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The Lusatian Mining Area Water Management Centre: A Case Study in Successful, Forward-Looking, Cross-Border Water Management in a Mining Region with Limited Water Resources

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Abstract

This case study describes the challenges posed by mining, the rehabilitation of open-cast mines, and the flooding of former pits. It shows how these challenges were overcome through targeted cooperation between the rehabilitation mining company, the state and federal authorities and the active mining company. It also shows how the parties involved are preparing for future challenges resulting from the end of lignite mining and climate change. The article follows a case study approach in which Lusatia is examined as a model region. It is based on the experience of a publicly funded mining rehabilitation company LMBV in water management over the past 25 years and considers the cooperation with ministries, specialist authorities, and companies. The insights gained are intended not only to provide an understanding of the transformation of water management in Lusatia, but also to identify starting points for other former mining regions.

Keywords: Pit lake flooding, water management, river basin management, cross-border water coordination

Introduction and historical context

Due to lignite mining, Lusatia is one of the regions in Germany that has undergone the most significant transformation in terms of water management. The history of lignite mining in Lusatia goes back over 200 years, with its beginnings in the 18th century and large-scale expansion since the second half of the 19th century. Active mining has resulted in rivers being straightened, channels being expanded and relocated, and groundwater being lowered over large areas in order to drain the mines.

One of the greatest challenges in Lusatia was and still is to restore the water balance, which has been significantly disrupted by mining, to a largely self-regulating state. At the peak of the lignite industry in the former socialist eastern Germany, up to 190 million tons of lignite were mined in Lusatia each year. This required the extraction of a total of approximately 1.2 billion cubic meters of water per year. In some places, the groundwater level was lowered by up to 100 meters. By 1990, this had resulted in mining-induced groundwater lowering over an area of around 2,000 square kilometres and a total deficit of approximately 13 billion cubic meters of water. Part of this area is still used today for active lignite mining.

With the closure of individual opencast mines since the 1990s, the restoration of the land in accordance with mining law has begun, coordinated by the publicly funded LMBV, a private company owned by the German federal government. The central objectives are to restore the water balance, flood the opencast mining pits to create post-mining lakes, secure embankments, prevent landslides, and limit iron and sulphate pollution through water management measures.

At that time, the region was undergoing a period of turmoil following political change: numerous mines were being closed down, and flooding the huge mine pits was a key objective in order to create new landscape and water structures. In Lusatia, which

otherwise has relatively little runoff, this project posed a considerable planning and technical challenge and laid the foundation for today's water management. This created the need to establish water management networks to coordinate both the technical processes of flooding and the cross-border interactions in the water balance. Against this backdrop, the first transformation of water management began.

The founding of the Lusatia Flooding Centre in 2000 was a decisive step for the situation at the time, which today proves to be an important starting point for the upcoming structural change. The aim of the LMBV was to flood the opencast mines as effectively as possible and create stable hydrological conditions in the remediation areas, while the federal states remained responsible for maintaining minimum water flows and managing the river basins. In order to combine both levels and advance the flooding process as quickly as possible, the Lusatian Flooding Centre was ultimately established as a technical unit within the LMBV.

Its main task was to coordinate the flooding of former opencast mines across state borders, regulate water levels, and ensure water quality. In Germany water management is generally considered to be a sovereign task of the federal states. In the mining area, however, the LMBV, as a private company, albeit owned by the state, has de facto taken over parts of these sovereign tasks. However, this primarily concerns the technical aspect, i.e., the assessment of the hydrological situation, the calculation of scenarios, and the formulation of control measures. The management proposals of the Flooding Control Centre were then discussed with the authorities of the two federal states. Once an agreement had been reached, the Flooding Control Centre initiated the control measures.

Study area

The area of activity of the Flooding Control Centre, which has since been renamed the Water Management Centre, covers a region in which a large number of former opencast mines, mining lakes, reservoirs, and watercourses interact with each other in a complex network system and across different federal states.

The Water Management Centre is in charge of 18 inlet structures, 12 outlet structures, 13 transfer channels, 65 weir systems, 47 pumping stations, 16 water treatment plants and three horizontal filter well systems. Additionally, the system incorporates numerous other water management facilities overseen by different federal states.

A characteristic feature of the region is the close interconnection between mining lakes, dams, reservoirs, and connecting canals and rivers and tributaries. The area is naturally a rather water-poor lowland area with sandy soils and low natural runoff and comprises the catchment areas of the Spree, Schwarze Elster, and parts of the Lausitzer Neiße rivers.

