

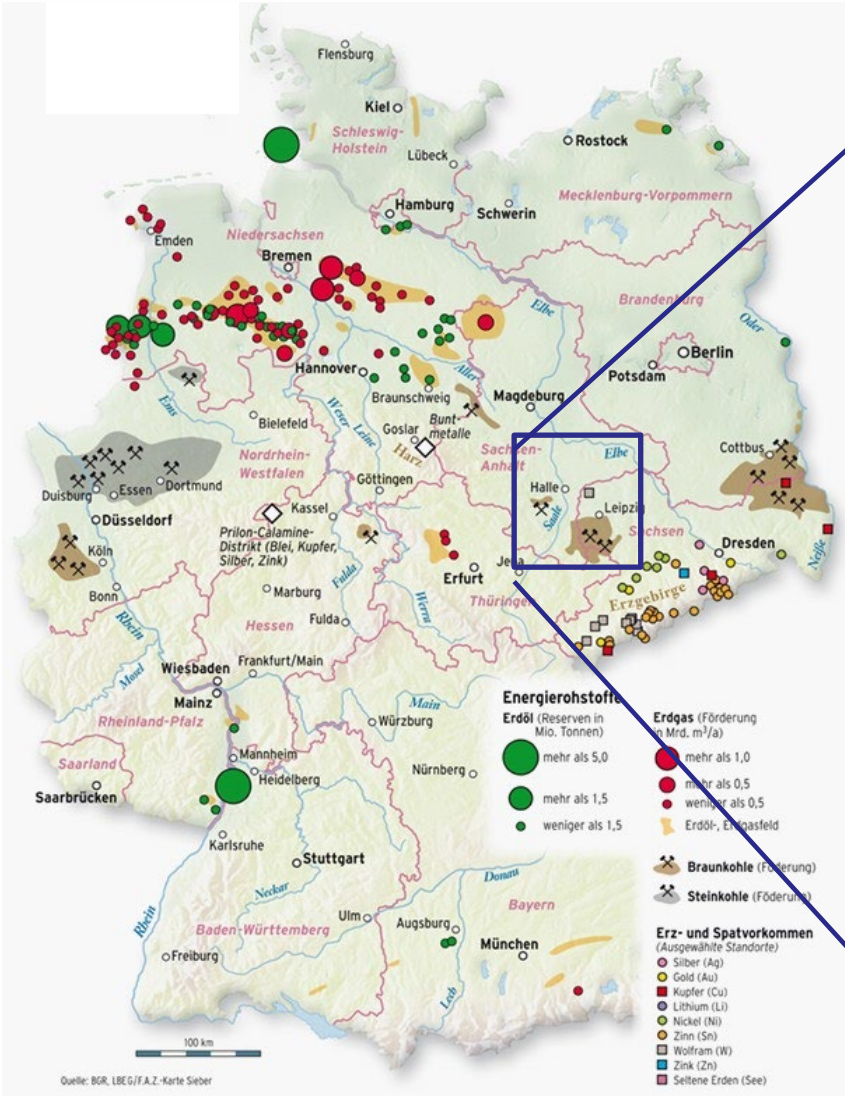
Mine Closure & Legacy Issues



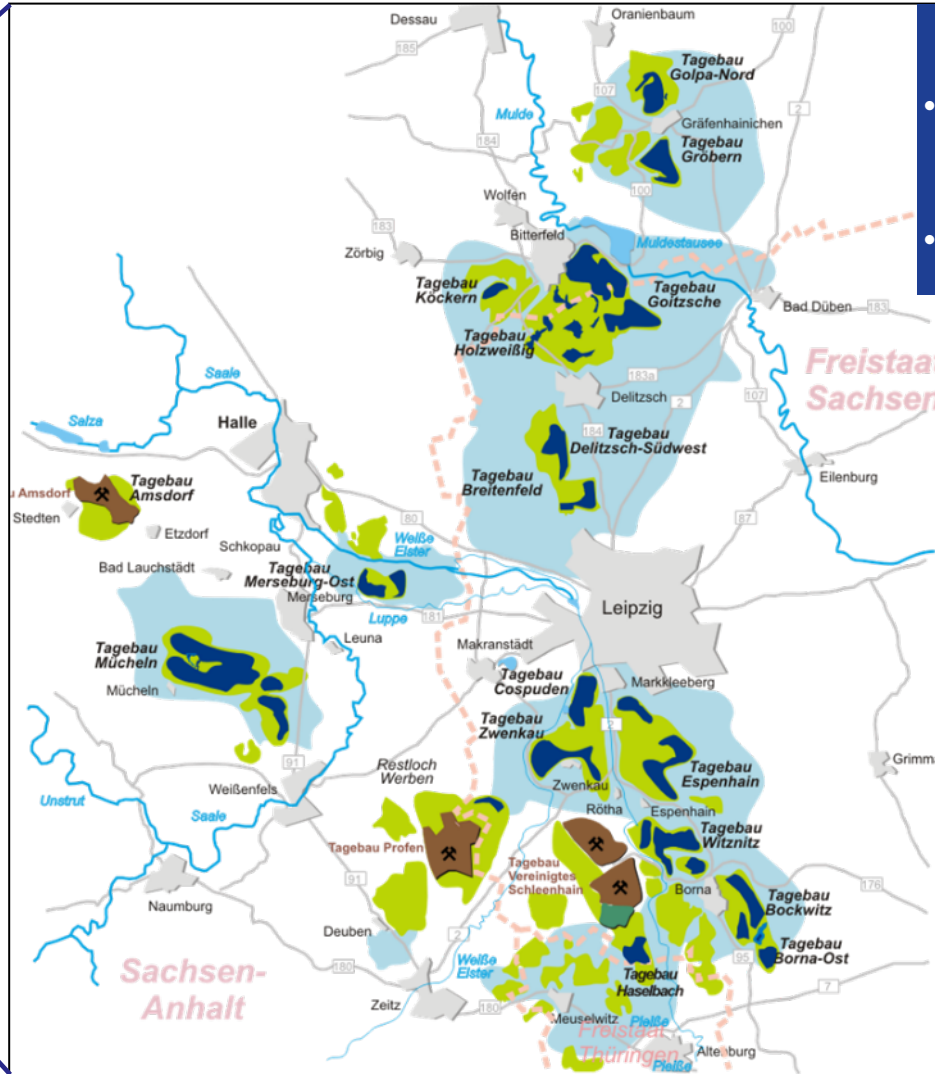
Ensuring the water quality of post-mining lakes in Central Germany by implementing two different aftercare strategies to meet alkalinity demand

Benno Janisch, LMBV mbH

Introduction



mineral resources of Germany (FAZ, 11/2011)



Central German Lignite Mining Area

- 1990:
- Cone of depression 1,860 km²
- Water deficit 5.7 bn. m³

Legende

- Grundwasserabsenkung
- Sanierungsflächen der LMBV
- Landschaftssee/ Bergbauflughafen
- Betriebsflächen MIBRAG, ROMONTA

LMBV

Lausitzer und Mitteldeutsche Bergbau-Verwaltungsgesellschaft mbH

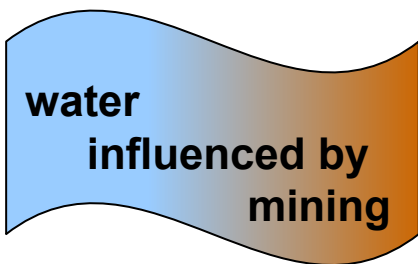
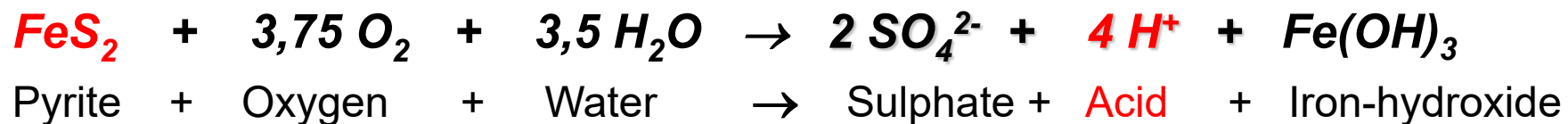
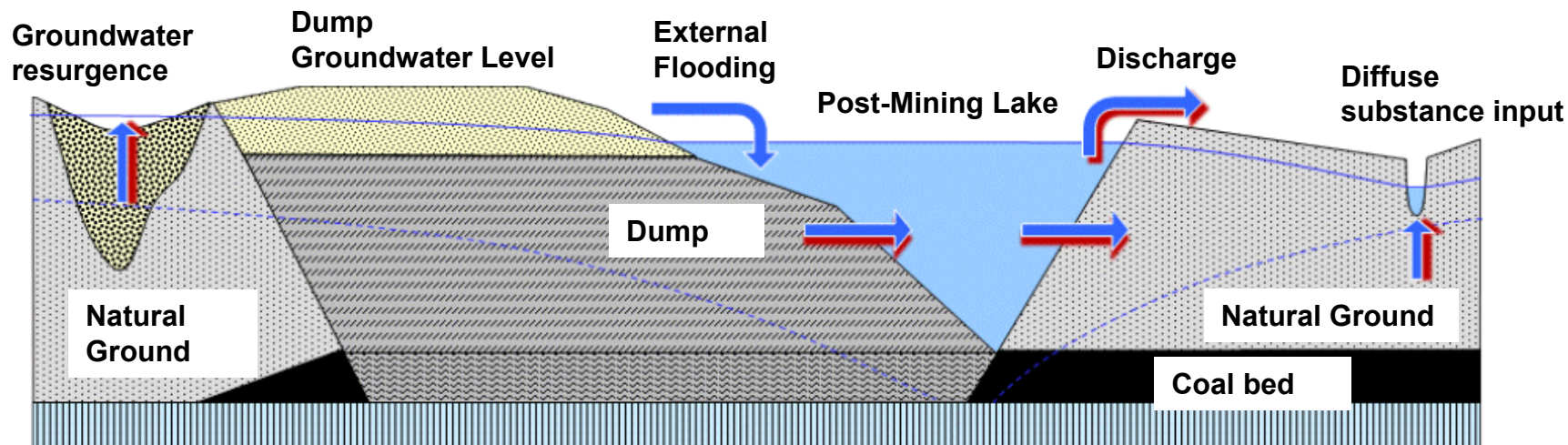


