Mining- and Environmental Rehabilitation

A sustainable investment into future



Workshop: Solutions for the remediation of contaminated sites in Slovakia

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Structure

Overview of the mining areas and LMBV

Geotechnical works

Rehabilitation of the Water household

Re-cultivation

Site Development and tourism

Summary

Lignite rehabilitation areas of LMBV

LMBV – the company

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- **State owned company (Ministry of Finance)**
- **Responsibility: Decommissioning and rehabilitation of sites used by the lignite mining industry of the GDR**
- **Includes:**
  - **the re-cultivation of dumps feasible for re-use in the public interest**
  - **the restoration of a self regulating water balance according to water quantity and quality**
  - **utilization of properties**

Organization of the lignite mining rehabilitation

Steering & Budgeting Council: StuBA
National Gov.: Ministries of Finance, Environment, Economy
4 Federal States: Ministries
Office of National Gov. & Federal Government
Hosts: LMBV, (Labor Agency)

- Acceptance of overall planning
- Budgeting and approval of projects
- Controlling
- Audits of Resource allocation

Regional rehabilitation council
(National/States/Communities)
- Acceptance of Planning
- Consideration of public interests

Federal Audit Office

Project Management Organization: LMBV

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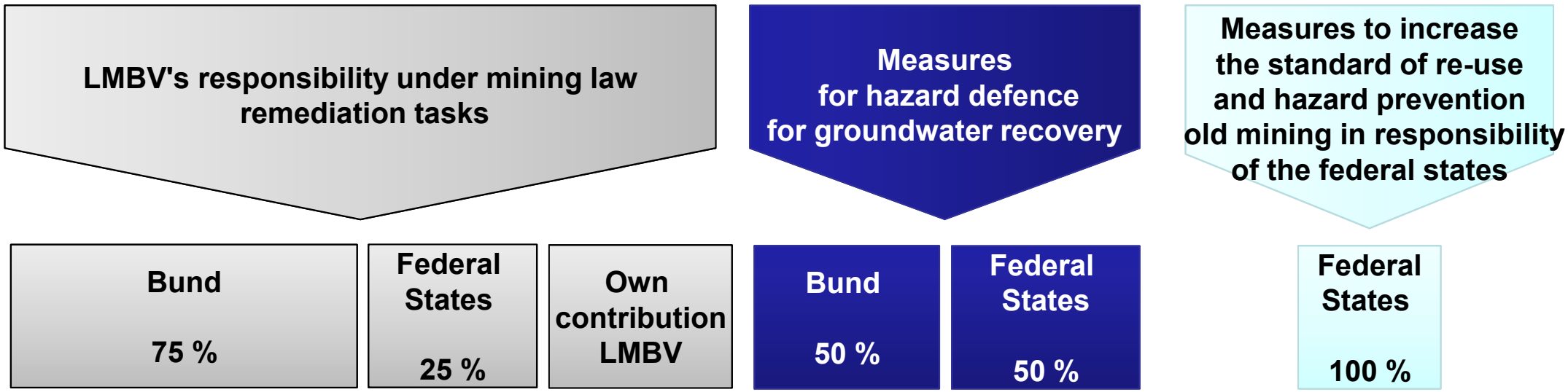
- Rehabilitation Planning
- Obtaining of permission
- Tendering / Contracting
- Project Control / Controlling
- Preparation of reuse / Utilization of properties
- Proof of fund allocation

Execution: Private Companies

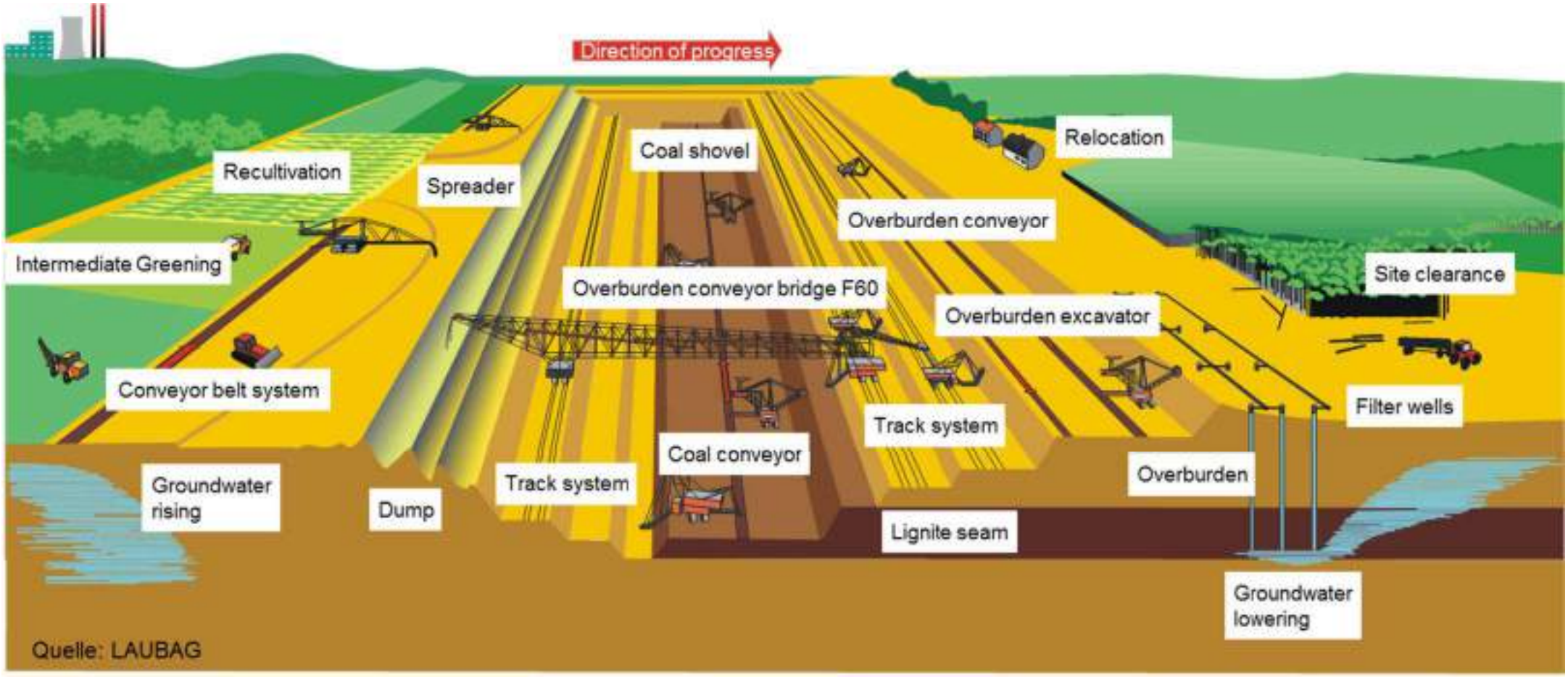
- Execution of rehabilitation work after competitive tendering
- Billing and handover of contract content