The main focus of management in the Spree river is on protecting the Spreewald Biosphere Reserve wetland and on the city of Berlin, where the water is used to produce drinking water. The primary concern in the Schwarze Elster river, on the other hand, is ensuring minimum ecological flows and facilitating tourist use of the post-mining lakes.

In addition to the issues of groundwater lowering and large-scale flooding related to mining, there are problems such as low water levels in watercourses, ensuring the supply of water for use, complying with minimum ecological flows, maintaining limit water levels in post-mining lakes and improving water quality, which is negatively affected by acid-mine-drainage.

Flooding of the Pit Lake Chain

The Pit Lake Chain consists of four interconnected, navigable opencast mining lakes and is located in the Schwarze Elster catchment area. Two of these lakes are divided by the border between two federal states, which means that two water authorities and two mining authorities are responsible for issuing permits.

The lakes were designed to help support the flow of the Schwarze Elster river when necessary. They are also very important for tourism in the region. Active flooding began in 2004 via the introduction of water from the Schwarze Elster river. A supply structure with a capacity of up to 10 m^3/s is available for this

purpose. However, as the Schwarze Elster has only very low flow rates, inflows from the Lausitzer Neiße and the Spree can be used via a transfer channel and two pumping stations. The flooding of all four lakes was completed in 2025. Together, they cover a water area of around 40 km² and have a total volume of approximately 580 million m³.

The flooding phase for these lakes, which lasted over 20 years, required complex water management and close coordination between various stakeholders. The Flooding Centre acted as a connecting element between the geotechnical remediation carried out by LMBV and the relevant approval, technical and supervisory authorities. A key challenge was distinguishing between the responsibilities of mining law and water law. As the flooding progressed, the opencast mines gradually transformed into recognisable water management facilities. This also altered the responsibilities and approval procedure requirements and responsible authorities over time. The Lusatia Flooding Centre played a pivotal role in communicating these changes to the LMBV and incorporating them into ongoing planning and remediation processes.

Coordination with the relevant authorities takes place primarily via an established committee structure, the River Basin Management Working Group (Fig. 1). This working group consists of a decision-making body, regularly convening specialist working groups, and topic-specific expert committees.

In contrast to traditional dam construction, the creation and restoration of opencast mining lakes takes place in parallel with flooding. It was therefore unusual for the water authorities to approve flooding, even though the final lake structure had not yet been completely established. Only through close cooperation between LMBV and the water authorities was it possible to repeatedly find compromises to ensure that the restoration work progressed.

The flooding occurred in stages. Due to geotechnical specifications, there were temporary limits on the water level that could not be exceeded. This meant that some of the water had to be pumped out. Before being discharged into the Schwarze Elster river, the drained water was chemically treated, neutralised and its iron content removed. As the Schwarze Elster river often has low discharge rates in summer, the