- **State owned company (Ministry of Finance)**
- **Responsibility: Decommissioning and rehabilitation of sites used by the lignite mining industry of the GDR according to Federal Mining Law**
- **Includes:**
 - **the re-cultivation of dumps feasible for re-use in the public interest**
 - **the restoration of water balance according to**

Water Quantity

Water Quality

Problems related to quality



- ➔ high sulphate concentration
- ➔ low pH-value → main problem of post-mining lakes
- ➔ high iron concentration

Water transfer from active open-pit mines (1998 – 2018)



Discharge of dewatering water from MIBRAG's active open-pit mines
Fast external flooding
 → Quickly reaching target water level
 → Ensuring Neutral water quality

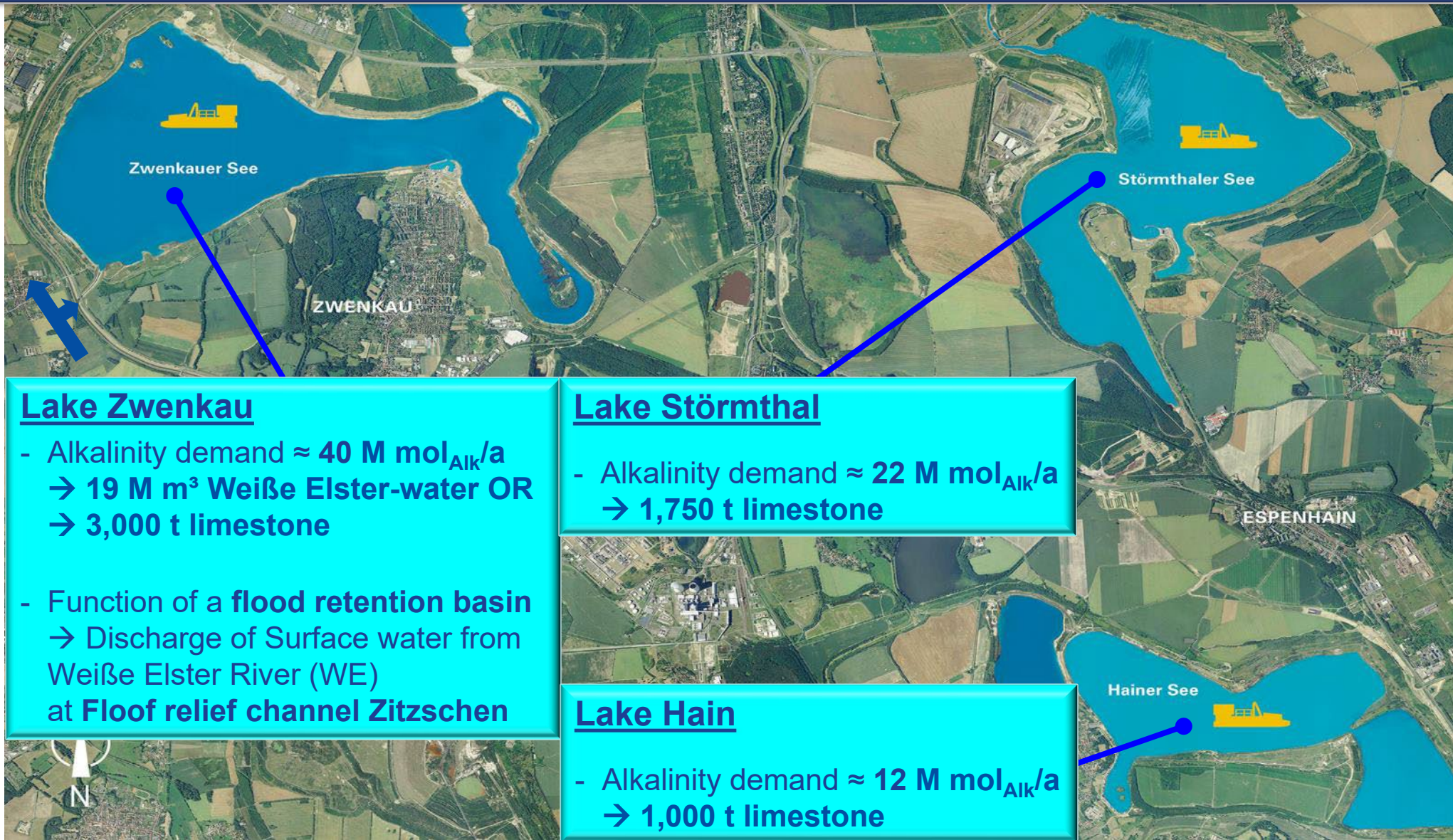
Quick Facts water transfer LMBV – MIBRAG (1998 – 2018)

Quantity:
 45 ± 5 m³/min (since 2013: 30 ± 5 m³/min)
 Σ 477 million m³

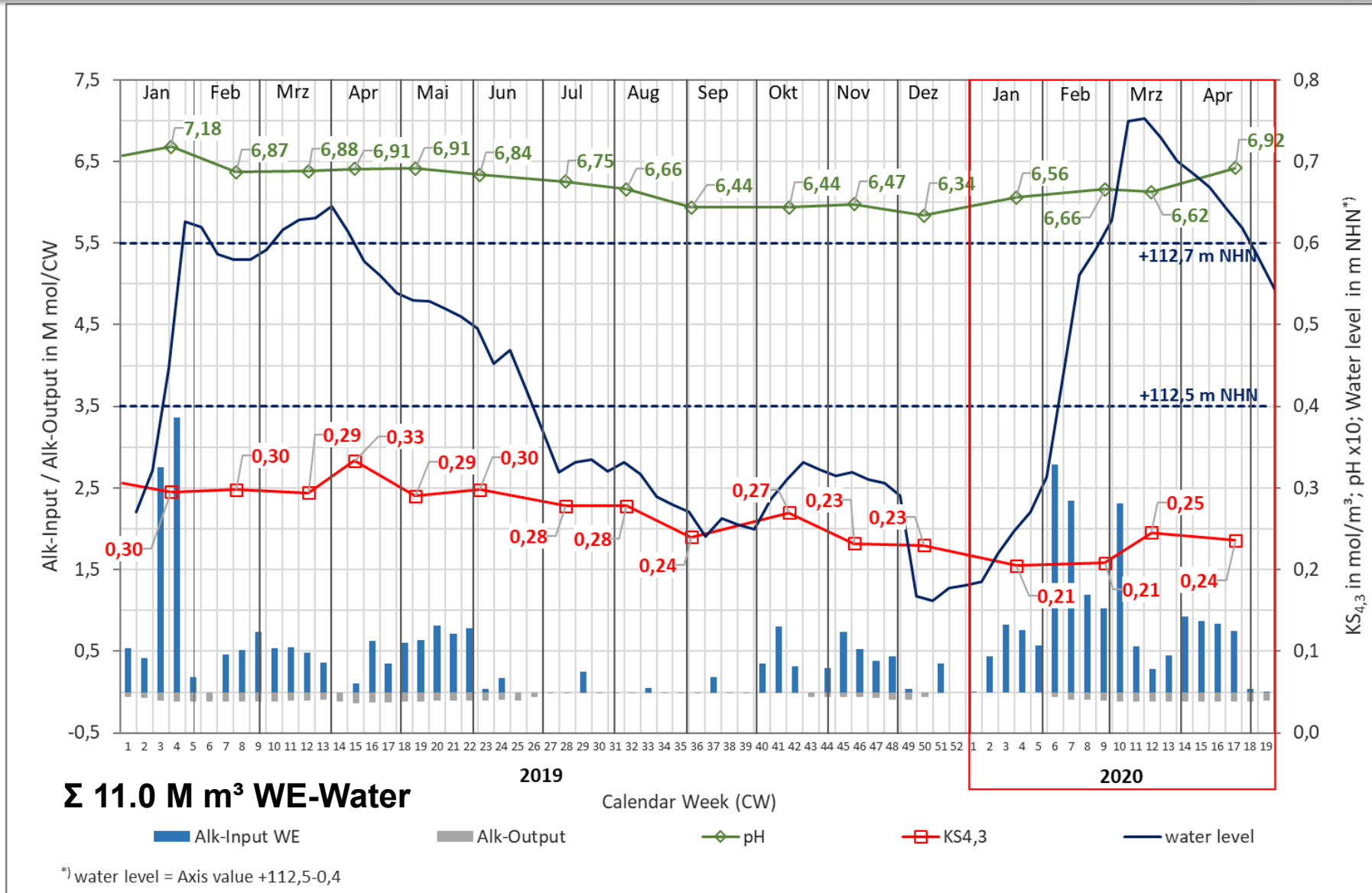
Quality: (annual mean value)

pH	>	6	
Net alkalinity	≥	2.0	mmol/l
Iron (Fe _{tot})	<	20	mg/l
Sulfate (SO ₄)	<	1000	mg/l

