3/s]), is it likely to achieve the transit depths required for Class III of a waterway along the entire course of the waterway, as stipulated in the goals of the Programme for the Odra 2006 or for Class IV (the lowest class of an international waterway)? For how many days in a year can the favourable conditions for navigation be maintained in years of average water conditions and for how many in selected dry years?

In order to answer these questions, hydrologic data for selected periods between 1951 and 2006 were analysed. Part of the data was purchased from the Institute of Meteorology and Water Management; generally available archival materials were used as well. Data was collected and analysed on the flow duration, minimum, average, and maximum water levels, and periods of occurrence of ice phenomena on the Odra.

The presented analyses below focused on the non-canalised reach of the Odra from Brzeg Dolny to the confluence of Lusatian Neisse (Nysa Łużycka). Adaptation of this reach to the needs of navigation seems a crucial issue for achieving the goals set by the Programme for the Odra 2006, as it connects the canalised section of the Odra with its section on the border, which is connected to European waterways.

Variability of water flow on the Odra

Navigation may be limited by a too low or too high flow of water (***low water*** or ***high water***) and ice. The most frequent phenomenon in Poland is low water, i.e. periods when the flow is lower than the average accepted as the limit for a given stretch of a river. A long-lasting lack of precipitation in summer and autumn along with simultaneous intensive growth of plants taking in big quantities of water results in lowering the level of the ground water and therefore limiting the supply of water to rivers and finally decreasing flow. In Poland low water occurs every 2nd or 3rd year on average. Sometimes it affects the entire basin of the middle and lower course of the Odra.

The most recent and significant low water flows on the Odra occurred in 1992, 2003 and 2004, lasting respectively 178, 189 and 102 days, all of them in the navigation season, which is defined as the period from 15th March to 15th December, i.e. 275 days. The decision on opening and closing the navigation season depends on the water levels and the ice cover on the river. Although for waterways of Classes II and III, the minimum transit depth is 1.8 m, currently, the navigation season on the Odra is opened at a depth of 1.3 m.

Modelling of flow phenomena occurring in the Odra's riverbed

In order to answer the two previously asked questions, i.e.:

I. For how many days in an average year and in selected dry years does the Odra meet the requirements of a waterway of Classes III and IV?

II. By how many days can the navigation season be extended in selected dry years, using the existing reservoirs assigned for supplying the waterway?

the team of experts used a mathematical model illustrating the variability of the flow in the riverbed of the Odra within the section from Brzeg Dolny to the confluence of Lusatian Neisse. The model used data concerning:

- the shape of the riverbed in 133 selected cross sections of the examined part of the river,
- flow duration for a given quantity of water,
- operations of reservoirs that supply the Odra, affecting the flow.

The model allowed for estimating the river's depth at the examined cross sections of its riverbed. With these estimations, it is possible to indicate the location of a 40 m-wide zone, as required of waterways in Classes III and IV, as well as the largest minimum depth. If the found minimum depth is at least 1.8 m, then the waterway meets the requirements of Class III and if it is at least 2.8 m, then the requirements of Class IV are met. Thus, it was determined, day-by-day, whether the given site in the riverbed would have the parameters of a given class. Taking into account information on the ice-related phenomena on the river, limiting or preventing navigation, the first question was answered.

To address the other question, by trial and error, the team „supplied" the necessary water to maintain the parameters of a given class of a waterway to the river in the selected dry years (1992, 2003, and 2004). The model assumed that low water starts on the day when the flow between Brzeg Dolny and the confluence of Lusatian Neisse falls to such a level that the waterway's class is reduced (from Class III to Class II or from Class IV to Class III). Supply of water from reservoirs started 3 days before the beginning of low water, corresponding to hydrologic forecasts, which are available 3 days in advance and it ended when reservoirs were empty. It was furthermore assumed that at the beginning of the supply, the reservoirs were full; this is untrue as the reservoirs usually serve also other purposes, too, e.g. flood prevention or generation of energy.

A comparison of the number of days when parameters of Classes III and IV were met with the supply from the reservoirs and without it allowed for answering the second question.

Results of the modelling of the flow for ensuring navigability of the Odra

Despite the performed regulation works at the examined part of the Odra, there are still alternate shoal patches (so-called ***shoals or low draught sections***) where the flow speed is high and pools (so-called ***deep waters***) with relatively low flow velocity. Therefore, to ensure relevant transit depths at the shoals, it is necessary to provide for higher intensity of the flow than currently at the deep waters.

Correlating the charts which indicate the flow intensity necessary for meeting the requirements for a waterway of Classes III and IV with the flow durations registered in the examined years, it was derived how many days navigation of the given class is possible.

- ***results for an average year in a multi-year period***

It was proved that in a multi-year period, parameters of Classes III and IV, i.e. a minimum transit depth of 1.8 m and 2.8 m, respectively, were significantly not met for at least 240 days in an average year.

In an average year of a multi-annual period, the condition for Class III is met only for about 90 days. With intensive deepening/dredging works at four crucial shoal patches, the navigation period may be extended up to about 150 days.

The condition concerning Class IV was met in an average year of a multi-annual period only for several days. Intensive deepening works at seven crucial shoal patches would allow for extension of the navigation period up to about 10-15 days.

- ***results for the navigation period (March-December) in a multi-year period***

In the navigation season between 15th March and 15th December, the condition related to Class III may be met for about 70 days in an average year and intensive deepening works at five crucial sections could extend it to about 80 days.

