Success story

Transforming abandoned mining pits into new lake districts

It is no secret that mining industry can have severe consequences for regions and the surrounding landscape, impacting vegetation and wildlife negatively when mining production is abandoned. Rehabilitating old mining areas can be a highly difficult challenge and few succeed. However, with the right strategies and tools available, abandoned mining pits can be turned from lifeless landscapes into prosperous manmade lake districts. This is what has been done in Eastern Germany, where DHI-WASY was able to provide accurate analysis and the right strategies for creating a new lake.

Rehabilitating Eastern Germany mining pits

Large parts of Southern Brandenburg and Saxony in Eastern Germany are characterised by large industrial mining zones used for extraction of lignite and electricity. Although mining activities are still on-going and three large power stations continue to produce electricity, some of the industrial activities are planned to be phased out by 2015. A number of old pits left by the mining process have already been transformed into a new landscape, creating a huge new lake district never before seen in this region. In connection with the development of a new lake, Cottbuser See, which is approximately 19 km² in size, DHI-WASY was contracted by Vattenfall Europe Mining AG to analyse the flooding process.

Reducing flooding period

The challenge consisted in providing the right strategy for filling up the lake in a reasonable short amount of time while still maintaining control and guaranteeing an acceptable discharge within the source of additional surface water. DHI-WASY came to the conclusion that by using a strategy that included additional surface water inflow, the time necessary to complete the flooding of Cottbuser See could be reduced significantly. The results showed that it will take approximately five years to flood the lake up to a level of +63.5 m AMSL by using additional surface water inflow from the river Spree. This means that the flooding will be finished around 2023, which is more than 10 years earlier compared to the flooding period applying a strategy without additional surface water inflow and about seven years earlier than previous studies estimated.

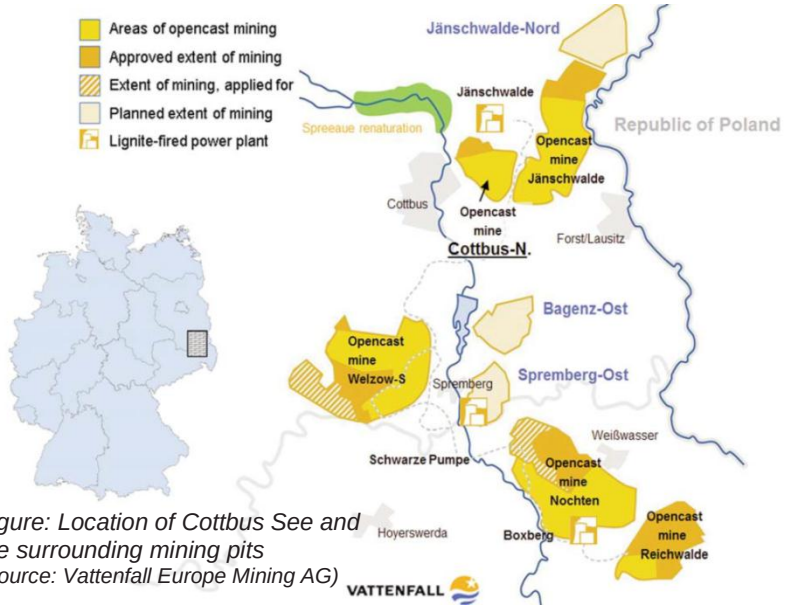

Figure: Location of Cottbus See and the surrounding mining pits
(Source: Vattenfall Europe Mining AG)

Precise, integrated and reliable modelling proves essential

In order to reach these results, the use of integrated groundwater modelling was essential. The following modelling components were used:

- a 3D FEFLOW groundwater model
- a FEFLOW plug-in termed IfmLAKE enabling detailed description of the flooding
- a WBalMo water and allocation model to identify long term water needs and optimal allocation strategies
- a MIKE 11 surface water model to describe different options for the outflow to the river Spree.

For more information about the MIKE by DHI software products, please visit www.mikebydhi.com.
For more information about this project, please contact Bertram Monninkhoff at B.Monninkhoff@dhi-wasy.de
*This success story is based on the text by Bertram Monninkhoff & Junfeng Luo in the DHI-WASY Aktuell 3/12.

By using FEFLOW, DHI-WASY was able to describe the water level development of the lake. This was done with detailed information about the inflow into the lake available in the form of groundwater inflow, surface water inflow, and rainfall and evaporation at the surface.