Financing basis Administrative Agreement Lignite Mining Rehabilitation



In 1992, the federal government and the affected states agreed on the joint financing of the ecological contaminated sites on the territory of the former GDR. This resulted in the administrative agreement on lignite remediation.

Principle of overburden and lignite excavation and movement



- **Short distance (Direct dumping combination)**
- **Mixed substrates => physical and chemical quality problems possible**
- **Lose material density in Lusatian region (sandy substrates)**

Lignite mining with conveyor belt bridge

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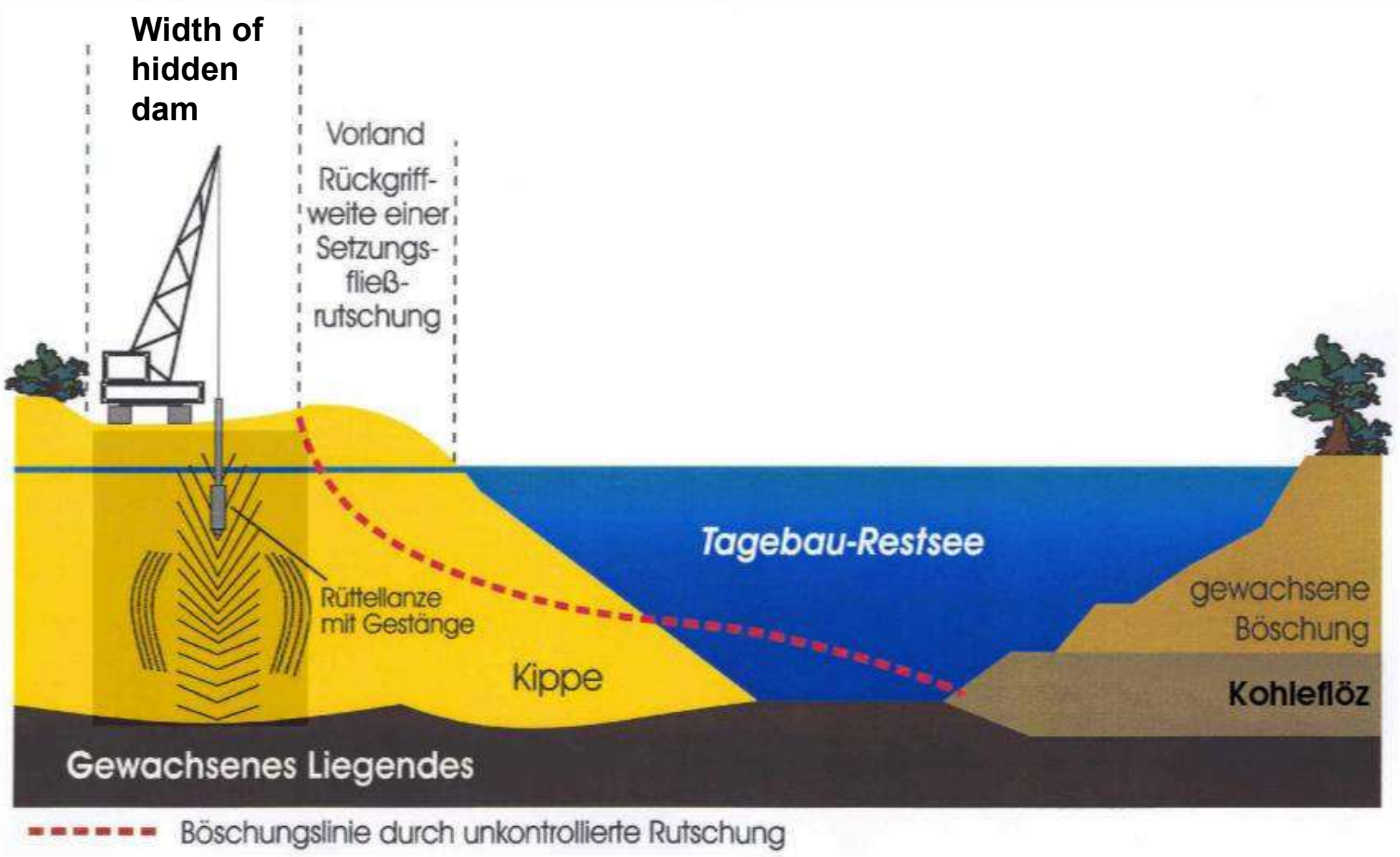
Principle of vibro-compaction for dump-slopes