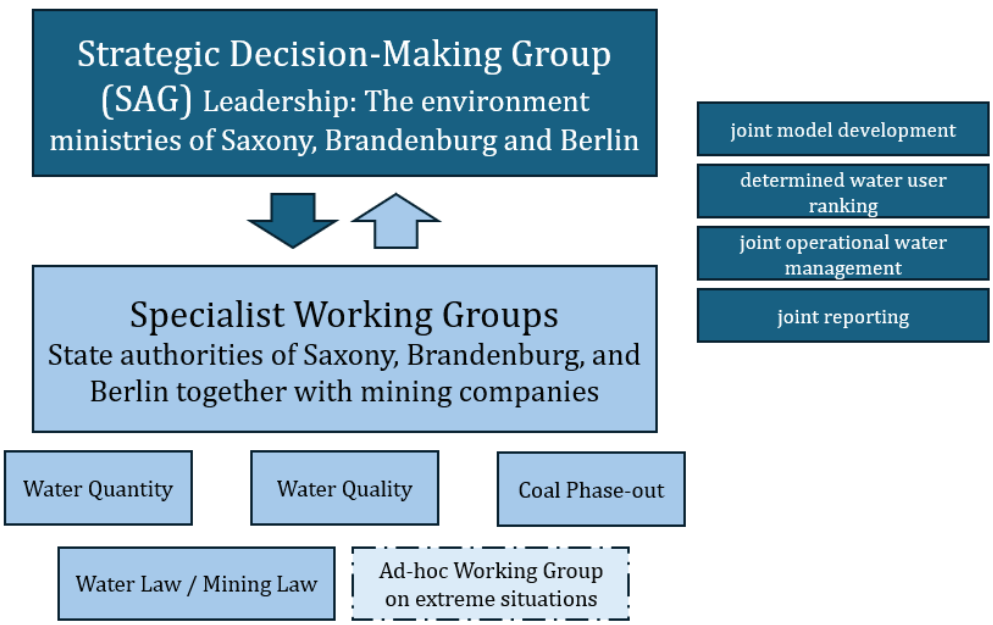

Figure 1 *River Basin Management Working Group Scheme.*

water authorities decided from early on that the Pit Lake Chain would have to provide a permanent water supply to support the river. To avoid jeopardising the remediation process, scenarios were developed using a joint management model that would allow simultaneous flooding and river support.

Similar coordination processes were required again in 2023, when a nearly constant water level in a pit lake was needed for several months for earthworks and compaction measures. The state authorities involved then examined whether temporary storage could be provided in the neighbouring lakes. The issue was raised early on in the Water Quantity working group and prioritised as a short-term measure. Various solution scenarios were calculated using the management model, and ultimately, a variant was approved that ensured the success of the remediation.

Dry period

Between 2018 and 2020, Lusatia experienced a pronounced dry period, which posed considerable challenges for water management. Not only was 2018 the warmest year since weather records began in 1881, but with a precipitation deficit of 36%, it was also one of the driest. Over the course of the entire dry period, this deficit amounted to around -612 mm, which is comparable to the average annual precipitation in the region (DWD 2026). The high temperatures also led to exceptionally high evaporation.

Consequently, several sections of waterway dried up and the water supply to the UNESCO Spreewald Biosphere Reserve wetland was sometimes severely compromised. Fortunately, thanks to the existing institutional structure, the Ad Hoc Working Group on extreme situations could be convened quickly to develop appropriate management strategies and make optimal use of the available water resources.

As part of these measures, the existing management rules were temporarily adjusted. For instance, lower minimum flows were permitted in watercourses to ensure the storage reserves in reservoirs remained available for longer. To conserve water reserves in the reservoirs, guideline values for sulphate concentration in the Spree were also temporarily increased. Additionally, water from the management lamellae of pit lakes undergoing remediation was used to support watercourses. Overall, the LMBV pit lakes provided over 210 million m^3 of water to the rivers during the three dry years (Scholz and Lucke 2019, Scholz and Totsche 2020, Scholz and Totsche 2021). Furthermore, the active mining company reduced the amount of drainage and thus also the discharge of particularly sulphate-rich water into the Spree during particularly critical periods in order to maintain water quality.

To systematically record the hydrological situation, a large-scale, cross-state flow measurement campaign was carried out in 2019. Around 150 measurements were taken in the Spree river and the UNESCO Spreewald Biosphere Reserve during this campaign. Thanks to the close collaboration of the environment ministry representatives in the Ad Hoc Working Group, these measures were implemented swiftly and without bureaucracy. This was followed by a joint cross-state evaluation of the events and the preparation of a comprehensive low water report (Creutzfeld *et al.* 2023). The data and findings from the measurement campaigns formed the basis for the development of a low water concept. Without the close coordination of the parties involved and the targeted use of water from the opencast mining lakes still undergoing remediation, the effects of the dry period on land use and aquatic ecosystems would have been much more severe.

Future challenges

Restoring the over many decades severely depleted water balance is one of the core tasks of the LMBV. By 2025, the original water deficit of 7 billion m^3, consisting of 2.5 billion m^3 in pit lakes and 4.5 billion m^3 in groundwater depressions, had been reduced by 6.4 billion m^3 within the LMBV's area of responsibility.

After 30 years of successful work, the flooding of the Lusatian opencast mining pits has largely been completed and the resulting pit lakes are now being used for water management and tourism purposes.

This reflects the fact that water management, rather than flooding, is now the main focus. The Lusatian Flooding Centre was renamed the Lusatian Water Management Centre in 2025. Despite the successes already achieved, restoring the water balance in Lusatia will be a task for generations to come.

The impending phase-out of coal will directly impact the water balance of the watercourses in Lusatia. Currently, around half of the summer discharge originates from active mining operations. In the Spree river, discharges from active mining are almost constant at 150 million m^3/a (5 m^3/s). Once coal has been phased out by 2038, these discharges will cease over the following years. This will significantly impact the water balance in Lusatia. At the same time, huge new opencast mines will need to be flooded. The expected water deficit in 2038 will be around 1.7 billion m^3 in the opencast mines, and an additional 3.1 billion m^3 will be lost from the groundwater.