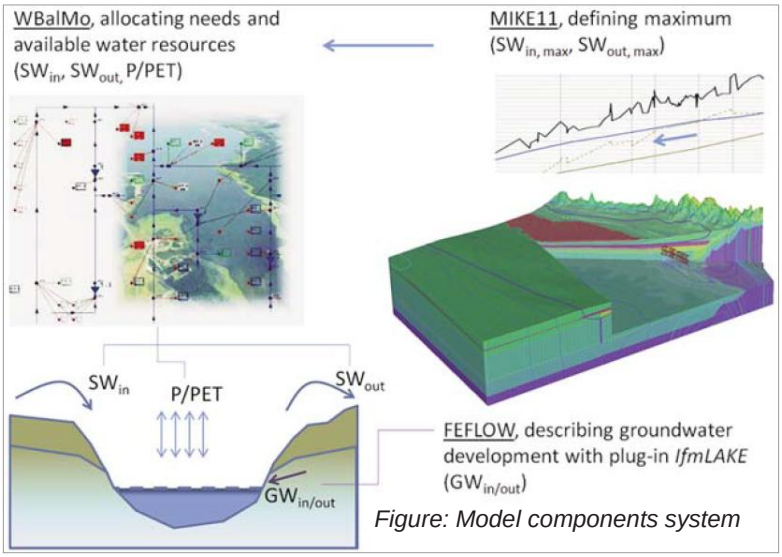

Figure: Model components system

In addition to the inflow into the lake, it was important to get detailed information about the long term water needs as well as the availability of Spree River. For this purpose, the water management and allocation software WBalMo was extended and updated to provide a good basis for long term management analyses of the lake Cottbuser See. Optimisation analyses of the WBalMo model had to be restricted with respect to the maximum possible outflow discharge towards the Spree. For this reason, first hydrodynamic analyses using a MIKE 11 1D model were made for routes along the existing branch Schwarzer Graben, as well as for alternative routes directly towards the Spree. By applying the MIKE 11 model component, DHI-WASY was able to analyse the maximum outflow rate of the planned diversion system.

For this project, the FEFLOW IfmLAKE plug-in was extended to offer the possibility of linking series of lakes. With the plug-in FEFLOW nodes can be defined as basin linking points including corresponding weir levels and widths. In case the basin levels at both sides of a single weir are above the weir crest, both lakes are regarded as a single lake and the corresponding water level–volume curves are integrated. This feature was used to divide the lake Cottbuser See into eight separate parts. This was necessary to describe the flooding of the different basins, especially the basin which was used to fill the lake with additional surface water from the Spree River.

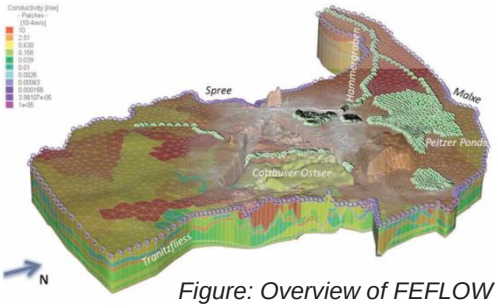

Figure: Overview of FEFLOW 3D groundwater model with applied

Applying new features of FEFLOW 6.1

For the purpose of this project, new features of FEFLOW 6.1 were successfully applied. This was especially useful to derive exchange rates between each basin and the different geological horizons. Expression based selections could be used to define observation point groups for each single exchange area. These results could then be used by Vattenfall Europe Mining AG to analyse also qualitative aspects of the flooding process.

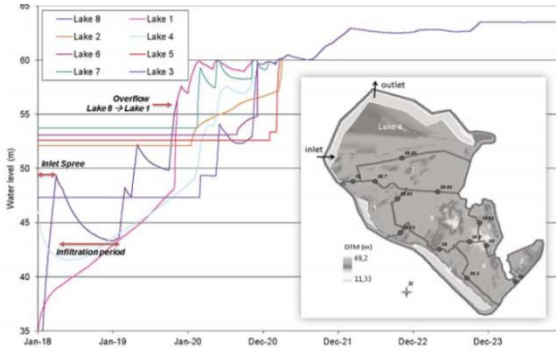

Figure: Water level development within single lake basins with additional surface water inlet