Geotechnical tasks

Open-pit Meuro 2013

In total: compaction of 1,167 bill. m³ of masses on LMBV dump slopes

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Geotechnical reinforcement

- **Earth moving and contouring as support of the eastern slope of former open-pit Wulfersdorf**
- **Compaction with Drop Plate Compaction**

Geotechnical reinforcement railway bed Lohsa

depth compaction eastern slope Silver-lake:

950 m length

50 m width

Temporarily with 4 machines

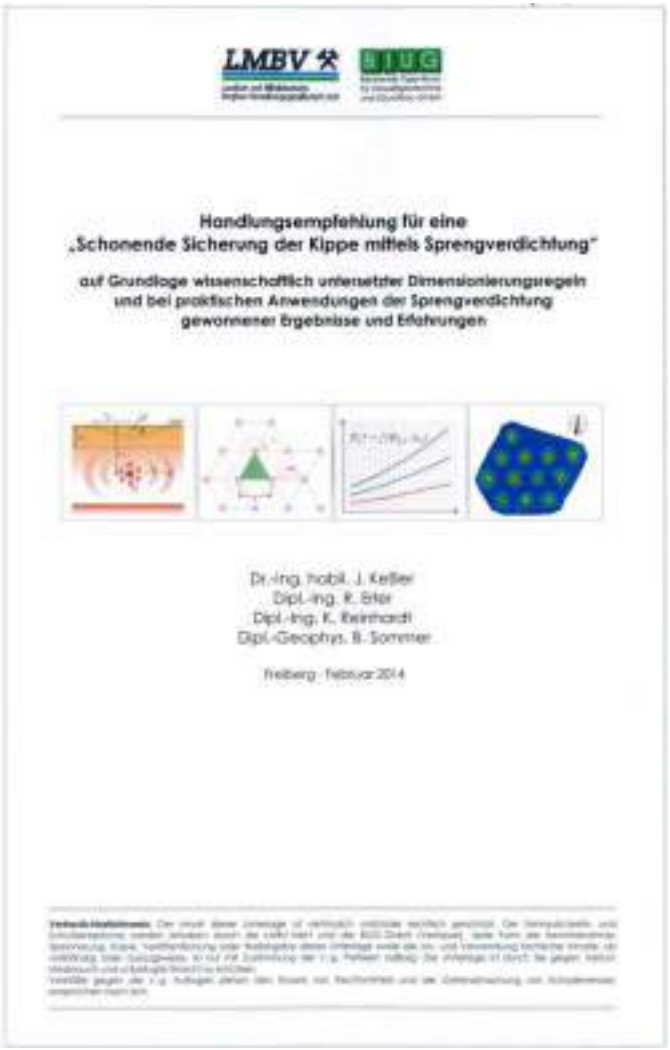
Site collapse inner-dump Spreetal in October 2010, 170 ha

New technology: gentle blasting compaction

Total geotechnical restricted areas : approx. 33,500 ha
Areas with geotechnical securing requirements: approx. 20,600 ha
Gentle blasting compaction 10,000 ha (only 7 -22 kg explosive material per borehole)
Vibrating pressure compaction 840 ha
Earthworks 20,000 ha

Gentle blasting compaction

Solving the new geotechnical problems



LMBV

BIUG

Handlungsempfehlung für eine
„Schonende Sicherung der Kippe mittels Sprengverdichtung"

auf Grundlage wissenschaftlich untersetzter Dimensionierungsregeln
und bei praktischen Anwendungen der Sprengverdichtung
gewonnener Ergebnisse und Erfahrungen

Dr.-Ing. habil. J. Keßler
Dipl.-Ing. R. Brör
Dipl.-Ing. K. Reinhardt
Dipl.-Geophys. B. Sommer

Freiberg · Februar 2014

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CDM Smith

Handlungsgrundlage
zur komplexen Bewertung
der Innenkippenflächen der LMBV in der Lausitz

Senftenberg, Januar 2015

Dr. Keßler
BIUG

Dr. Reinhardt
CDM Smith

Schiedrich
Geschäftsführer

ppa. Scholz
Bereichsleiter Technik

Erneuert 2024

LMBV

IGF Ingenieurbüro für Geotechnik Dr.-Ing. Friedrich

Anwenderempfehlung

für Belastungsversuche als Bestandteil von
Standsicherheitsnachweisen von Innenkippenflächen