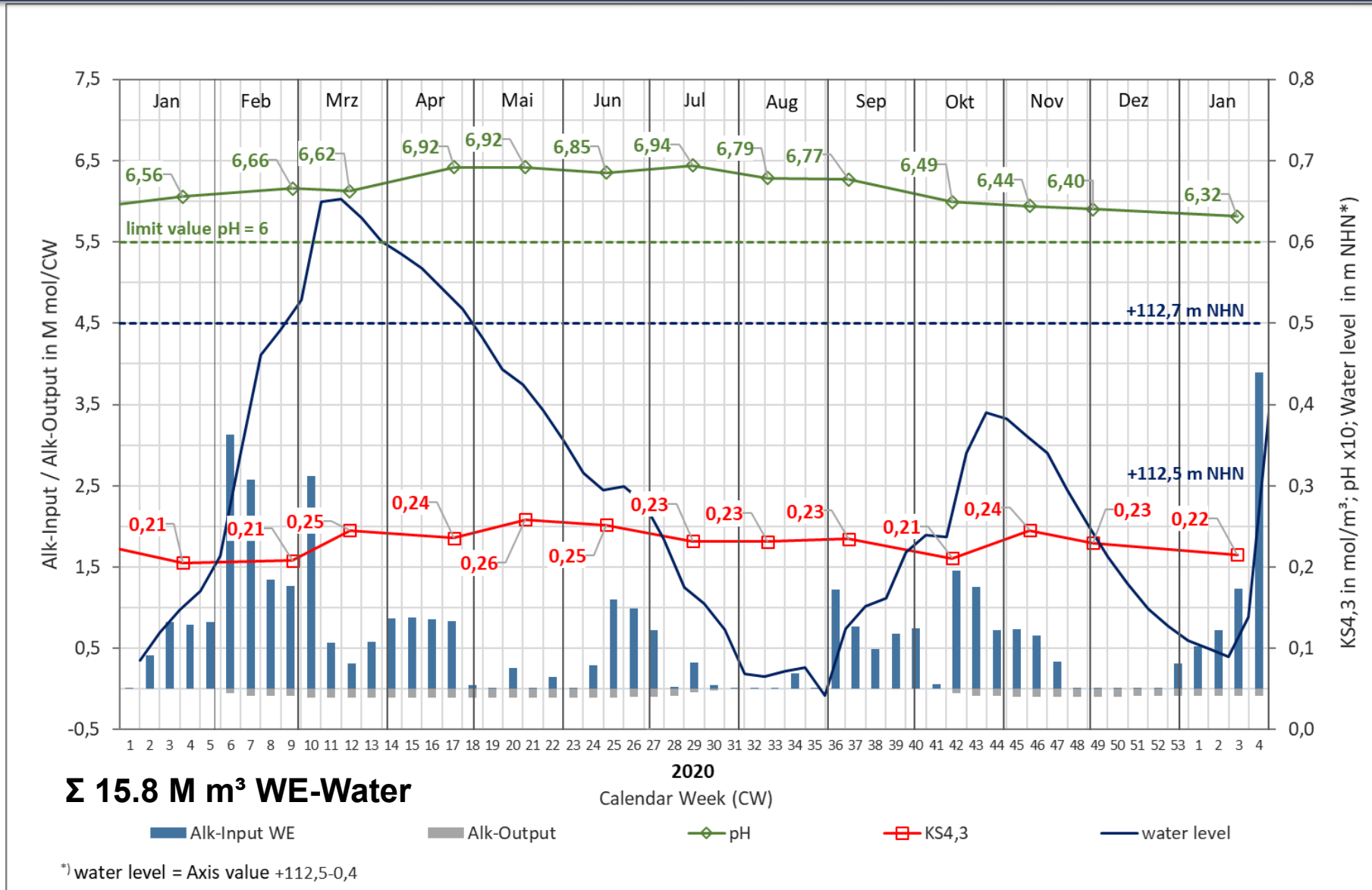
LMBV-flooding pipeline (≈ 65 km, DN 600 – DN 800)