Climatic changes are already noticeable. Temperatures are rising and precipitation patterns are changing. Heavy rainfall events that are intense but short-lived are becoming more frequent. Long-lasting, steady precipitation is becoming less common, however. These changes are already impacting groundwater recharge and, consequently, runoff formation throughout the entire area. While the pit lakes can partially compensate for the outflow in summer, the likelihood of the storage capacity being refilled in winter and spring is declining.

The Lusatian mining region has become accustomed to high water availability due to the long-standing oversupply of mine-water. However, increasing periods of drought are showing that there is no longer enough water in Lusatia for all uses. The phase-out of coal by 2038 and the subsequent end of water extraction will further reduce the water supply. At the same time, huge new opencast mining pits will need to be flooded, creating additional competition for water resources. These developments are further compounded by climate change, which is bringing longer dry periods and lower precipitation.

State authorities and mining companies are therefore collaborating intensively within the River Basin Management Working Group to develop new strategies. Models are being updated extensively, and studies on storage optimisation, as well as the maintenance and expansion of the technical networking of watercourses, are being commissioned. Additionally, investigations are being conducted to ascertain whether new storage locations can be identified within the catchment areas, or if transfers from other regions are feasible.

Conclusion

The case study demonstrates that the added value of the Lusatian approach lies not only in technical water management, but in the establishment of a permanently coordinated governance and management system. The establishment of the Flood Control Centre, which brought with it additional responsibilities for the LMBV in terms of watercourse management, was a win-win situation for both the LMBV and the authorities. The authorities were supported in their work by a group of highly qualified specialists with sophisticated models for forecasting and water management. The LMBV, on the other hand, obtained optimal water control to implement its remediation tasks. Over time, both the state authorities and the LMBV began to view their respective areas of responsibility, i.e., the authorities' responsibility for rivers and water distribution and the LMBV's remediation tasks, as a joint task. Neither side waited for the other to make proposals, but worked together to find a joint solution.

The existing close cooperation in both strategic planning and the development and updating of model bases creates the conditions for overcoming the current challenges in the best possible way. Key instruments include coordinated reporting systems, documented decision-making processes, and the joint use of storage management models to evaluate different scenarios. It is essential to involve all relevant institutions at an early stage in order to streamline approval procedures and identify potential conflicts between mining law and water management requirements at an early stage. The advantage of the committee work lies in

its structural anchoring, high transparency, and interdisciplinary continuity. This creates trust, supports a common understanding of complex interrelationships, and enables coordinated and legally secure decisions to be made even under exceptional conditions such as droughts or remediation constraints.

The establishment of a water management unit at a mining (remediation) company and the close cooperation with the authorities, structured through committees, can serve as a model for other mining areas with demanding water management requirements. Transferable principles include: (i) the early institutional integration of mining and water authorities, (ii) the use of shared data and modeling frameworks as a basis for decision-making, (iii) the establishment of flexible regulatory frameworks for extreme situations, and (iv) the active use of opencast mining lakes as strategic water reservoirs within larger river basin systems.

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References

DWD (2026) Climate Data Centre, Deutscher Wetterdienst 2026, Offenbach am Main, https://opendata.dwd.de/climate_environment/CDC/

Scholz E, Lucke B (2019) Wasserwirtschaftlicher Jahresbericht der LMBV für den Zeitraum 01. Januar–31. Dezember 2018. Lausitzer und Mitteldeutsche Bergbau Verwaltungsgesellschaft, Senftenberg 03/2019, p 10

Scholz E, Totsche O (2020) Wasserwirtschaftlicher Jahresbericht der LMBV für den Zeitraum 01. Januar–31. Dezember 2019. Lausitzer und Mitteldeutsche Bergbau Verwaltungsgesellschaft, Senftenberg 03/2020, p 17

Scholz E, Totsche O (2021) Wasserwirtschaftlicher Jahresbericht der LMBV für den Zeitraum 01. Januar–31. Dezember 2020. Lausitzer und Mitteldeutsche Bergbau Verwaltungsgesellschaft, p 19

Creutzfeld B *et al.* (2023) Auswertung Niedrigwasser 2018, 2019 und 2020 – Spree, Schwarze Elster und Lausitzer Neiße, Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (LfULG), Dresden 24.02.2023