BOMAG

Freiberg, Senftenberg, 05.12.2016

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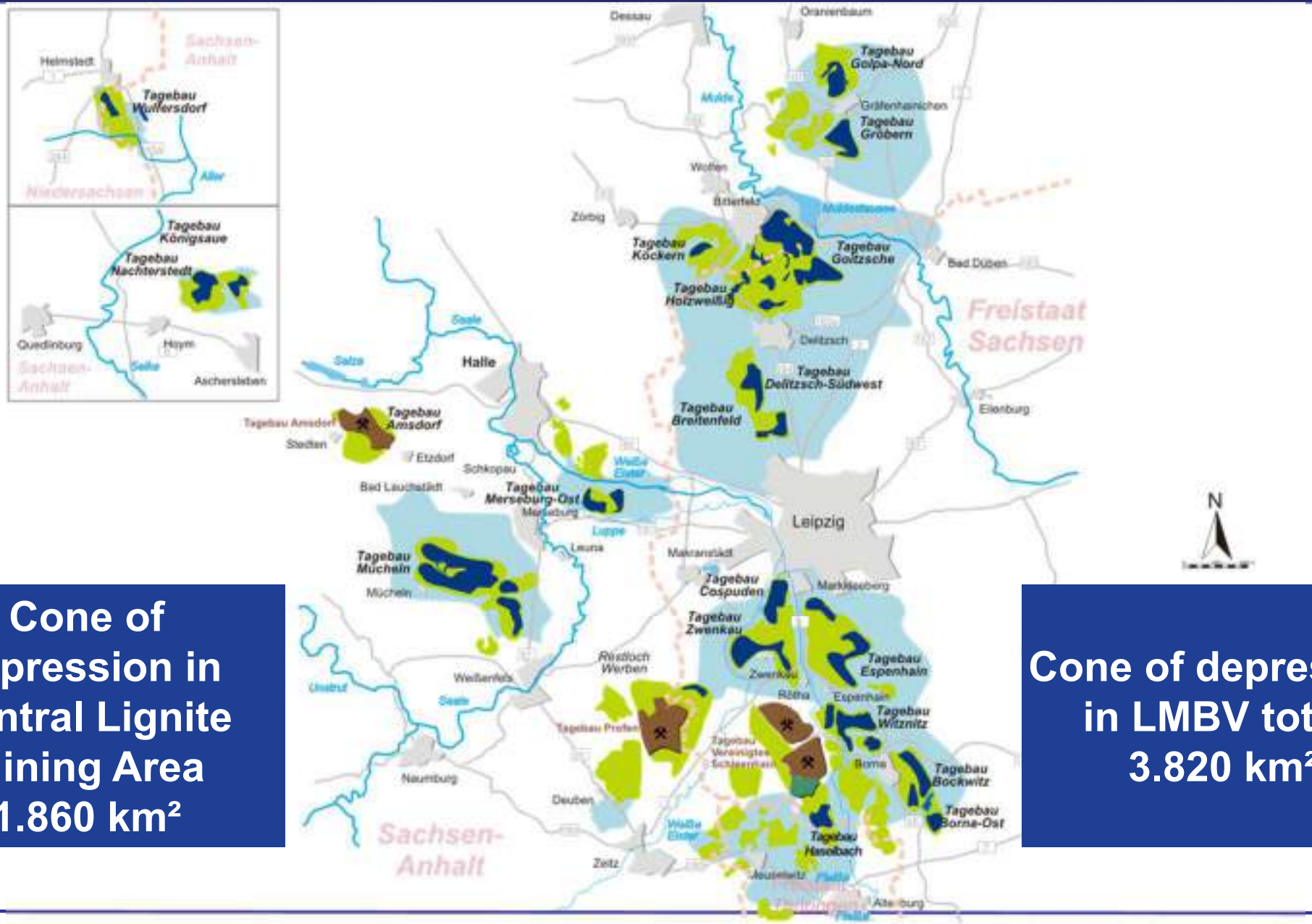
Groundwater lowered area caused by open-pit mining



Cone of depression in Central Lignite Mining Area 1.860 km²

Cone of depression in LMBV total: 3.820 km²

Flooding of the pit-holes

- Flooding of 170 post- mining holes

  there as 51 great post-mining lakes

- Total water area app. 25.000 ha

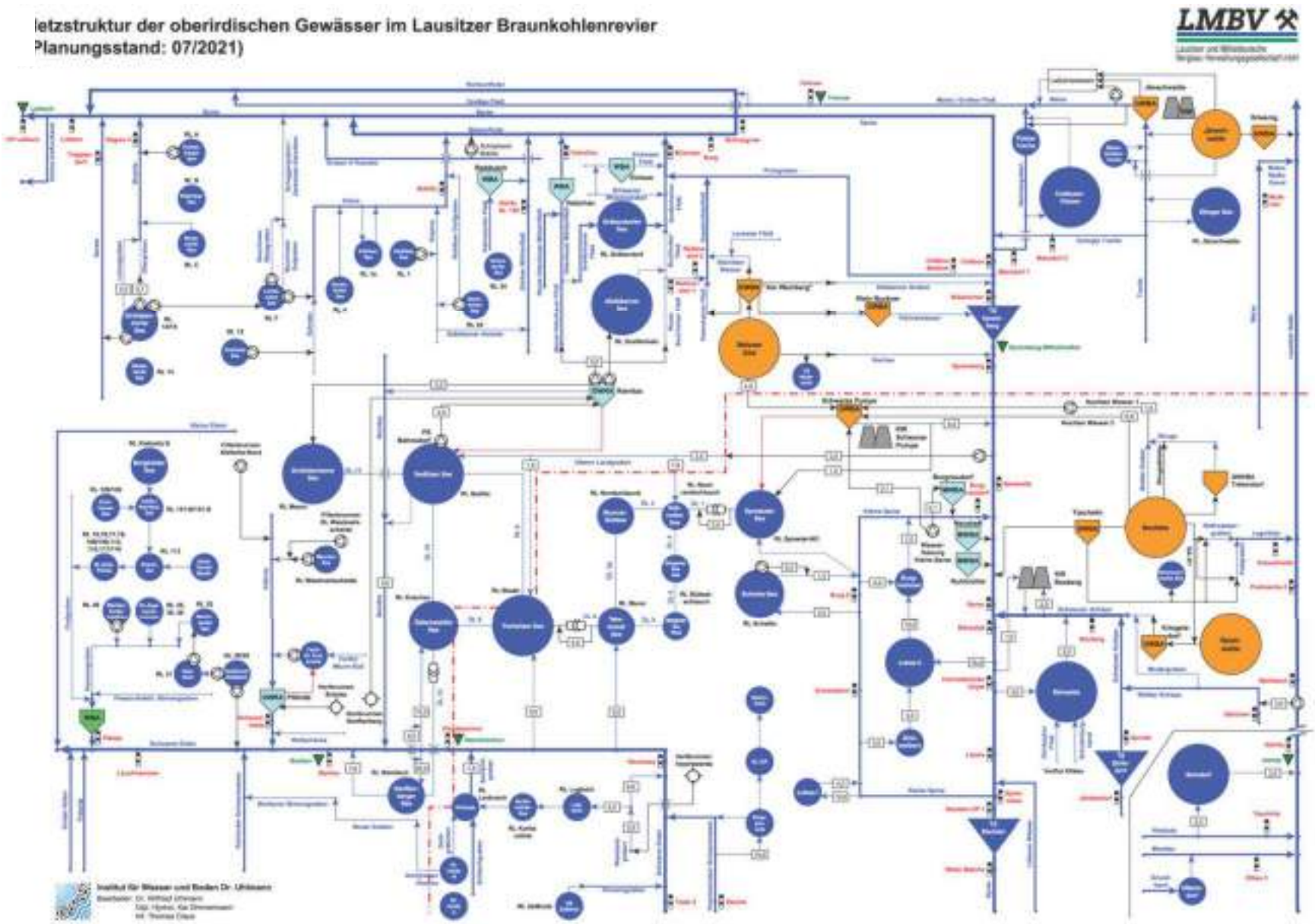
Maximum use of extraneous water (Fremdwasser)