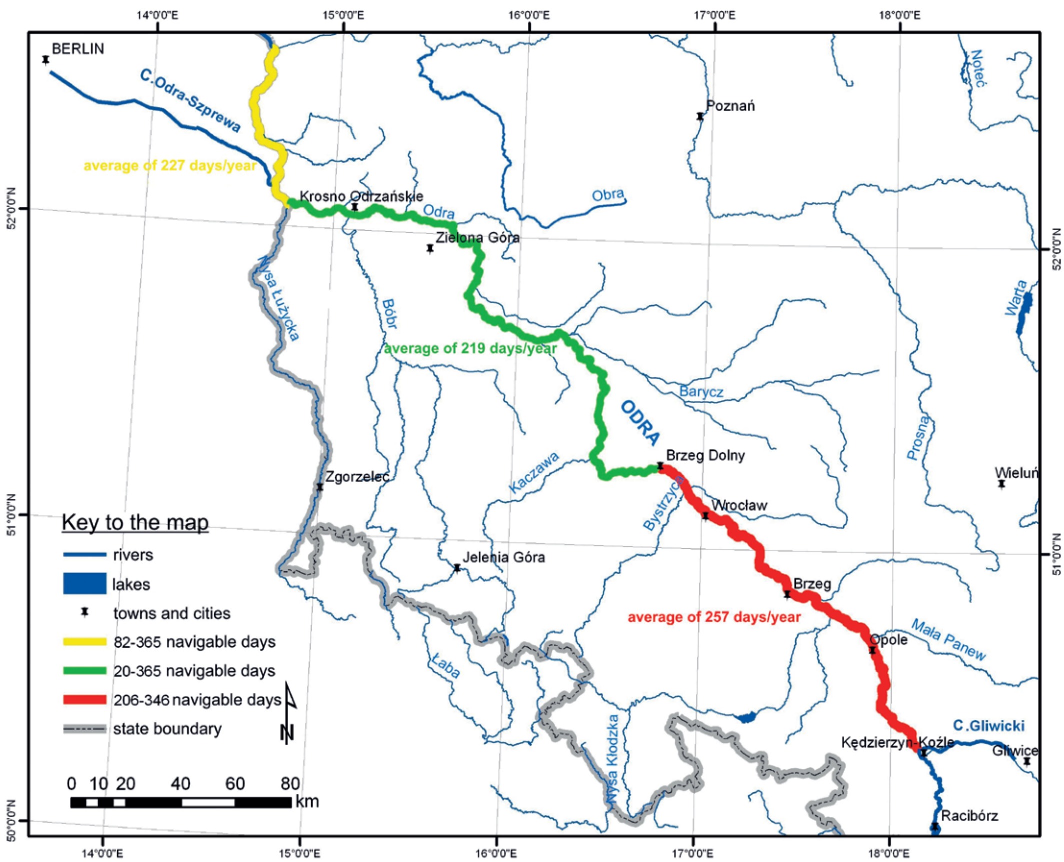
The condition concerning Class IV cannot be met. Deepening at 10 crucial sections would make navigation possible during about 20 days.

- ***results for the winter season (December-March) in a multi-year period***

In the winter season lasting from mid December to mid March, the condition related to Class III may be met for about 20 days (of 90) and the condition concerning Class IV cannot be met at all.

- ***results for the navigation season in dry years: 1992, 2003 and 2004***

In the navigation season of the dry year of 1992, the condition concerning Class III was met for about 50 days and concerning Class IV - for about 18 days. Moreover, during the navigation season of the dry years of 2003 and 2004, the condition related to Class III was met for several days, while the condition concerning Class IV could not be met at all.



However, it should be noted that the above-described results do not take into account the limitations of navigation related to icing, too-small radiuses of meanders and the occurrence of too-high water levels, when navigation is impossible because of inadequate clearances beneath bridges.

Results of modelling potential supply of the Odra with water from reservoirs

The deficiency of water in dry years turned out to be so large that a simulation of potential supply of the Odra from reservoirs to achieve parameters typical of Class IV was worthless.

The applied model of simulating supply of the river from the existing reservoirs in dry years showed that the navigation period in Class III was extended by: 22 days in 1992, 18 days in 2003 and 25 days in 2004.

However, these are maximum values, impossible to achieve in reality, e.g. because the reservoirs serve several purposes at the same time.

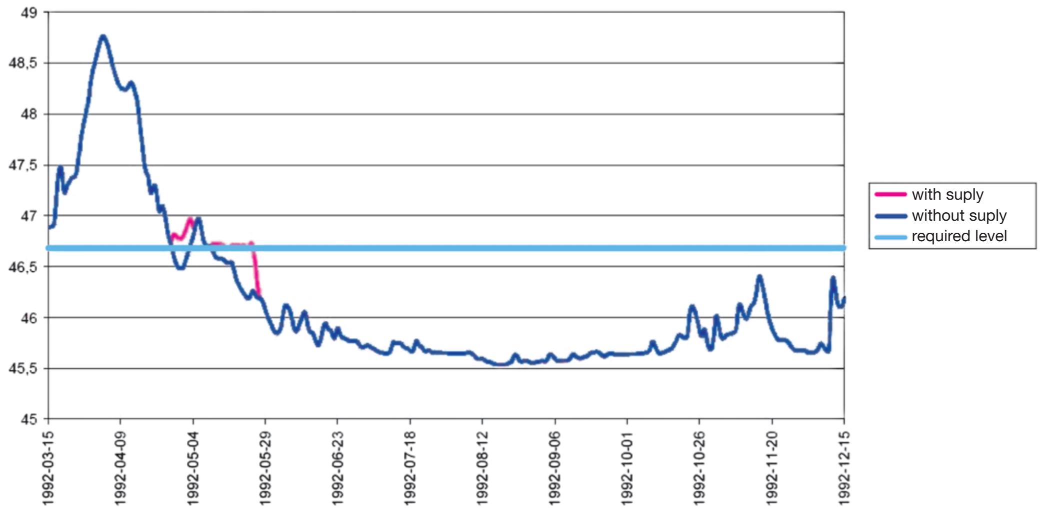


Figure 1: Potential improvement in the navigation conditions with supply from reservoirs in the basin of the upper reaches of the Odra. The ordinate of the chart illustrates the water level on 480 km of the Odra (the area with the most significant shoals). The blue line reflects the ordinate of water levels corresponding to parameters of a waterway of Class III. The dark blue line illustrates the water level of the Odra without the supply from the reservoirs. The pink line presents the water level, which could be maintained with a water supply from reservoirs before they are emptied.

It was estimated that the compensation of very low water in 1992, 2003, and 2004 would require a capacity of about 2000 million m^3, 2400 million m^3 and 2200 million m^3 respectively. A significant extension of the navigation period would therefore, require immense additional capacity of reservoirs, impossible to attain considering spatial, financial, and environmental issues.

Ice-related phenomena on the Odra

The period of icing on the examined part of the Odra River from Brzeg Dolny to the last observation post before the confluence of Lusatian Neisse was determined according to data from the years 1981-2006. It was revealed that such phenomena as ice and brush ice appear no earlier than at the end of November and do not last longer than until the end of March. The ice cover forms usually in mid-December and lasts until mid-March, which corresponds to the conventional dates of the beginning and end of the navigation season, i.e. 15th March and 15th December. **The icing phenomena on the Odra in the navigation season between mid-March and mid-December are rare and their effect on navigation is of minor importance.**

Morphometric analysis

To be considered a waterway within a given class, a river has to meet the requirements concerning its transit depth, but also relevant riverbed parameters, such as width and radius. This is where the third question comes in: Does the analysed part of the Odra meet the morphometric conditions of a waterway of Classes III or IV?