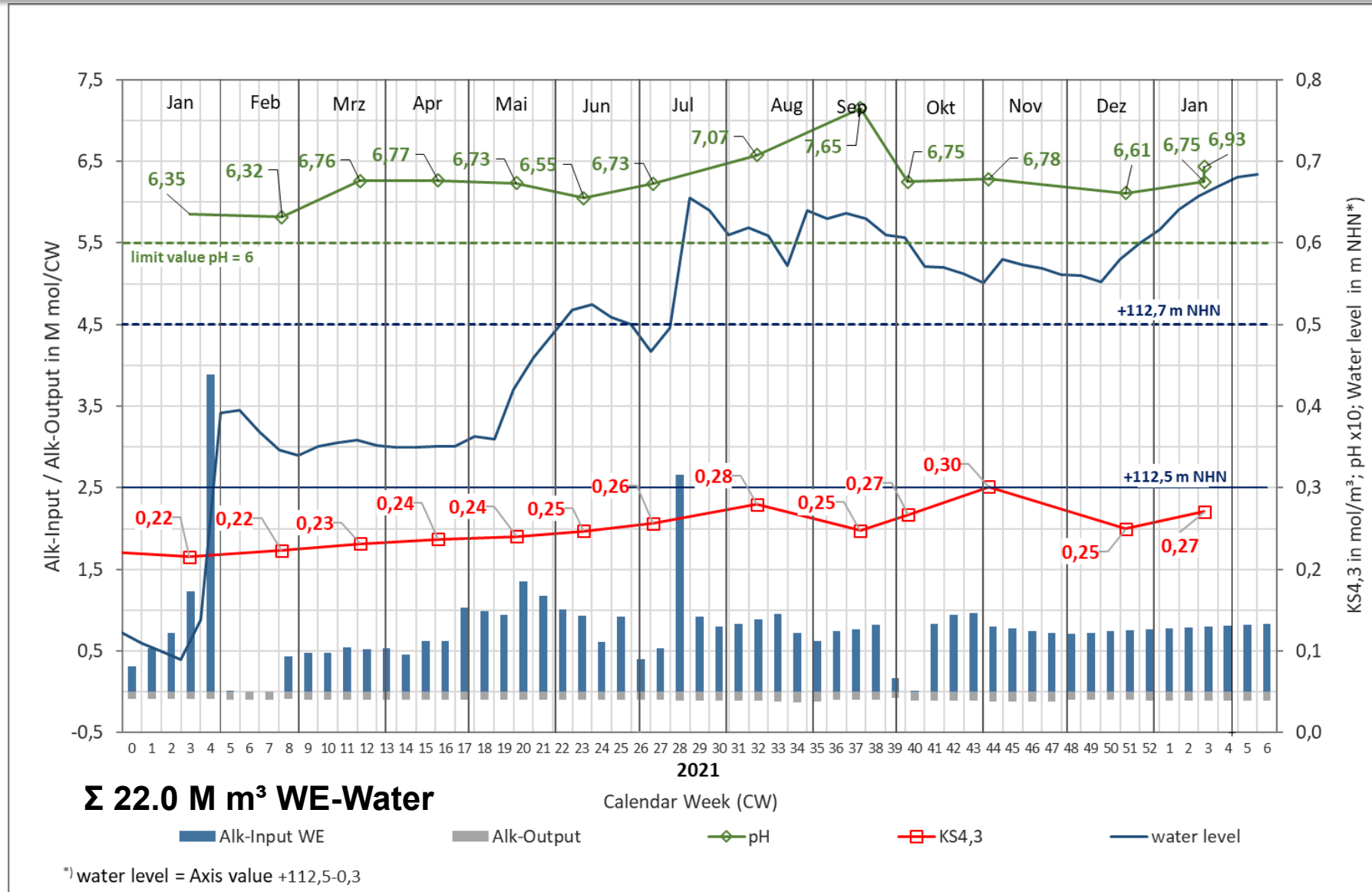
Lake Zwenkau 2019



Lake Zwenkau 2020



Lake Zwenkau 2021

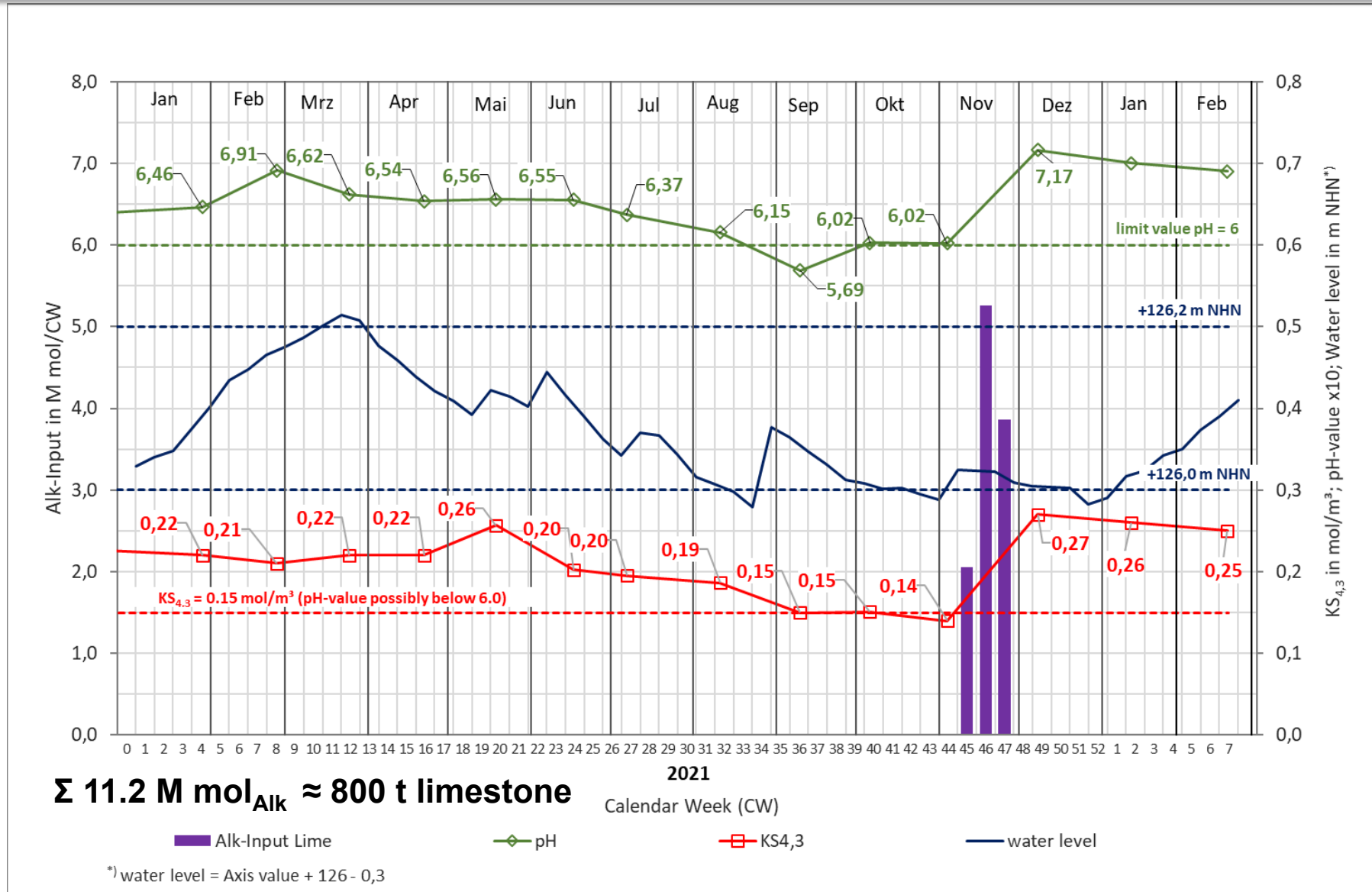


Flood relief channel Zitzschen

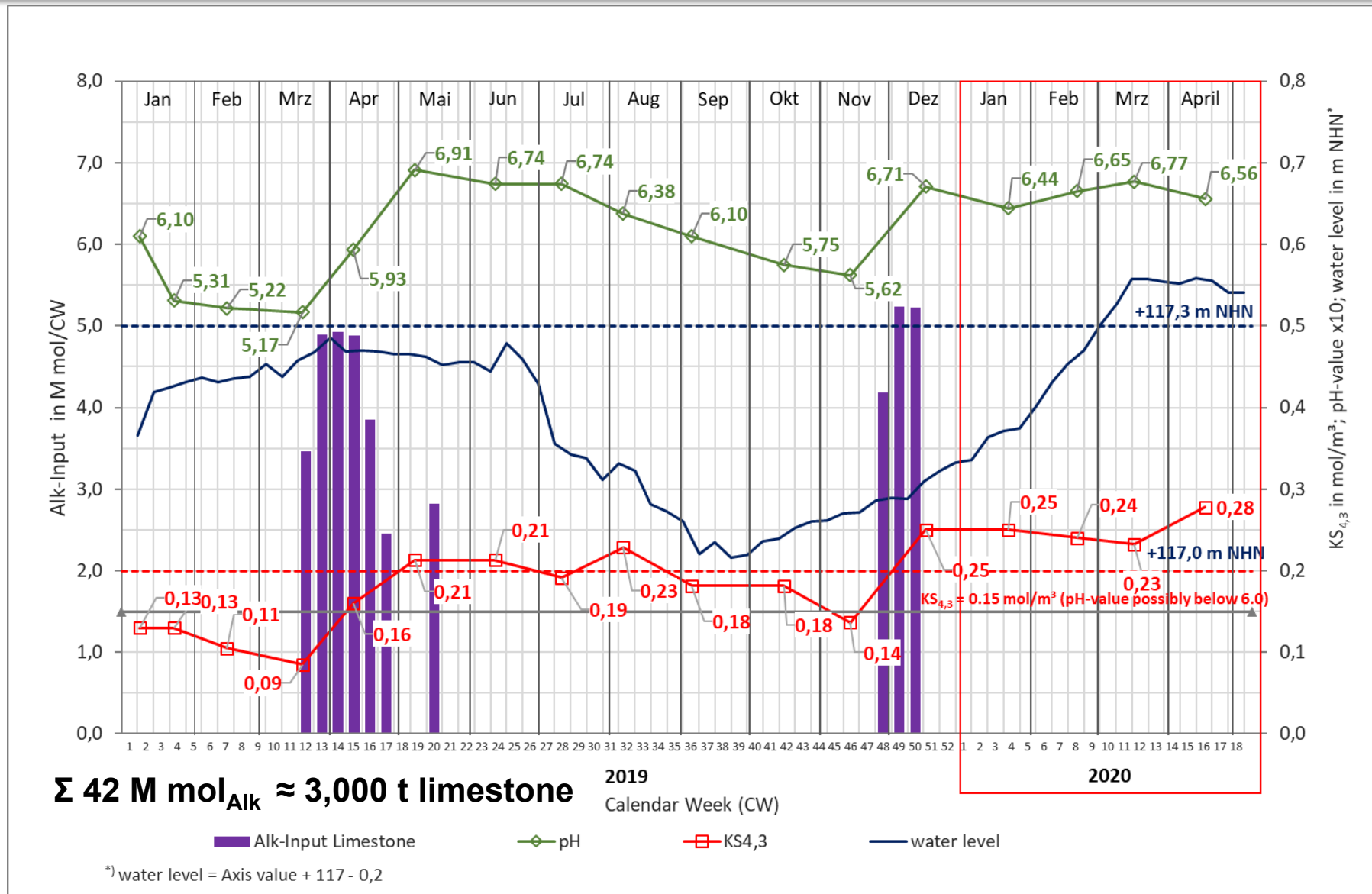


- Discharge capacity: 130 m³/s
- Flood retention capacity: 18.5 M m³
- Bypass capacity ≤ 3 m³/s
- Weiße Elster-Water: 1.4 – 2.8 mmol_{Alk}/l

Lake Hain 2021



Lake Störmthal 2019



Limestone input 2019 – 2023 [t]

	Lake Hain	Lake Störmthal
<i>estimated annual demand</i>	1,000	1,750
2019	1,003	1,948 + 1,046
2020	500	1,405
2021	798	0
2022	0	1,599
2023	604	1,491
Total 2019 - 2023	2,905	7,489

In-Lake Treatment by Ship-based Liming



- liming campaigns take place discontinuously as required (pref. full circulation)
- Lime suspension (2 - 5 %) using lake water
- Sub-surface application
- Application at lower pH-values increases yield of alkalinity



In-Lake Treatment by Ship-based Liming



- **Flooding of Central German PML (LMBV) basically finished**
 - **Lake-specific aftercare required**

- **Permanent and reliable means to ensure water Quality**
 - **Ship-based liming + Surface Water (Lake Zwenkau)**
 - **counter ongoing acidification**
 - **flexible regarding amount / place / time**
 - **at short notice**
 - **ensure compliance with specifications according to plan approval decisions**

- **No imminent problems regarding water Quantity**
 - **continuous evaluation + studies**
 - **ongoing consultations with authorities to meet existing obligations**
 - **future challenges – Climate Change**



Glück Auf!

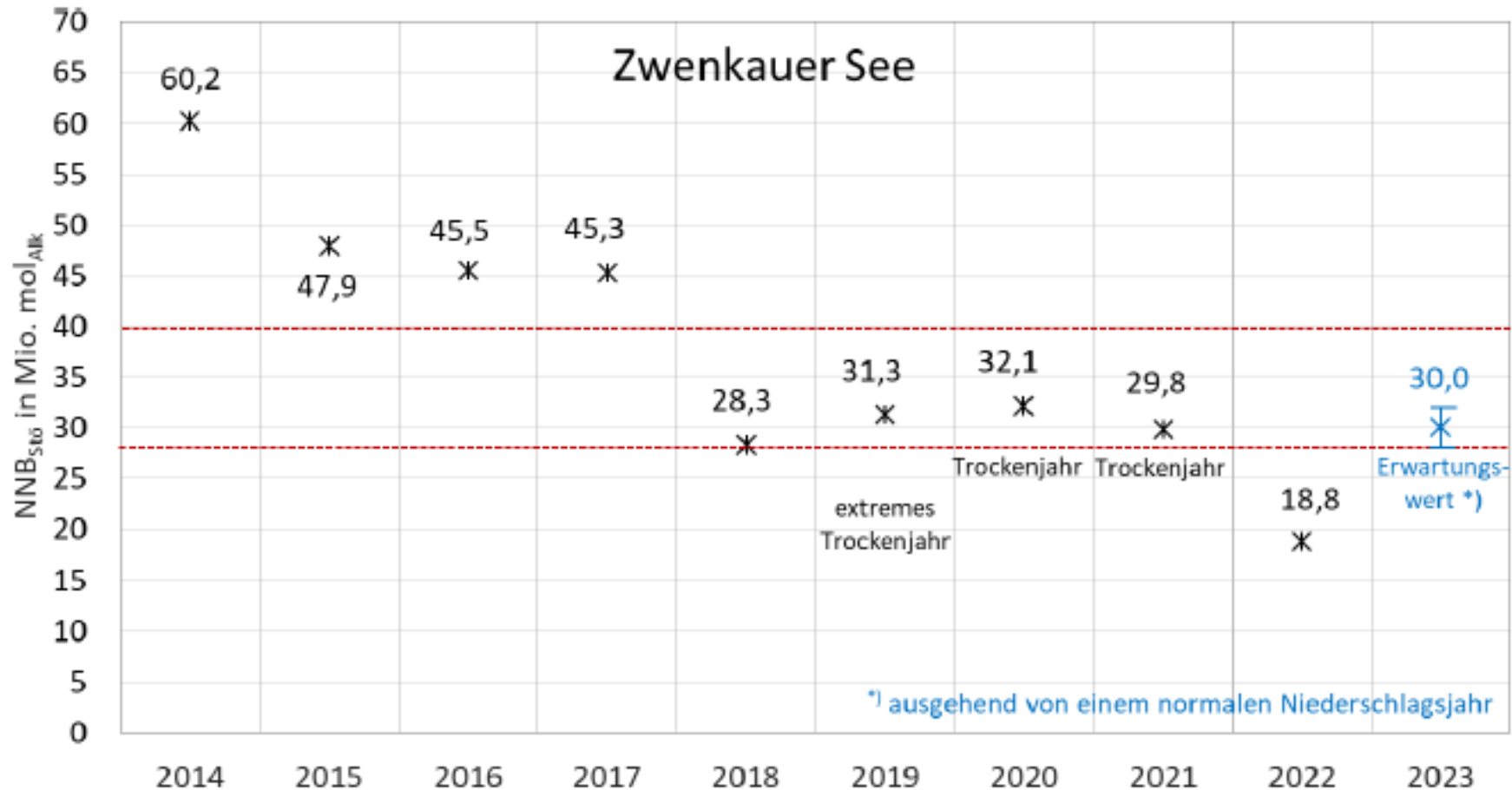


Abb. 10 Entwicklung des NNB_{ZWE} von 2014 bis 2022 und der prognostische Wert für 2023