Goal

- Fast flooding
- Ensuring geotechnical stability of the slopes
- Enhancing the water quality

Net structure of surface waters in Lusatian lignite mining region

Flooding Control Center



Rehabilitation of Water household

Construction of channels for flooding with water from rivers

Construction of pipelines

Outflow from post-mining lake Bärwalde

Connecting channel 12 (Koschener Kanal)

Extension of the channels above hydrological needs to use them for touristic purposes with boats and excursion boats

Lusatian lake chain

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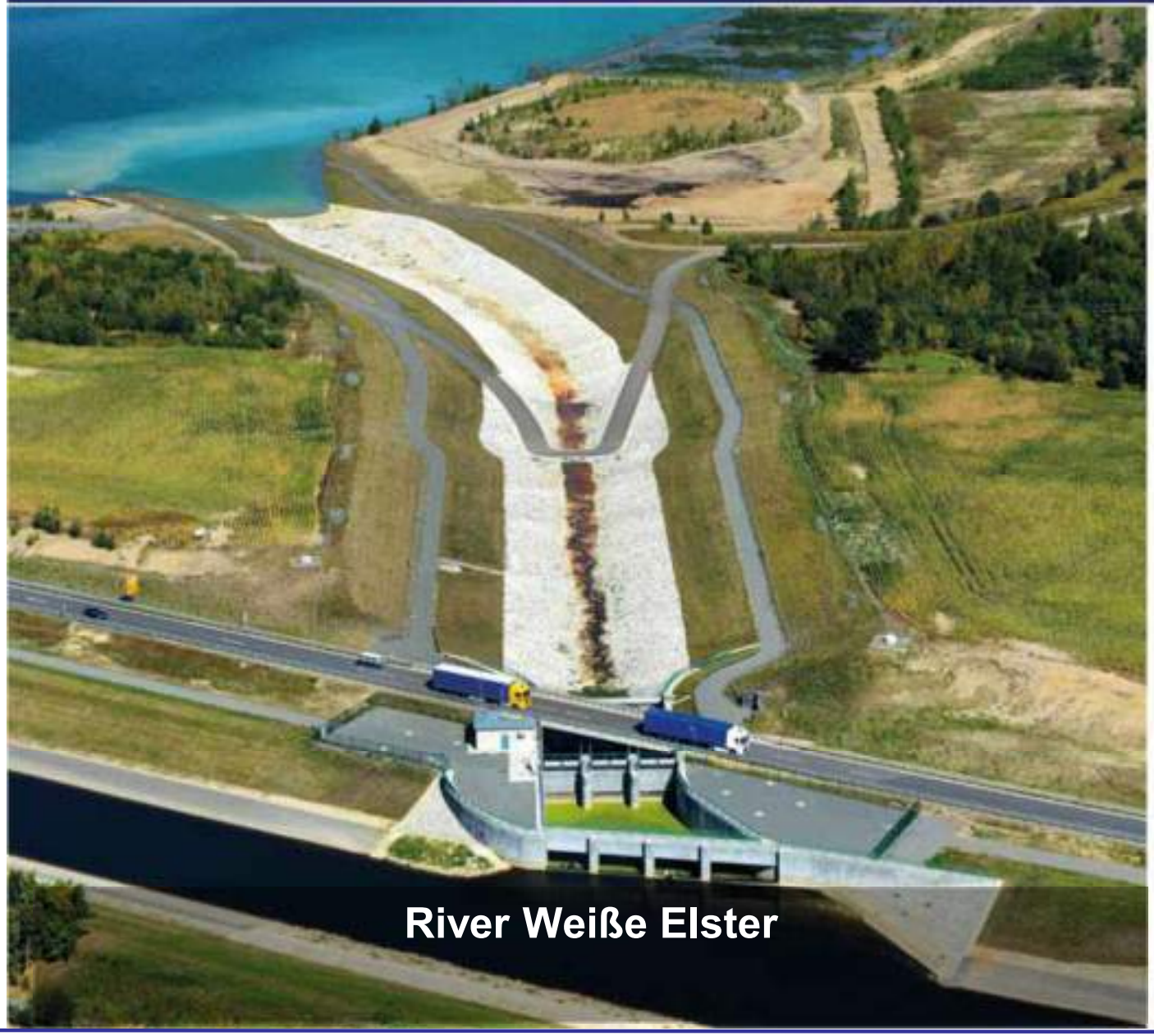
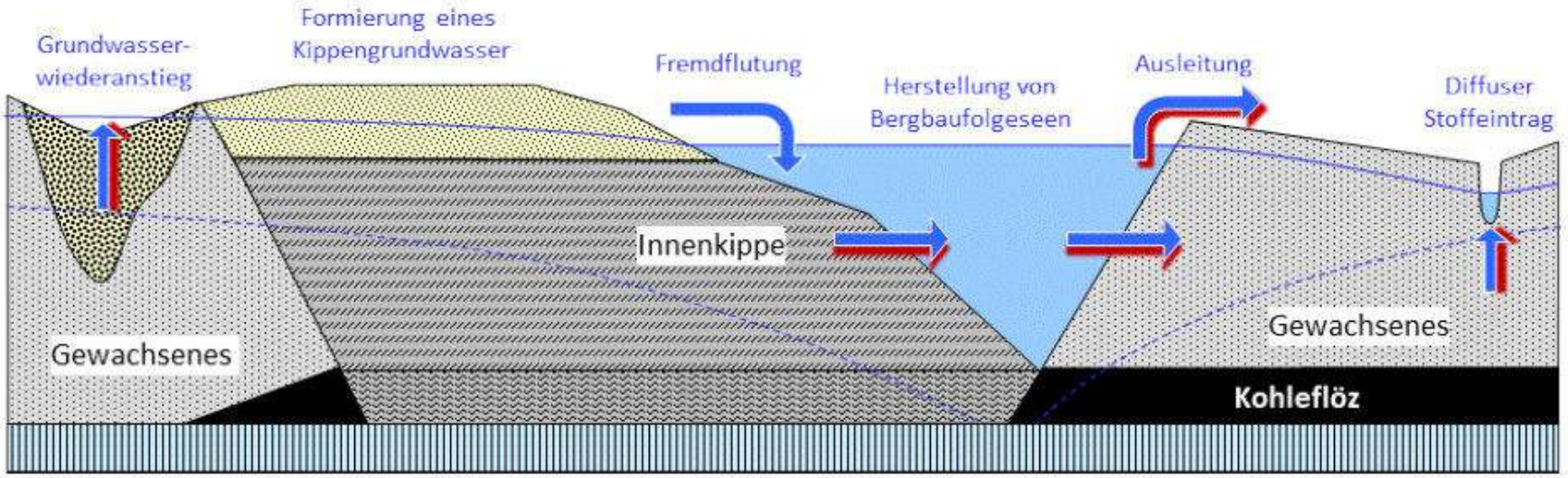
Flood protection: Open-pit Zwenkau