A river is a dynamic system; transport of sediments along the riverbed causes constant changes of its shape and the river's tendencies to ***meander***, i.e. to form curves within the valley. River training is therefore a somewhat Sisyphean task – the same forces that transform the shape of a natural riverbed, tend to undermine river training structures in a trained riverbed.

This is why further in the document, the following data were analysed: the riverbed's shape, rate of silting up in between groynes, depth of the Odra's riverbed and sediment transport in particular river stretches. The data were compared to historical information, allowing for identification of tendencies of the riverbed's changes and for an indication of places of especially high dynamics. For the sake of completeness, the analysis also included the initial part of the Odra from Chałupki to Racibórz, which is not classified as a waterway by the Regulation of the Council of Ministers of 7th May 2002.

Changeability of the shape of the riverbed of the Odra

A comparison of the course of the Odra's riverbed on archival and modern maps, as well as on aerial photographs, applying GIS computer tools (*Geographic Information System*) has allowed for illustrating the changes to the riverbed's width and sinuosity, which have occurred between 1940 and now.

The observed changes consist mainly in narrowing of the riverbed and decreased sinuosity. The reduction of meanders and protection of banks with groynes result in keeping the main stream constantly in the axis of the river. In sheltered basins between groynes, the material carried by the water (drifting and traction sediments) settles and fills the basins gradually. At the same time within the river's axis, the riverbed's erosion is enhanced.

Within six decades, the Odra's riverbed narrowed locally, by even more than 100 m. The maximal narrowing (by 130 m) was recorded between the confluence of Lusatian Neisse and the confluence of Warta. The riverbed's width increased only on those reaches that were developed with locks and barrages, mainly in the canalised part of the river between Kędzierzyn-Koźle and Brzeg Dolny.

Table 3: Minimum and maximum width of the riverbed and the most significant changes in width of the Odra's riverbed between Chałupki and the confluence of Warta between 1940 and 2000

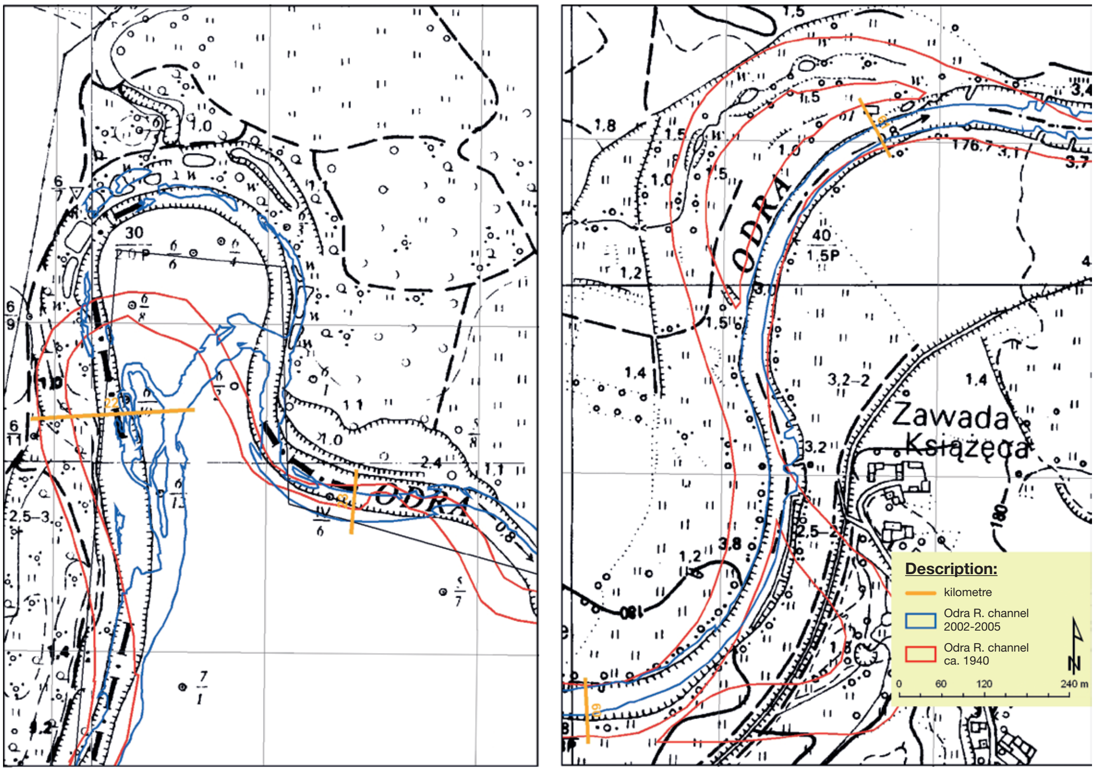
RIVER REACH	Range of width change between 1940 and 2000 [m]	Maximum reduction of width between 1940 and 2000 [m]	Number of narrowings ≤ 40 m*
Chałupki – Racibórz	6 – 42	-34	23
Racibórz – Koźle	3 – 53	-52	38
Koźle – Brzeg Dolny	15 – 405	-109	12
Brzeg Dolny – confluence of Lusatian Neisse	40 – 107	-91	1
confluence of Lusatian Neisse – confluence of Warta	84 – 144	-130	0

* width of river channel measured every 1 km

Considering that the required minimum width of a waterway of Classes III and IV is 40 m, achieving this parameter on the Odra would require significant works on 51 narrow stretches between Racibórz and the Warta mouth.

The minimum radius of a meander on a navigation route of Class III is 500 m, while on the Odra between Kędzierzyn-Koźle and the confluence of Lusatian Neisse there are as many as 61 meanders of a smaller radius. Adaptation of the Odra to parameters of Class IV, where the minimum meander radius is 650 m would require reconstruction of several more dozens of meanders.

Another problem concerns too-small clearances beneath bridges and too-small distances between bridge spans. Adaptation to requirements of a waterway of Classes III and IV would involve a necessity to reconstruct at least a dozen bridges.