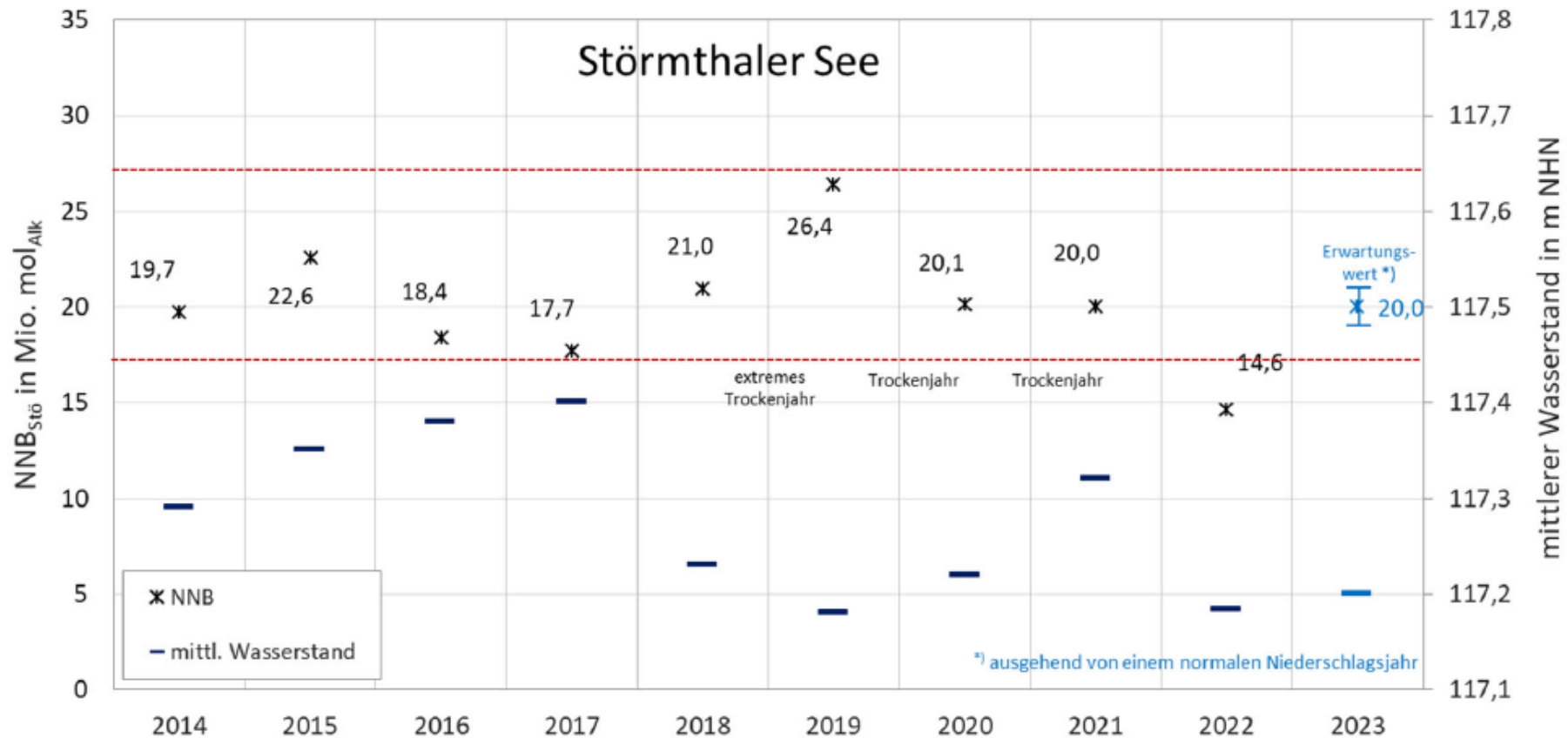


Abb. 11 Entwicklung des $NNB_{STÖ}$ von 2014 bis 2022 und der prognostische Wert für 2023 sowie die mittleren Wasserspiegellagen

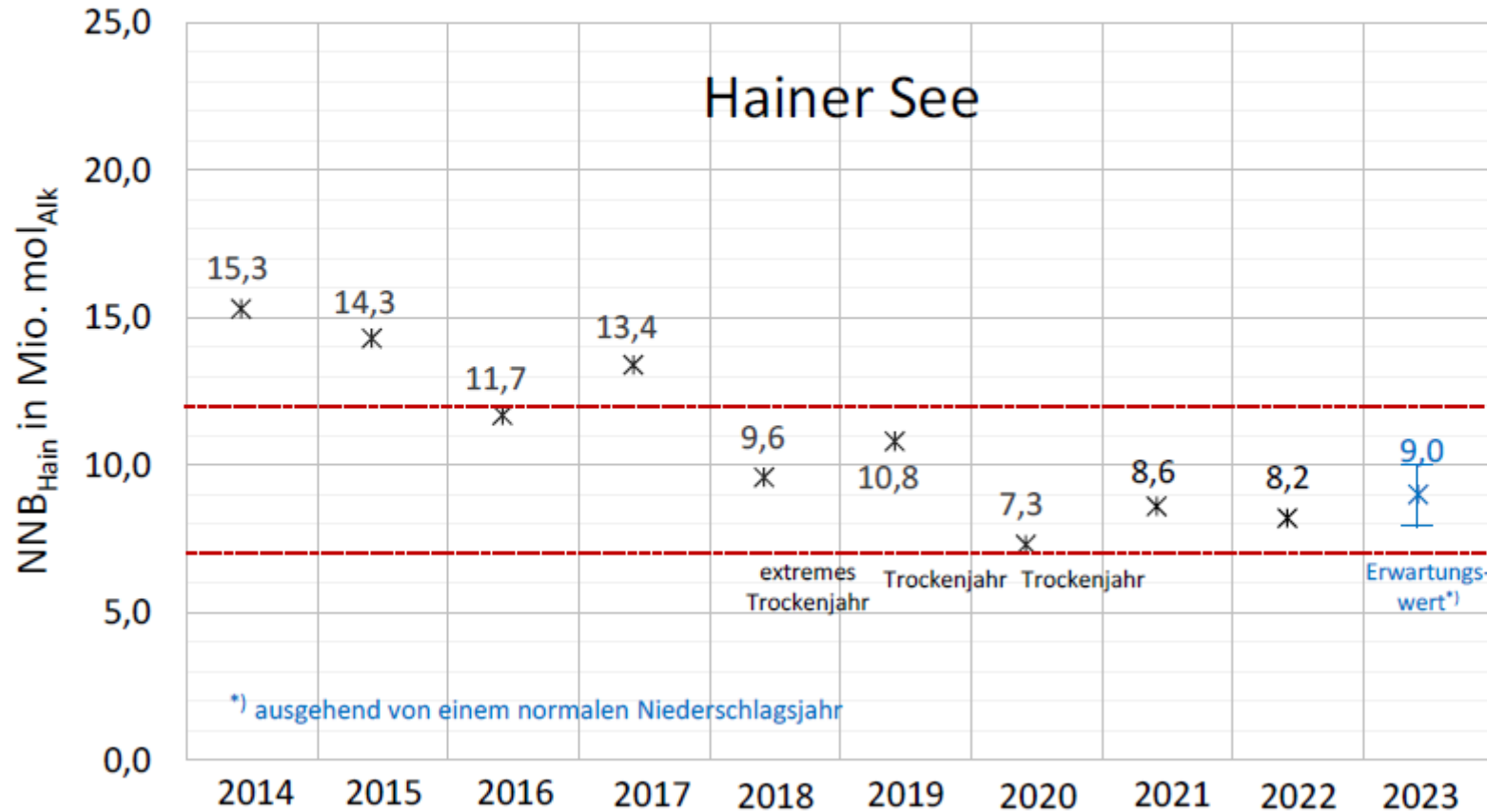
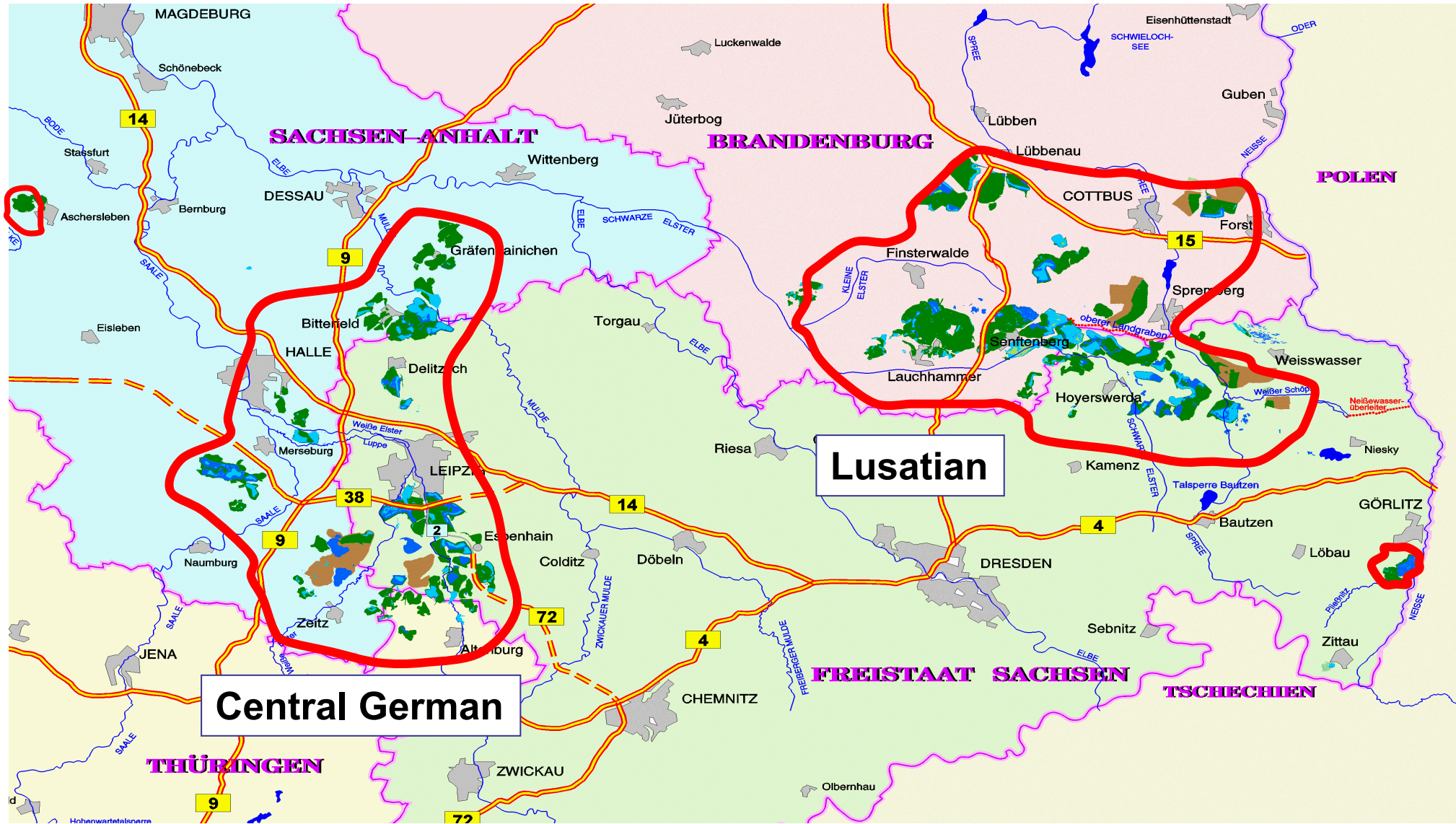