Inauguration May 2013	
Costs of construction:	**11 Mio. €**
Capacity:	**130 m³/s**
Flood protection volume:	**18,5 Mio. m³**
Discharge in 21 days:	**14,5 Mio. m³**

Problems related to quality



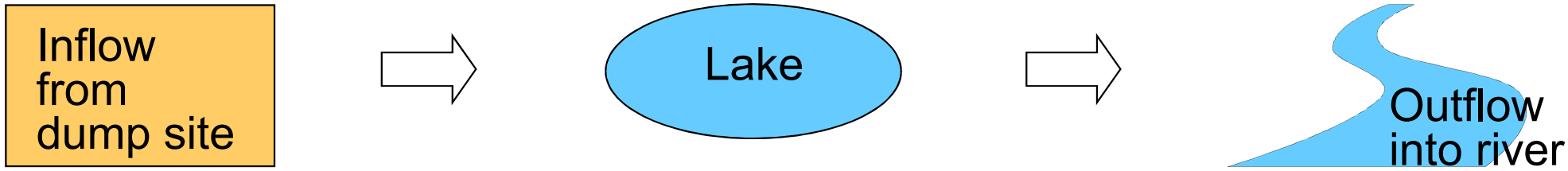
$$FeS_2 + 3{,}75\ O_2 + 3{,}5\ H_2O \rightarrow 2\ SO_4^{2-} + 4\ H^+ + Fe(OH)_3$$

Pyrite + Oxygen + water → Sulphate + acid + Iron-hydroxide

water influenced by mining

- ➡ **high sulphate concentration**
- ➡ **low pH-value**
- ➡ **high iron concentration**

Treatment of affected Mine Water



Reduction of the load by reducing the groundwater inflow

Microbial sulphate reduction in the inflow

Inflow water

Application of lime to neutralise water bodies with stationary and mobile systems

Improvement of sustainability and economic efficiency through additional buffering with CO2

Lake water

Treatment in mobile or stationary water treatment plants and discharge into the watercourse

Microbial iron reduction in the inflow to the watercourse

Outflow water

Gewässerbehandlungsschiff „KLARA“

Das Gewässerbehandlungsschiff „Klara“ besteht aus seewasserbeständigem Aluminium, versehen mit einer speziellen Beschichtung, und ist damit für die Gewässer der Restlochkette mit saurem pH-Wert einsetzbar. Gebaut wurde es in der Schiffswerft „Hermann Barthel“ in Derben (Elbe).
Der eigentliche Schubverband im täglichen Einsatz besteht aus zwei Teilen. Für eine kontinuierliche Bekalkung – ohne Stillstand bei Beladung – wurden zwei Leichter gebaut. Ein Leichter kann beladen werden, während der zweite zusammen mit dem Schubschiff die Wasserbehandlung durchführt. Dies verkürzt herkömmliche Verfahren.
In mehreren Zyklen pro Tag bringt das Schiff jeweils rund 25 Tonnen Kalkprodukte in das Gewässer ein. Eingesetzt werden vor allem Branntkalk und Kalksteinmehl.
Das Schiff besitzt zwei Deutz-Motoren mit einer Leistung von jeweils 89 kW. Der Antrieb erfolgt über zwei fünfflüglige Propeller mit einem Durchmesser von 650 mm. Die Ruderanlage besteht aus zwei Balance-Rudern mit jeweils zwei Ruderblättern. Zusätzlich besitzt jeder Schubleichter ein Bugstrahlruder mit einem Durchmesser von 260 mm. Die Leichter selbst sind nicht angetrieben.