The reach between the confluence of Lusatian Neisse and the confluence of Warta has the best rate of accomplishment of parameters for a waterway of Class III. The most significant reconstruction works would be necessary between Brzeg Dolny and the confluence of Lusatian Neisse.

Rate of sediment accumulation in basins between groynes

In the analysis of sediments in the Odra's riverbed, the existing research results on accumulation of sediment in basins between groynes over the last 200 years were applied. The accumulation rate is estimated based on the content of substances or materials related to activities of men, such as fine coal, heavy metal, and plastic. **According to the available study results, just after the river training, the accumulation rate of sediments was about 2 cm per year, while recently it has reached even 6 cm per year and a flood can cause even 30 cm of new sediments in a single year.** In small basins between groynes, the sediment layers reach about 1 m, while in big basins they exceed 2 m. The sediments' layer decreases along the river's course, as the riverbed's indentation decreases.

It was revealed that sediments accumulated in the Odra's riverbed are strongly contaminated with heavy metals, and as the river indents deeper in the riverbed, the old sediments are gradually scoured, releasing the deposited contaminants. Regulation works necessary to adapt the Odra to parameters of a waterway of Classes III or IV would involve additional costs related to proper management of sediments dredged up according to the national Regulation of the Minister of Environment of 16th April 2002 on the types and concentrations of substances that qualify extracted material as contaminated.

Changes of the Odra's riverbed elevation

In order to estimate the changes of depth of the Odra's riverbed, the minimum and maximum annual water levels were analysed according to water gauge stations between 1901 and 1953 for the liquidated water meter in Racibórz, and from 1940 to 2000 for existing water meters. At sites where the water level was significantly reduced, one should expect intensive erosion and a decrease in the elevation of the riverbed's floor, while on sites where the water levels grew, it is likely that sedimentation on the riverbed has occurred.

In the last century in the upper reaches of the Odra, riverbed-deepening tendencies dominated, while close to Kędzierzyn-Koźle, the riverbed narrowed in general. The riverbed of the reach between Brzeg Dolny and Gozdowice seems quite stable, while below the barrage in Malczyce (which is currently being constructed), an enhanced erosion of the riverbed is observed, confirming that building new dams on the river is not a solution to the problem of eroding the riverbed below the existing dam, but it only transfers the problem downstream.

The above-described changeability of the elevation of the Odra's riverbed is another important factor to be taken into account in the plans to use the river as a waterway. Maintaining the relevant parameters of the waterway would require studies that are more detailed in order to identify new shoals and the necessary deepening works to maintain the required transit depth.

Conclusions of the hydrologic and morphometric analysis

The following conclusions can be drawn from the performed hydrologic and morphometric analyses:

- **The natural features of the Odra as a potential waterway are overestimated.** The Odra is supplied with precipitation and ground water. The river basin of the Odra is located in the border zone of oceanic and continental climates, which leads to frequent changes in weather, especially concerning precipitation. River regulation using groynes leads to deepening of the riverbed and lowering of ground water levels in the vicinity of the riverbanks. The quantity of the natural water supply of the Odra is insufficient to ensure water levels allowing for navigation of international, or even regional, significance.
- **The analysed part of the Odra does not meet the requirements of a waterway of Class III, not to mention Class IV** (the lowest class of international waterways). In an average year, the required transit depth of Class III was present only for about 90 days, and of Class IV for only a few days. In dry years, the situation is further deteriorated. The potential water supply of the Odra by existing water reservoirs is too small to improve the situation significantly. Currently:

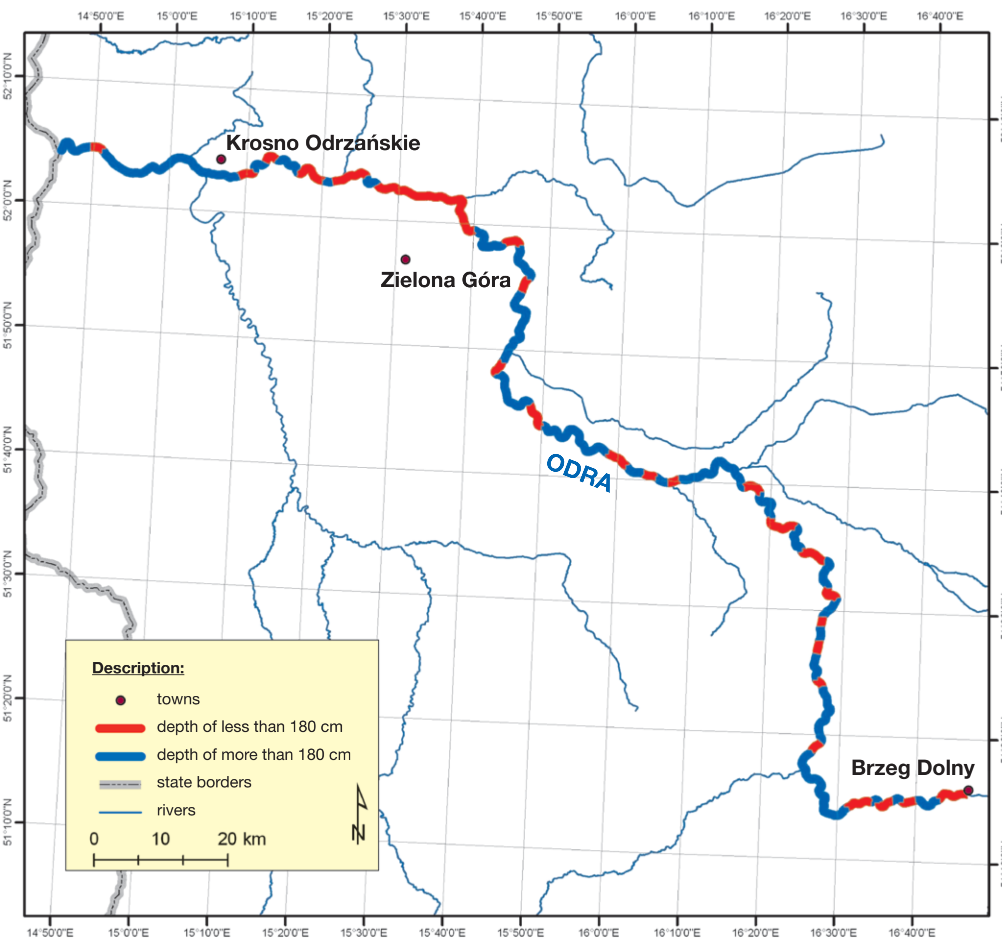


Figure 2: Minimum transit depth of a waterway of Class III at the stretch of the Odra from Brzeg Dolny to the confluence of Lusatian Neisse in an average year. Fragments of the riverbed, where the minimum transit depth achieves 1.8 m for at least 240 days (as required for a waterway of Class III) in an average year have been marked in blue. Other reaches of the Odra do not meet the parameters of Class III.