Abb. 8 Entwicklung des NNB_{Hain} von 2014 bis 2022 und der Erwartungswert für 2023

Overview of the mining areas and LMBV Rehabilitation of the Water household Aftercare Strategies

Lignite rehabilitation areas of LMBV



Overview of the mining areas and LMBV

Rehabilitation of the Water household

Aftercare Strategies

Flooding of the pit-holes (Central Germany)

- ➔ Flooding of 21 post-mining holes
 - 11 in Saxony-Anhalt
 - 10 in Western Saxony/Thuringia
- ➔ Total water area \approx 10.400 ha (\approx 25.000 acre)

Maximum use of outside water sources

Goal

- ➔ Fast flooding
- ➔ Ensuring geotechnical stability of the slopes
- ➔ Enhancing the water quality
- ➔ Compensation of volume deficit

Overview of the mining areas and LMBV Rehabilitation of the Water household Aftercare Strategies



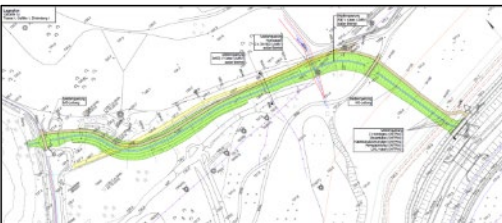
LMBV-flooding pipeline (1998 – 2018)

- Water transfer contract MIBRAG – LMBV (WÜV09)
- External flooding with dewatering water of MIBRAG for the creation and quality control of post-mining lakes (PML) (1998 – 2018: Σ 477 million m³)
- Flooding of 8 PML with good water quality
- Expiry of water transfer contract 31.12.2018; since 2019 alternative aftercare options for PML with acidification required → Q+Q



Ship-Based Liming (since 2019)

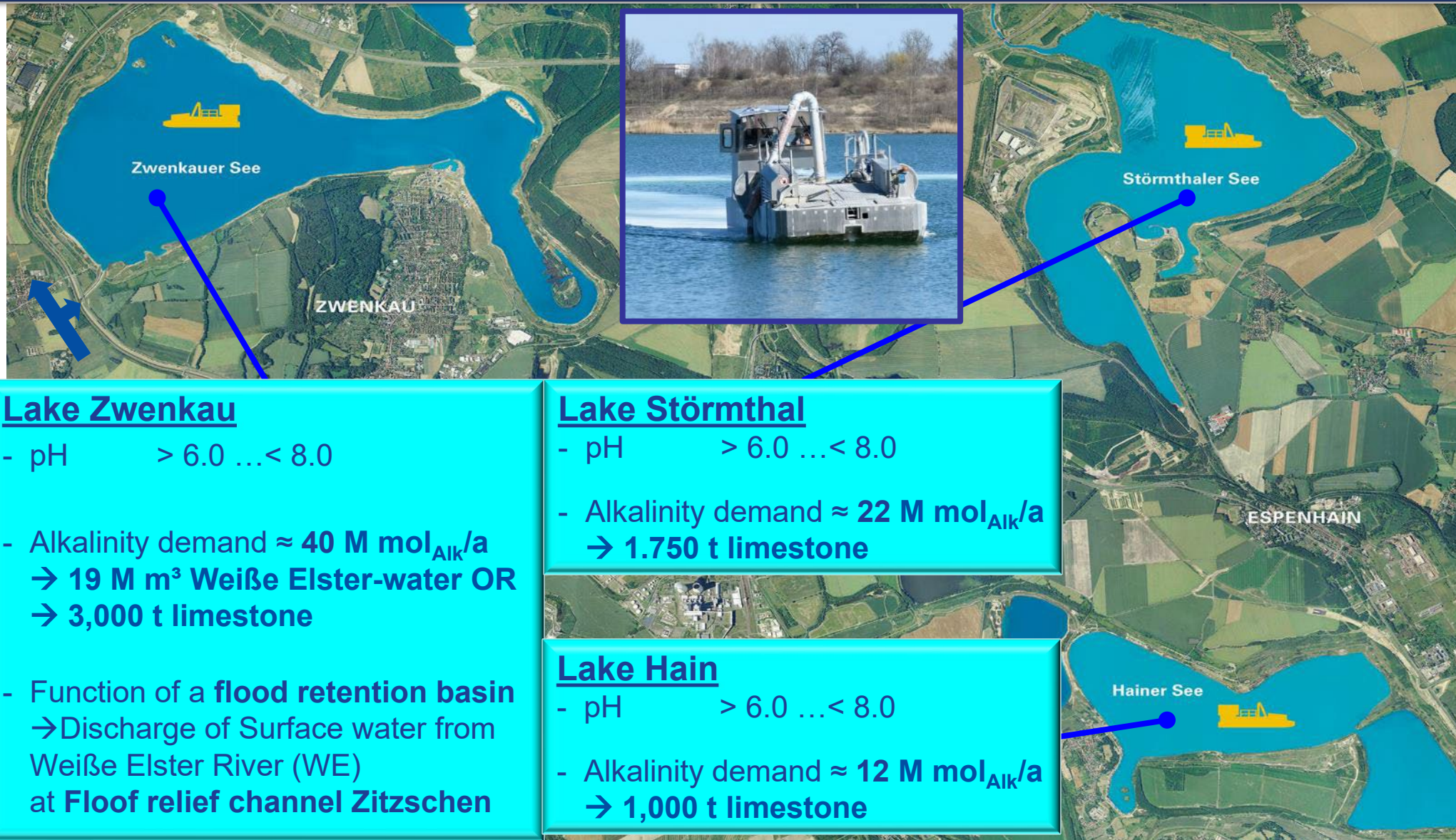
- PAD plan approval decisions (Planfeststellungsbeschl.): pH > 6 ... < 8
- ➡ Quality Control for 3 PML (Lake Zwenkau, Lake Störmthal, Lake Hain) required to comply with plan-approved pH-values
- Long-term contracts in place → Q