Technische Parameter

Schubboot	
Länge über alles	12,80 m
Breite über alles	5,02 m
Tiefgang voll ausgerüstet	1,05 m
Gewicht	ca. 23,00 t
Schubleichter	
Länge über alles	14,30 m
Breite über alles	5,02 m
Tiefgang voll ausgerüstet	1,02 m
Fassungsvermögen Kalksilo	25,00 t

Maiden voyage of the rehabilitation ship KLARA – September 2016

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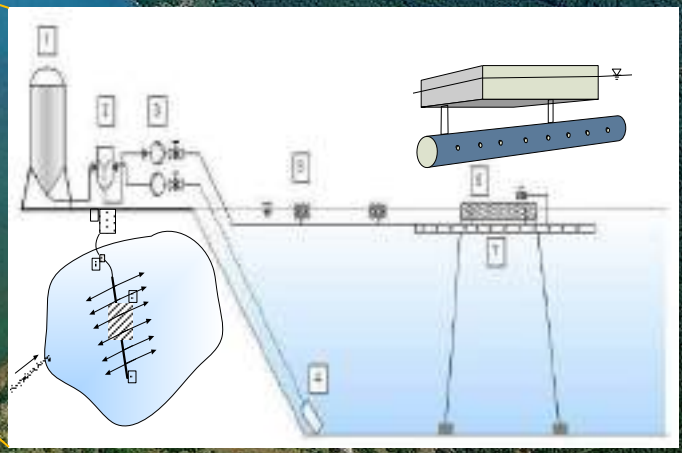
Water treatment at post-mining lake Scheibe

Initial neutralization with innovative technology

submerged pipelines with jets for the lime and CO_2 injection



- Pilot and Demonstration project with partners from industry and science -
specific costs of 0,7 Cent/mol are very economical

Acid Mine Water Treatment Plant Plessa

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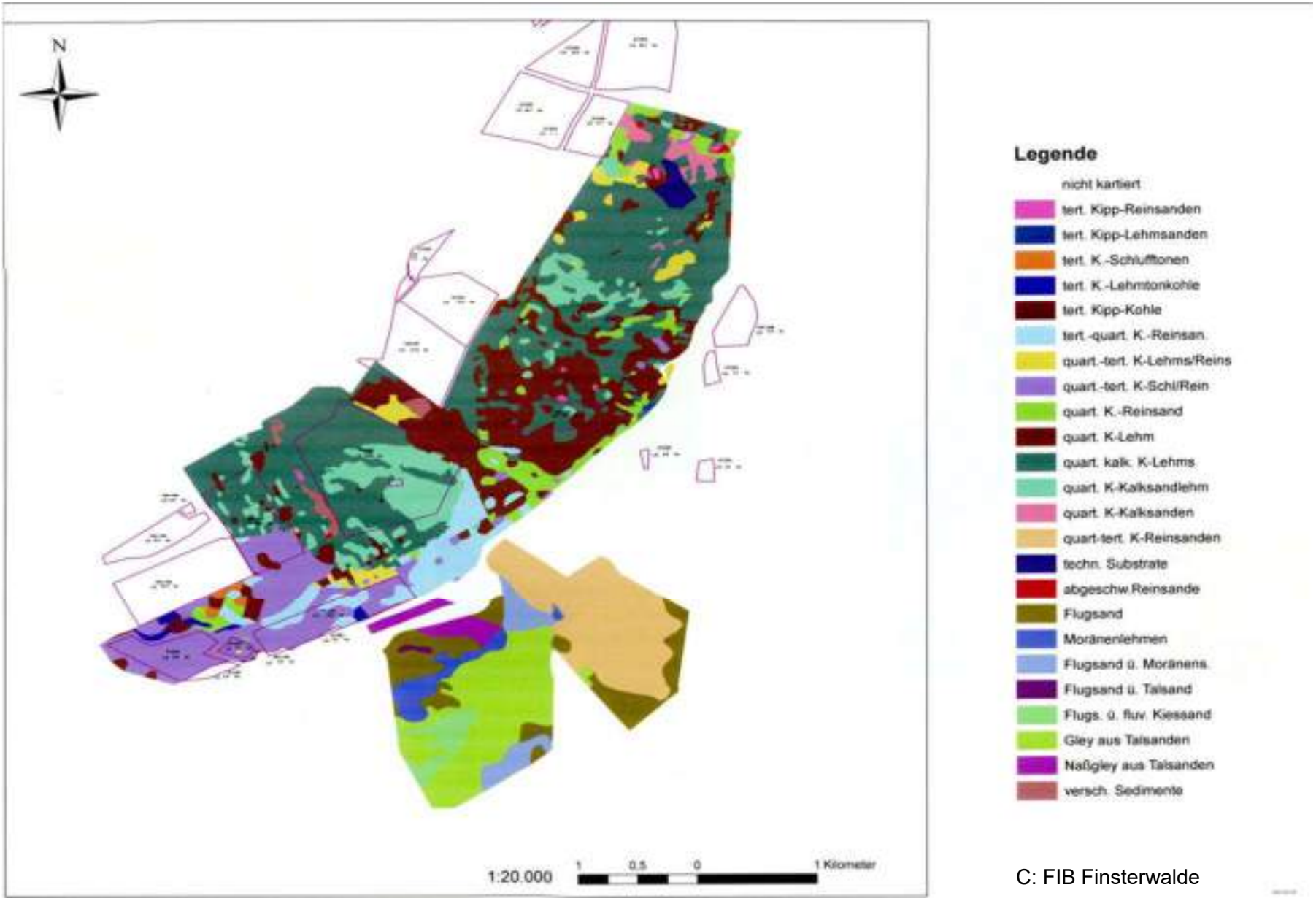
Soil geological mapping using the example of the Welzow opencast mine