- the reach between Racibórz and Kędzierzyn-Koźle meets the requirements for a waterway of Class I,
- the reach between Kędzierzyn-Koźle and Brzeg Dolny meets the requirements for a waterway of Class II - insufficient depth, too-narrow riverbanks and too-small radius of 25 meanders do not allow for classifying this reach as a waterway of Class III (as indicated in the Regulation of the Council of Ministers of 7th May 2002),
- the reaches between Brzeg Dolny and the confluence of Lusatian Neisse and between the confluence of Lusatian Neisse and the confluence of Warta meet the requirements of a waterway of Class II.

- **Adapting the Odra to parameters characterising a waterway of Class III due to the river's highly variable flow and high natural dynamics of changes of the riverbed would require not only initial investments in river regulation works, but also constant expenses for modernisation and deepening.** Moreover, achieving the abovementioned goal defined in the Programme for the Odra 2006 would likely cause severe environmental damage, such as river ecosystem deterioration and a decrease in groundwater tables. **Considering the hydrologic conditions, achieving parameters of Class IV by the Odra Waterway seems entirely impossible, unless the entire middle reach of the river is canalised and dammed.**

Estimation of costs and benefits related to the adaptation of the Odra to parameters of a waterway of Class III was undertaken by another team of experts.

Social and economic analysis

The aim of this part of the analysis is to answer the question whether implementation of the investments planned within the Programme for the Odra 2006 is economically effective. In other words, do the benefits for society justify the spending of public funds on improving the navigation conditions on the Odra?

The Odra as a transport route

In the 1st half of the 19th century, steamships appeared on the Odra; canals between the Odra and other European rivers were constructed. As a result, waterway transfer increased significantly. At the beginning of the 20th century, the Odra-Spree Canal could transport as much as 4 million tonnes of goods per year from Silesia to Berlin. Another important connection was the Odra-Havel Canal, joining Szczecin and Berlin. War damages as well as economic and political changes caused by WWII resulted in a decrease of the transported tonnage to about 1 million tonnes per year in the 1950s. With the introduction of towboats and motor barges, river transport was gradually revived. Currently, the transport along the canalised segment of the Odra does not exceed 3 million tonnes per year, and the overall transport along all the Odra is up to 6 million tonnes per year, which is comparable to the data of the first half of the 20th century.

At the same time the quantity of goods transported by roads, rail or by air has increased by several thousand percent.

As it was discussed in the first part of the analysis, the main limitations of the water transport along the Odra are related to the duration of the navigation season, which depends on climate and weather. In a period of low or high water, water transport is put on halt, and therefore the promptness of deliveries cannot be guaranteed. This is why suppliers tend to choose other means of transport.

The width of the waterway, size of locks at barrages, dimensions of clearances between bridge spans and beneath bridges – all these elements determine the size, draught, and capacity of ships and barges. For instance, at the segment between Gliwicki Canal and the confluence of Lusatian Neisse, the maximum width of a watercraft is 9 m, while the standard width of barges in Europe is 11.4 m. These parameters limit the barges' capacity, increasing the cost of transport.

Adaptation of the Odra to the needs of navigation requires not only investments in hydraulic engineering within the riverbed, but also modernisation of ports and vessels. The infrastructure of the river ports is not satisfactory. The condition of vessels is a serious problem, too. The number of registered ships and barges in Poland is falling and they are mainly repaired obsolete barges.

And yet, the management of the Odra as a waterway is currently the best in Poland as the river services about 80% of water transport inside Poland. The Odra is used mainly to transport aggregates (sand and gravel collected from the riverbed), coal, ores, metals, fertilizers, and oversize loads. Passenger transport is of minor importance.

Water transport vs. competitive means of transport

During the last decade, inland waterway transport in Poland maintained a share below 1% of transport in total, and in 2006 amounted to only 0.6%. In the European Union, the average rate is 7%, but one should remember that in the Western part of Europe, climate and weather patterns are more predictable and that the river training implemented there has had significant environmentally adverse effects.

Within Poland, the greatest share of transport is carried out by road and rail. Forecasts indicate that this share will grow, leading to an increased overcrowding of roads and railways. Maritime transport is less important. Inland water transport and air transport are definitely the least important means.

Considering the nature of the loads transported by water, such as coal, aggregates, metallurgical articles, and products of chemical industries, the most important competitor to the Odra Waterway on the route from Silesia to Western Pomerania is rail.

The railways and roads have a competitive advantage over the waterway due to:

- ***their independence from weather*** and
- ***infrastructure, which is more developed, constantly modernised and extended.***

Inland waterway transport's main advantages are:

- ***environmental impact***; transport by ships is a cleaner means of transport than road (especially as far as emissions to the atmosphere are concerned) and one of those which are involved in the least accidents.
- ***price per 1 km of distance and price of reloading***; inland waterway transport is currently about 30% cheaper than railways; however, this advantage over the land transport matters only on longer distances, considering the comparatively low cost of conveyance and quite high cost of reloading.

In practice, the transport of loads on the Odra is concentrated mainly on the canalised stretch from Koźle to Brzeg Dolny. In most cases the distance is lower than 50 km, while water transport is competitive as compared to railways only at distances over 150 km. This is especially important in the case of the Odra, where the navigable distance from Koźle to Brzeg Dolny is 187 km and it is separated from the next navigable reach from the confluence of Warta to Baltic Sea (of 147 km) by a 334-km-long segment of limited navigability.

Development of the Odra Waterway would probably only result in the shifting of a certain fraction of the mass transport between Silesia and Szczecin from roads and railways to the waterway.

Environmental external effects as an element of the economic analysis

As it was mentioned above, this part of the analysis will attempt to answer the question whether benefits caused by improving the navigation conditions on the Odra compensate the costs of the necessary investments.

The costs must include direct costs of hydro-engineering investments, e.g. construction of the barrages, weirs, and embankments. The direct costs of an investment are the design costs, costs of materials and labour, etc.