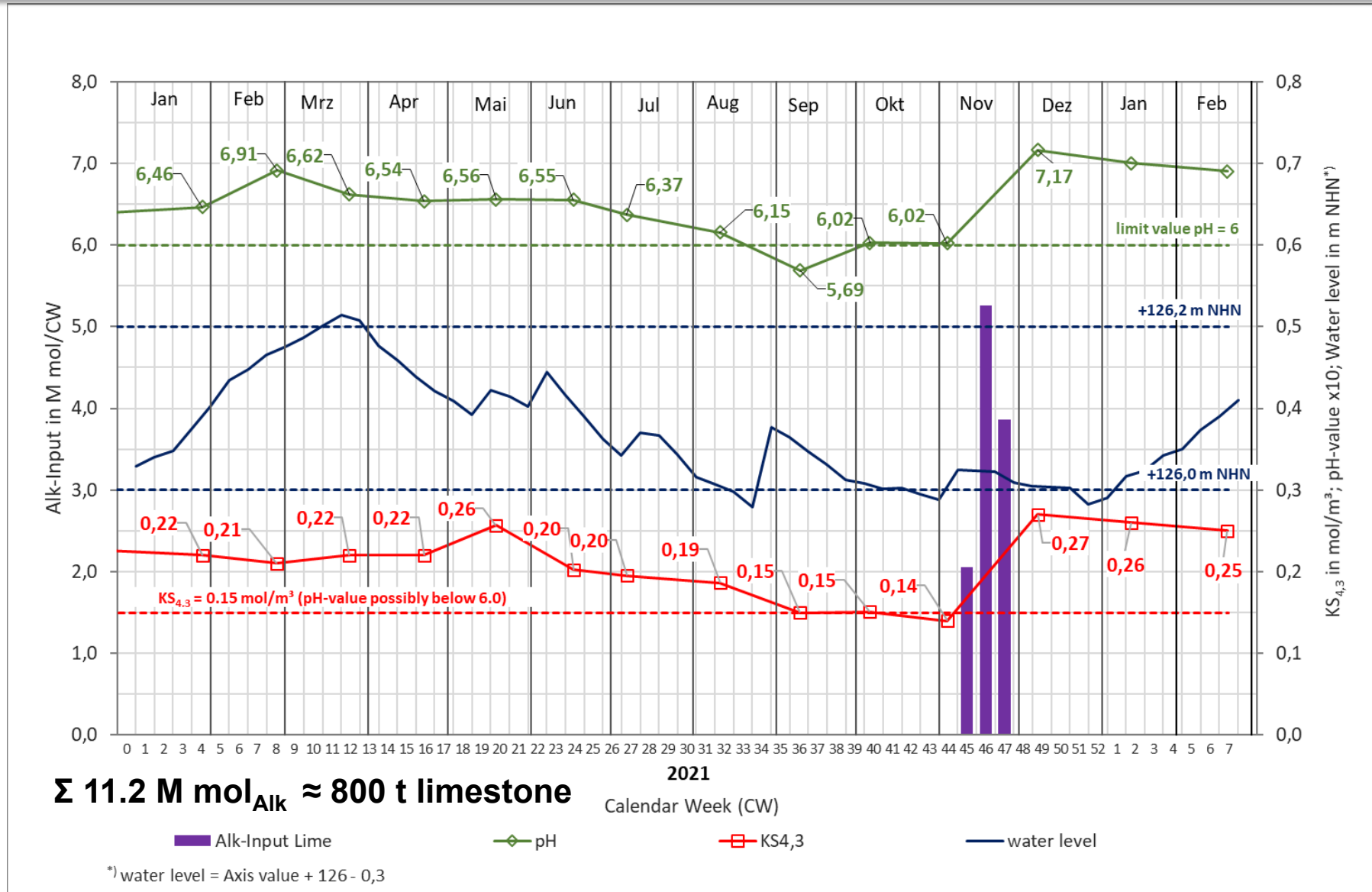
Integration of running waters (from approx. 2029)

- Concepts/planning of the integration/partial discharge of watercourses in PML (Weißer Elster River, Gösel River, Wyhra River)
- extensive coordinations with authorities → Q+Q

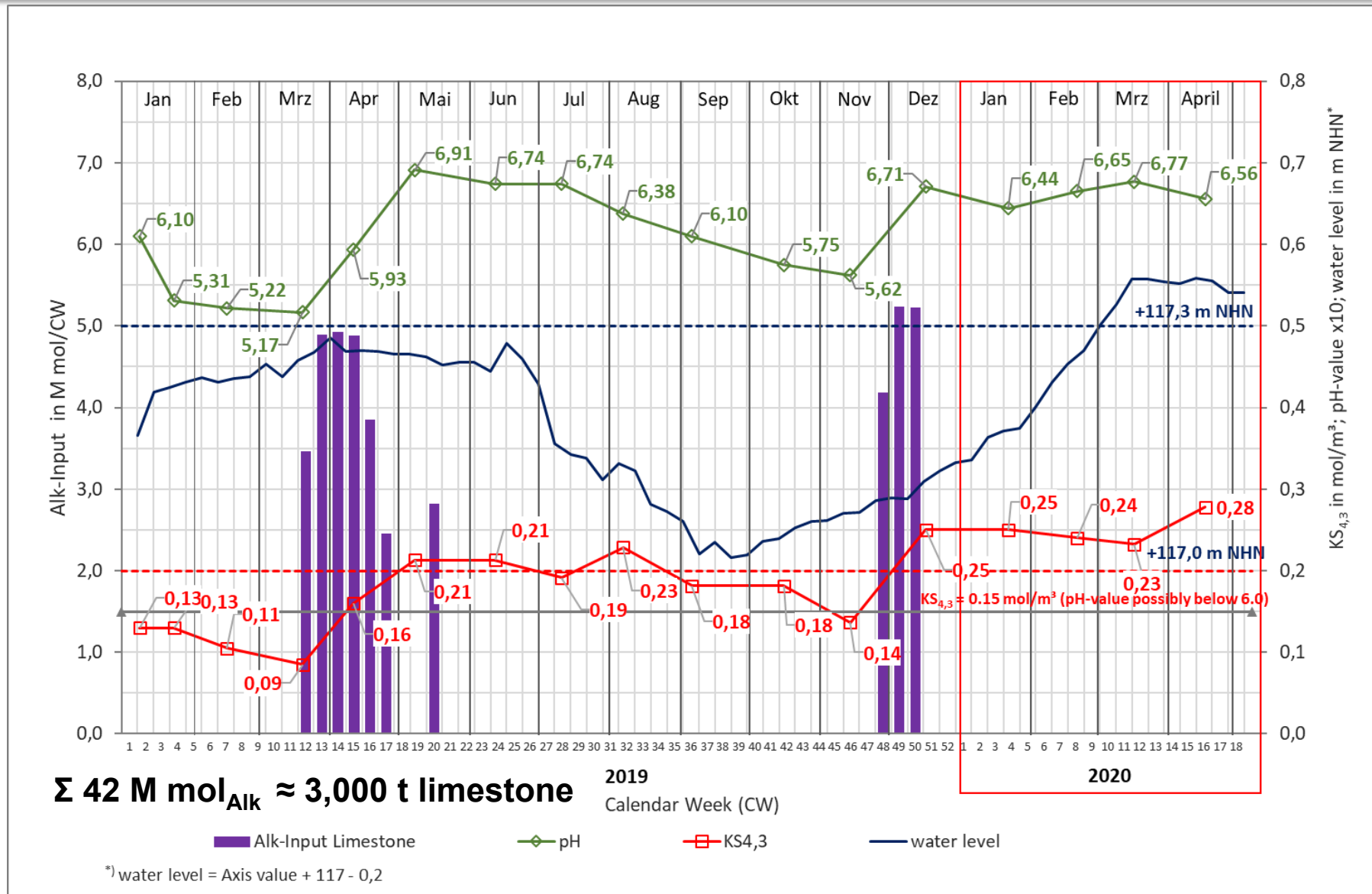
Acidification – Aftercare demand



Lake Hain 2021



Lake Störmthal 2019



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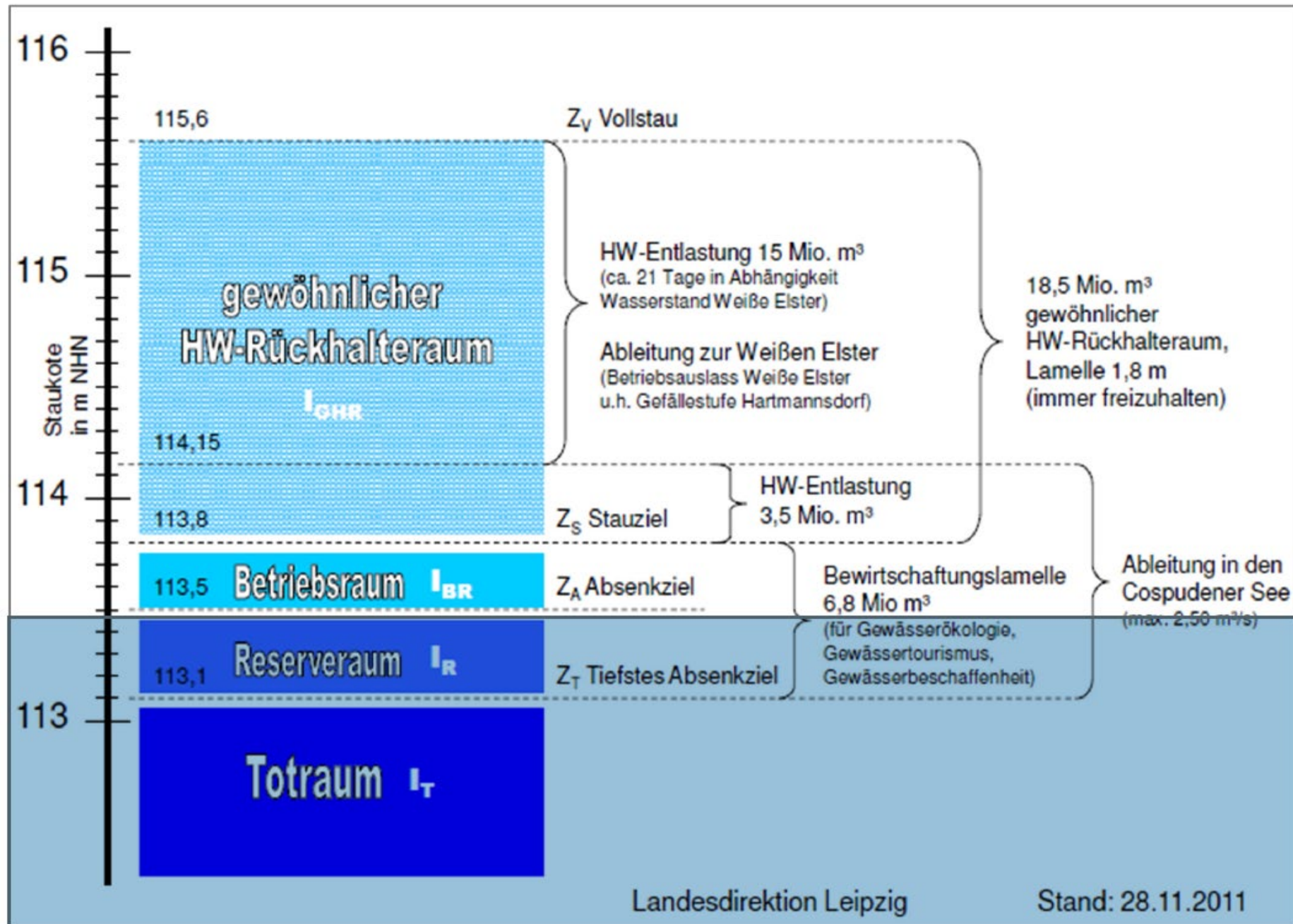