C: FIB Finsterwalde

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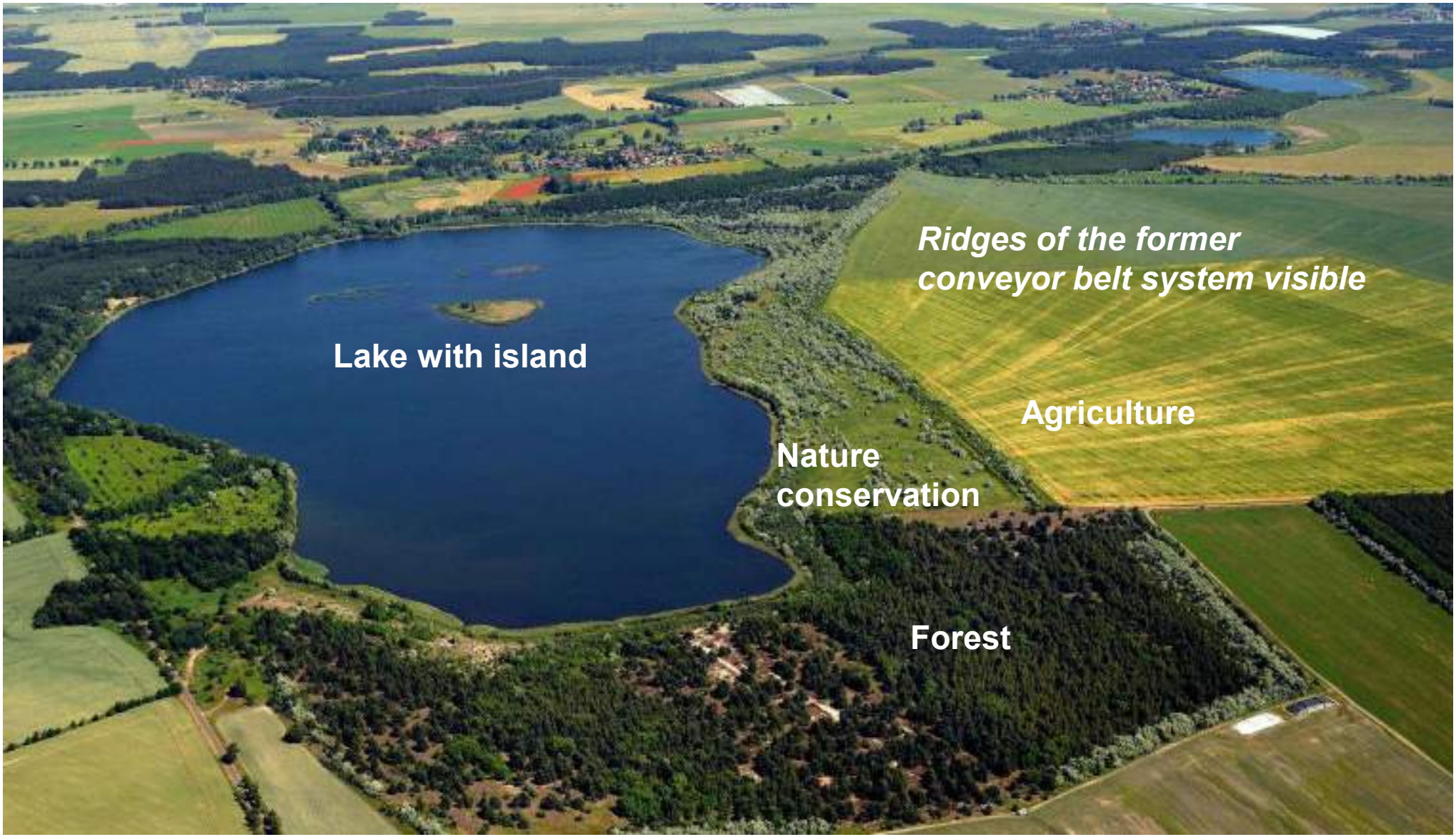
Re-cultivation



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Inner dump site with wind power plants

Preferred photovoltaic sites

Bicycle bridge channel 11 (Ilse-Kanal)

Eröffnung der Radwegebrücke am 17.04.2014

Framework-Tub-Aluminum-Bridge:

Length **52 m**

Width **3 m**

Marine-touristic investments on Hainer lake

Lusatian Lake Land – Swimming houses

Lock between lake Senftenberg and lake Geierswalde

Canoe-park at post-mining lake Markkleeberg

Tourist-boats in the post-mining landscape

Lessons learned from reclamation in East Germany

1. **Mining operations have a large potential to impact seriously the environment and there is a corresponding need for appropriate forms of control.**
2. **The mining industry´s image and reputation is greatly enhanced when it adopts best practices of environmental governance.**
3. **A reclamation strategy „simply green“ is not enough.**

   Reclamation must be seen as an opportunity to promote structural change that will help the reclaimed area achieve sustainable development.
6. **The establishment of a market led to innovations and cost reductions.**
7. **The scientific support and applied research are prerequisites for sustainable success.**
8. **The close involvement of local authorities enables early private investment in the post-mining landscapes.**


Glückauf!
Good luck
Zdar Boh