The completion of investments necessary for improving the navigation conditions on the river also involves environmental impact through pollution of the atmosphere or damage to habitats and/or the species living in the river or on the neighbouring floodplains and riverbanks. These are additional costs of the investments, which are not reflected in the construction materials' prices or the designing costs, and which are therefore difficult to present in monetary values, i.e. ***external costs.*** These costs are not incurred by investors or users of the waterway, they affect the entire society, and they are often neglected during assessment of projects.

Environmental external costs of improving the navigation conditions on the Odra

For the purpose of the present analysis, navigation improvement investments carried out within the Programme for the Odra 2006 were defined to include construction of barrages and locks, dredging, and clearing of the riverbed and water constructions, e.g. groynes and embankments. These investments generate significant external costs, which have to be considered during assessment of the economic effectiveness of modernising the Odra Waterway.

In the case of an investment adapting a river to navigation, the following sources of external effects apply:

- ***emissions of contaminants to the atmosphere*** related to the generation of energy and use of raw materials for hydro-engineering structure construction, e.g. CO_2 emitted during the production of cement, SO_2 and NOx emitted by cars transporting materials.
- ***modification of water conditions in the river valley***, flooding of the valley upstream of the barrage and drying out of the valley below the dam results in lower water levels in wells, in the loss of valuable habitats (such as riparian forests dependent on periodical flooding), increased flooding downstream due to loss of water retention areas and accelerated flow along the canalized river section, to name a few.
- ***release of harmful substances deposited in sediments on the riverbed,*** deepening and widening of the waterway requires removal of an immense quantity of sediments; remobilisation of contaminants present in these sediments (e.g. heavy metals) could be dangerous not only for the environment, but for human health, too.
- ***fragmentation of the river's ecosystem*** with weirs and barrages that are a significant obstacle for migrating aquatic organisms. This concerns both diadromous fish, which breed in rivers and mature in seas or vice versa, as well as river organisms which migrate along the riverbed in search of food or to spawning grounds or winter habitats. The majority of

existing or planned fish passes at hydro-engineering structures on the Odra are ineffective because of faulty construction or location.

- ***loss of habitats and reduction in the river valleys' biodiversity***; embankments, dredging or collection of rubble from the riverbed during the project's implementation stage results in destruction of water plants, spawning grounds and hiding places for organisms living in the river. At the maintenance stage, changes in the level of ground water and lack of periodical flooding result in a decay of vegetation typical of floodplains.

The level of external costs can be estimated based on costs of activities aimed at preventing the adverse effects, e.g. costs of constructing structures allowing aquatic organisms to pass weirs or barrages.

One should also remember that the functioning of barrages involves a disturbance in sediment transport, resulting in sedimentation above the dam, in erosion of the riverbed below it and in sedimentation of the eroded material in the lower sections of the river. This in turn leads to a necessity to adjust the depth of the waterway by dredging at the shoals.

The costs of these actions were not included in the Programme for the Odra 2006 and they cause a significant increase in maintenance costs of the waterway. Moreover, if actions to deepen the riverbed are not taken, the navigation conditions will deteriorate, reducing the expected benefits from the investment.

Table 4: External costs of implementing the Programme for the Odra 2006. The table lists external costs, divided by their type and time of arising. W – costs related to impact on water; A – atmosphere; S – soil; N – direct influence on nature and man

Element of the plan	Description of the external cost	Construction stage	Maintenance	W	A	S	N
1. Weirs and navigation locks	1.1 Emissions related to the construction process, use of raw materials and energy	+		+	+		
	1.2 Sedimentation above structures and erosion of the riverbed below them		+				+
	1.3 Destruction of migration routes of aquatic fauna		+				+
	1.4 Difficulties for other users of the river	+	+				+
2. Deepening and clearing of the riverbed	2.1 Emissions related to the construction process, use of raw materials and energy	+	+	+	+	+	
	2.2 Deterioration of the quality of aquatic habitats	+	+				+
	2.3 Release of contaminants from river sediments	+	+	+		+	
	2.4 Decreasing the ground water level in the valley		+	+		+	+
3. Hydro-engineering structures along the waterway	3.1 Emissions related to the construction process, use of raw materials and energy	+		+	+		
	3.2 Deterioration of habitats		+				+
	3.3 Increased temperature of water		+	+			+
	3.4 Increased erosion of the riverbed and banks, increased accumulation of sediments		+				+
4. Use of the waterway	4.1 Emission of waste gases		+		+		
	4.2 Accident risk		+				+
	4.3 Noise		+				+
	4.4 Difficulties for other users of the river		+				+
	4.5 Leakages of harmful substances		+	+			
	4.6 Increased erosion of the riverbed and banks		+				+
	4.7 Increased turbidity and sediment precipitation		+	+			+
	4.8 Destruction of spawning grounds by ship propellers		+				+

External costs of using the waterway as compared to other means of transport

In evaluating the external costs, the cost of an alternative option is considered. The alternative for constructing barrages consists in resigning their construction and it involves no alternative costs, i.e. no emissions related to the construction stage and no degradation of elements of the ecosystems related to the maintenance stage. At the same time, resignation of transporting goods by water involves transport by land and an increased emission of contaminants and greenhouse gases to the atmosphere. The transport of goods by water allows for preventing some emissions caused by road or rail transport. The value of thus prevented emission is included as benefits of improving the navigation conditions on the Odra.

According to the available studies on the financial estimation of costs of emissions to the atmosphere, the external cost of transporting 1,000 tonnes of goods per 1 km was estimated. The external costs included those related to noise, accidents, and pollution and greenhouse gases emitted during the transport and at other stages of the lifecycle.

The total external costs of transporting 1,000 tonnes of goods per 1 km in the situation of Poland were estimated as follows: PLN 76.71 for road transport, PLN 20.74 for railway transport and PLN 16.34 for inland water transport.

	External costs [PLN/1,000 tkm]		
	Road transport	Rail transport	Inland water transport
Pollution	32.22	8.16	9.77
Emission of greenhouse gases	7.62	4.04	3.66
Other stages of the lifecycle of fuels (production, transport to sale outlets, etc.)	12.31	2.13	2.91
Accidents	8.68	4.46	0.00
Noise	15.88	1.95	0.00
TOTAL	**76.71**	**20.74**	**16.34**

Table 5:
The external costs of transporting 1,000 tonnes of goods per 1 km in the conditions present currently in Poland [PLN/1,000 tkm].
External costs, i.e. costs that are incurred not by the user, but by the entire society, are the highest for road transport, which emits the biggest quantities of contaminants and greenhouse gases to the atmosphere, generates the most noise, and has the highest rate of accidents.

The above calculations allow for a conclusion that, as it was expected, at the operating stage, inland water transport has less effects on the environment and man than land transport, especially road transport.

A comparison of the above listed external costs of transporting 1,000 tonnes of goods per 1 km leads to the conclusion that the water transport of goods allows for preventing the cost of PLN 4.4 as compared to rail transport and PLN 60.37 as compared to road transport. These savings were included in the economic analysis as benefits.

At the same time, regarding the lack of sufficient data and difficulties in measuring such external effects as emissions of contaminants and adverse changes in ecosystems related to the construction of the navigation infrastructure, it was impossible to consider these external costs in the analysis. When analysing the further results, one should therefore remember that **in the calculations, environmental benefits of improving the navigation conditions on the Odra were taken into account and environmental costs were disregarded, and that these costs may be significant.**

The prepared economic analysis includes all elements that could be presented by their financial value. The data were taken from documents prepared for the Programme for the Odra 2006, supplemented by the analysis of external costs.

Time options

The analysis concerned two scenarios. In the first version, costs and benefits were evaluated with regard to the decision to commence the Programme for the Odra 2006, i.e. from the perspective of the year 2002.

The calculations in the second version concerned the potential decision to waive further implementation of investments aimed at improving navigation conditions within the programme, i.e. from the perspective of the year 2007, when the analysis was being prepared. The costs incurred between 2002 and 2006 were treated as “sunk costs” and were not considered in the calculations. However, it was analysed whether a continuation of the investment, i.e. spending of the remaining funds assigned for this goal, would bring benefits exceeding the related costs. Therefore, the second version will be seemingly cheaper, as it provides for achieving the expected benefits of the programme, while incurring only those costs which were planned for 2007-2016.

Discount rate options

An economic analysis of a multi-year investment requires a reduction in the amounts concerning different periods to comparable quantities. The actual value of the same amount of money changes over time, because of inflation and the changing level of wealth in a society. To compare the value of particular amounts (in the case of both costs and benefits of the investment) for different periods, ***discount rates*** are applied.

A low discount rate of about 3% is favourable for those projects, which require high initial expenses and bring significant benefits in the long-term. With a high discount rate of about 8%, projects that bring benefits in the short-term seem more profitable. Such a high discount rate is recommended by international financial institutions for investments implemented in countries of middling wealth, such as Poland, where funds should be focused on investments, which bring perceptible benefits quite fast, considering very high investment needs. A discount rate of about 5% reflects the forecasted growth rate of the Polish economy in the long-term. This is why the economic analysis was prepared for three versions with different discount rates.

Options concerning the costs of maintaining the waterway

The analysis includes estimated investment costs of hydraulic engineering structures as presented by the authors of the Programme for the Odra 2006. However, the programme assumes very low costs of maintaining the navigation route ranging from 1.5% to 2.75% of investment expenses for the initial modernisation and construction of new barrages and weirs.

However, one could expect that maintenance costs could be as high as 5% or 10% of the investment costs. Therefore, our analysis was prepared for each of the three versions of maintenance costs of the waterway.

Investment costs for infrastructure of alternative means of transport

A resignation from investments in the infrastructure of the waterway involves increased investments in road or rail infrastructure. It was assumed that savings concerning the planned investments for modernisation and developing roads and rails will be proportional to the conveyance load taken over by navigation. These savings were estimated at PLN 1.81 for road transport and PLN 0.31 for rail transport per 1,000 tonnes of goods overtaken by inland water transport per 1 km. These savings were included in the economic analysis as benefits.

It was assumed that the alternative for water transport on the Odra is a combination of 20% of rail transport and 80% of road transport, as it was observed at the beginning of implementing the Programme for the Odra 2006.

A comparison of costs and benefits related to implementing navigation investments on the Odra

Based on the above data and assumptions, the costs and benefits for various options were analysed. The results of the analysis are positive, i.e. the benefits are higher than the costs of the investments and maintenance of the waterway, but only in the case of the lowest discount rate and the low level of costs of maintaining the waterway. ***The internal rate of return (IRR)***, i.e. the total level of net benefits resulting from the investment is about 15% for 2007 and almost 5% for

2002. With a middle level of maintenance costs, the internal rate of return is respectively almost 5% and 0%. Moreover, the assumption of the highest maintenance costs of about 10% means that the value of the internal rate of return is negative, about -10%. The results of the analysis change similarly with a discount rate higher than 3%.

This means that with a high discount rate, and high maintenance costs, the total costs of the investment significantly exceed the benefits and it should be remembered that the analysis does not consider such external costs as degrading ecosystems.

The analysis carried out revealed that conclusions on justification of the planned investments to improve the navigation conditions on the Odra are equivocal. Improved navigation conditions on the Odra would bring many benefits but also costs difficult to express in monetary values. Relations between the benefits and costs of the investment depend on the technical and financial assumptions, on the discount rate and evaluation of the external effects.

In the case of modernising the Odra Waterway the ***net present value*** (NPV), reflecting the current value of future benefits related to implementing the investment, is low (or even negative, depending on the assumptions) both for the decision-making scenarios of 2002 and for 2007. The index is positive only if one assumes the lowest, quite unlikely costs of the waterway's maintenance. For the discount rates of 3%, 5% and 8% it is PLN 930 million, PLN 615 million, and PLN 316 million, respectively.

Assuming a more realistic level of maintenance costs at 5%, the index falls to PLN 162 million, PLN -4 million and PLN -150 million, respectively. If maintenance costs are estimated at 10%, which is still realistic, the index is PLN -904 million, PLN -1.003 billion and PLN -1.076 billion for the said discount rates.

		Level of maintenance costs		
		1.5-2.75%	**5%**	**10%**
Discount rate	3%	PLN 930 million	PLN 162 million	PLN -904 million
	5%	PLN 615 million	PLN -4 million	PLN -1.003 billion
	8%	PLN 316 million	PLN -150 million	PLN -1.076 billion

Table 6:
The level of the net present value (NPV) in million PLN for different versions of discount rates and different maintenance costs presented as a percentage of total investment costs. The higher the discount rate and maintenance costs are, the lower benefits become / the higher losses become in relation to implementing the investments to improve the navigation conditions on the Odra. Assuming the highest costs, which are still realistic at about 10% of the investment expenses, they exceed the benefits of the investment.

This proves that an exact estimation of the costs of maintenance of the waterway is the decisive factor for a comprehensive assessment of the economic effectiveness of the project of improving the navigation conditions on the Odra.

It is also worth noting that the benefits related to lower expenses for modernisation of road and rail infrastructure were evaluated at PLN 1 million per year until 2016, when the Programme for the Odra 2006 is planned to be terminated. The benefits related to a reduction in adverse environmental effects were evaluated at PLN 36 million per year. In addition, the benefits related to lower costs of the transport of goods by water as compared to land transport were evaluated at PLN 91 million per year. This means that most benefits will be perceptible to a limited group of private sector carriers and their customers, while both direct and external costs of the investment will be incurred by the entire society.

Conclusions of the social and economic analysis

Stressing that the results of the economic analysis are equivocal, one can draw the following conclusions:

- **The economic effectiveness of investments aimed at improving the navigation conditions on the Odra is positive only if one assumes an unlikely, low cost of maintaining the waterway and a low discount rate**, reflecting the society's readiness to spend big amounts on investments, which will bring benefits in the long-term.
- **As the assessment of economic effectiveness of the investment depends on assumed costs of the waterway's maintenance and the level of the discount rate, this may drive an analyst to question the grounds of the decision to initiate the Programme for the Odra 2006, taken in 2002, and to continue the investment after 2007.** For obvious reasons, in 2002 when the initial decision was taken, the profitability of the investment was much lower than in 2007.

- **The unaccounted environmental costs or costs of actions taken to compensate the environmental damages further decrease the investment's economic effectiveness.** The analysis only includes the benefits related to lessened adverse environmental effects when part of the transported loads is taken over by water transport from means of land transport. However, the authors did not manage to include the costs, which are difficult to express in monetary values, i.e. costs related to deterioration of the environment caused by river training and river fragmentation.
- **If it is resolved to continue the navigation investments on the Odra, their funding should be based on a public-private partnership.** Most benefits from improving the navigation conditions on the Odra will be perceptible to carriers and their customers as transport costs will be lower. Meanwhile, the analysis revealed that the benefits perceptible for the entire society due to a lesser environmental impact at the waterway operating stage will be much lower.

Conclusions

In an attempt to answer the question how realistic and how economically effective the scenario of development of the Odra Waterway is, it was revealed that the feasibility and profitability of investments aimed at improving the navigation conditions of the Odra are doubtful.

The potential of the Odra as a waterway is overrated. The quantities of the natural supply of water to the Odra are insufficient to ensure water levels relevant for navigation of regional, not to mention international, importance. The possibilities of supplying the river with water from reservoirs are limited. The Odra's riverbed has many meanders and narrow sections, too, which significantly limit ship and barge traffic.

Adaptation of the Odra to requirements for Class III of waterways, as planned in the Programme for the Odra 2006 would incur high investment costs, as well as maintenance costs. Apart from significant initial financial expenses for river training and the construction of reservoirs, maintenance of the waterway would require constant funding for modernisation and dredging, as riverbed of the Odra is constantly shaped by erosion and sedimentation processes resulting in the destruction of hydro-engineering structures, formation of shoals and deep waters that would hinder navigation.

Considering the hydrologic and morphologic conditions, meeting parameters required for an international waterway (at least Class IV) on the entire Odra Waterway is virtually impossible without a significant increase in financial investments and without large-scale environmental damages. The impossibility to connect the Odra Waterway with European waterway networks leads to questioning the sense of further involvement of public spending in the project.

The economic effectiveness of waterway investments provided for in the Programme for the Odra 2006 is quite low. It is only positive if one assumes an unlikely, low maintenance cost for the waterway of about 1.5-2.75% of investment costs and a low discount rate of 3%. With a more realistic estimation of maintenance costs and a higher discount rate, the investment should be regarded as economically ineffective. If environmental costs related to control of the riverbed were considered, they would further reduce the economic effectiveness of the planned investment.

The results of the hydrologic and morphometric analysis, as well as the economic analysis suggest the questionability of grounds for the decision to initiate the navigation-related investments in the Programme for the Odra 2006, which was taken in 2002, as well as grounds for the continuation of the investment from the perspective of the year 2007. Implementation of the planned investments involves the necessity to incur immense financial costs in the implementation and operating stages with significant, though hard to express in monetary values, damages to the ecosystems, and ecosystem services, of the river valleys. Taking into account the results of the above analysis, it should be considered to give up actions aimed at adapting the Odra for navigation and to assign funds previously planned for them to implementing projects that bring definite benefits to society and involve a lesser environmental impact.

MICHAEL OTTO
STIFTUNG

The Michael Otto Foundation for environmental protection

Founded in 1993, the Michael Otto Foundation develops strategies and supports projects that lay out the future prospects in the area of nature conservation and environmental protection. This aim is pursued by financial support for large scale nature conservation projects which aim at sustainable protection of waters and wetlands as well as by assisting children and young people in the implementation of their “aqua-projects”.

Furthermore, the Foundation is committed to the sphere of education. It institutes foundation professorships, fosters research and educational centres, and has initiated with its project of “aqua-agents” a learning opportunity for primary school pupils from Hamburg. The third core area is the initiation and moderation of dialog projects: In case of conflicts of interest in current environmental policy issues, the Foundation searches, jointly with decision-makers from the sectors of nature conservation, politics, science and economy, for sound solutions for people and nature.

We protect the environment with people and for people.

WWF is one of the world's leading conservation organisations in the world.
Since 1961 our mission is to stop the degradation of the natural environment and to build a future in which humans live in harmony with nature.
All over the world, WWF is currently running 1,300 projects.

In Poland we deal with the protection of the most valuable rivers and pristine forests, work against the impacts of climate change, carry out a project on the protection of the large carnivore species – wolf, lynx and bear.
We are trying to reduce illegal wildlife trade and ensure that the economic development in Poland takes place while protecting the nature and human needs.

We are able to successfully carry out our mission thanks to the people in Poland and in the world who support us.

Help us to protect nature effectively by making a donation to our account:
24 1030 1999 7111 0000 0700 0001

More information at: www.wwf.pl

WWF®

for a living planet®