In-Lake Treatment by Ship-based Liming

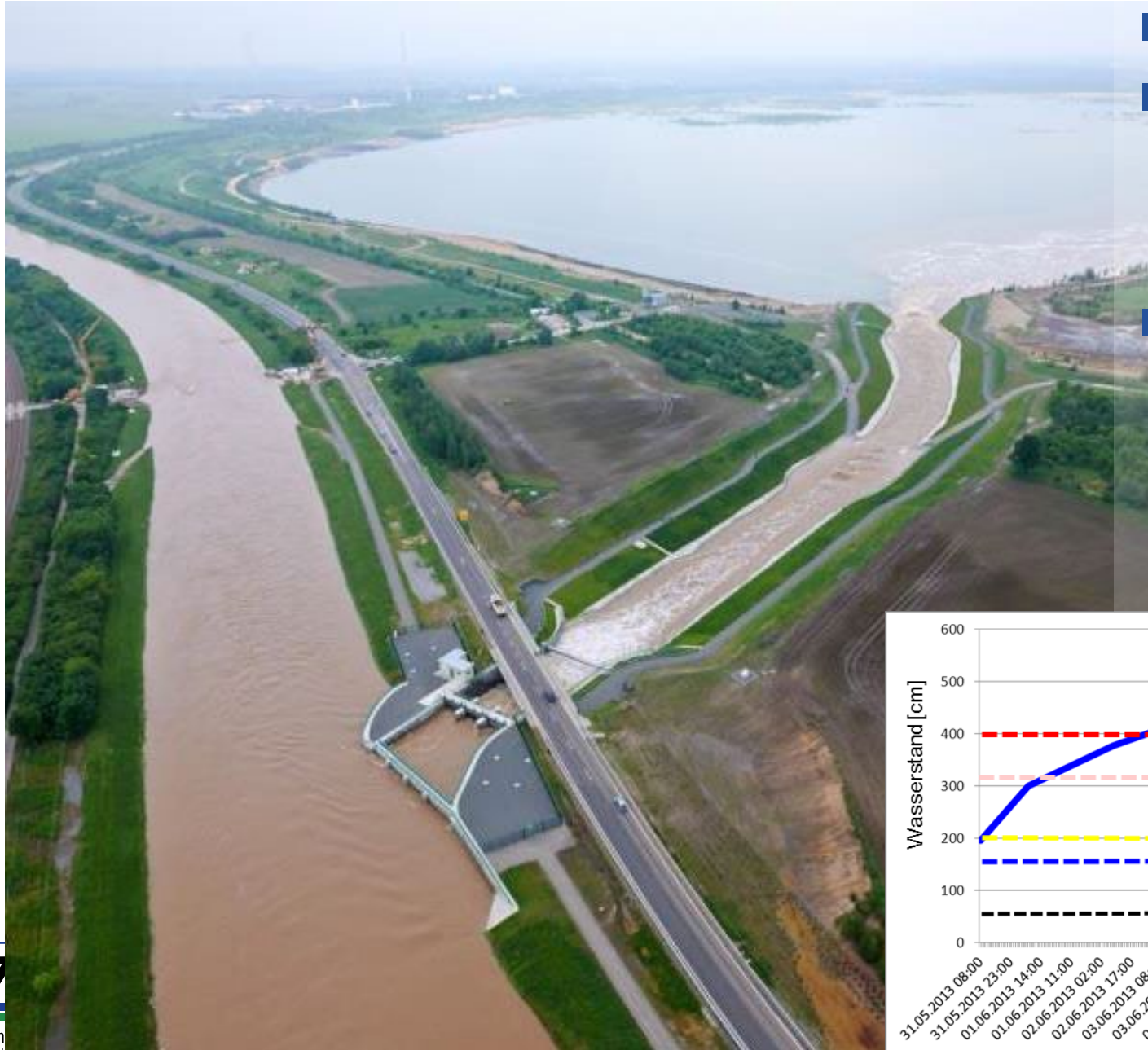


- **Flooding of Central German PML (LMBV) basically finished**
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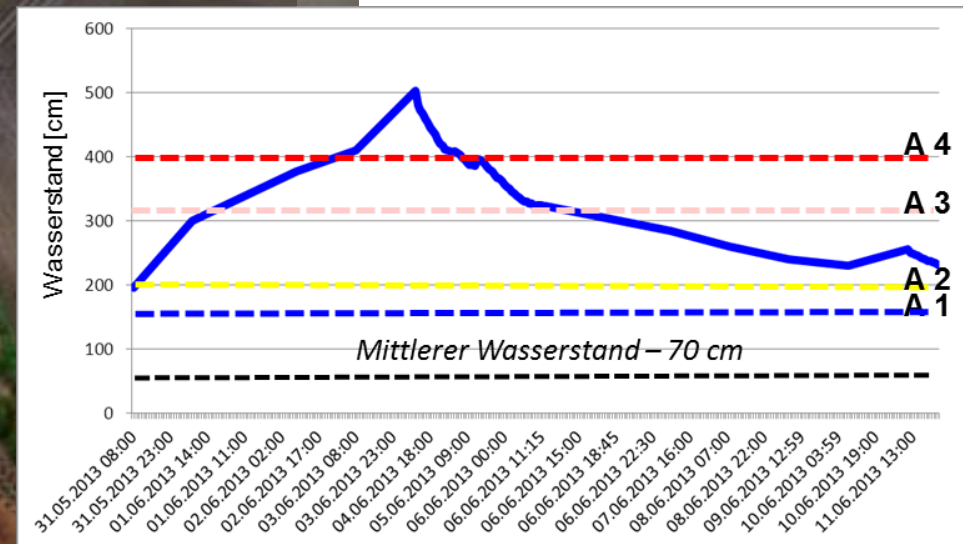
Staurationaufteilung Zwenkauer See gem. PFA 2008



Hochwasserereignis Juni 2013



- Einleitung max. **138 m³/s**
- innerhalb von **55 h** → **Einleitung 20 Mio. m³** Weiße-Elster-Wasser in den Zwenkauer See
- Anstieg des Wasser-
spiegels im Zwenkauer
See um **2,5 m**



Zwenkauer See

■ **Landschaftssee** (**Hochwasserschutzfunktion** für Stadt Leipzig) bergrechtlich notwendig (963 ha; 176 Mio. m³, WS_{akt} 112,42 m NHN)

■ Fassungsvermögen
HWR 18,5 Mio. m³

■ mittlerer Wasserstand
113,5 m NHN

■ Abzuschlagende Wassermenge am Einlaufbauwerk:
bis zu: **130 m³/s**

■ **Durchfluss Weiße Elster** wird im Hochwasserfall zum Schutz der Stadt Leipzig auf **450 m³/s** reduziert

Auslassbauwerk Zwenkauer See in die Weiße Elster
(Betriebsauslass Weiße Elster)

Verbindungskanal Zwenkauer See – Cospudener See
(Harthkanal)

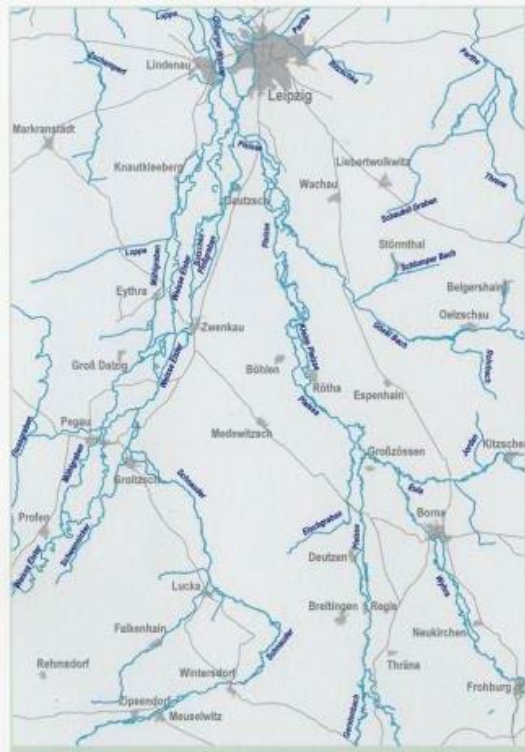


Einlaufbauwerk Weiße Elster in den Zwenkauer See
(HWE Zitzschen)

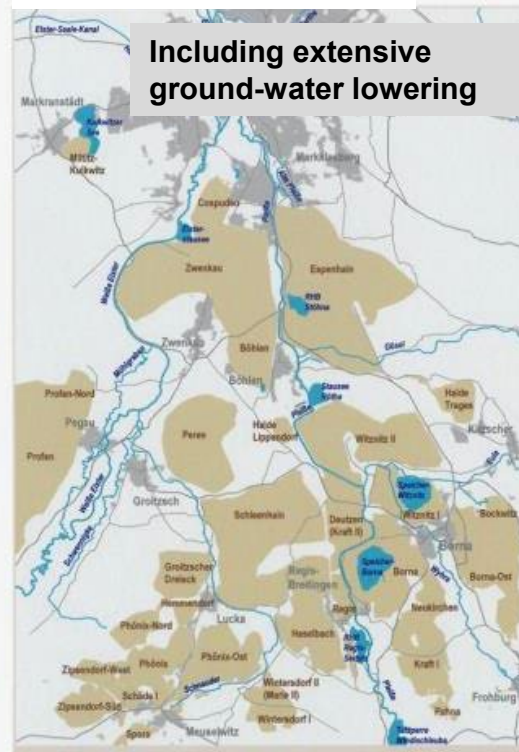
Ensuring the water security
by implementing two

Changing landscapes

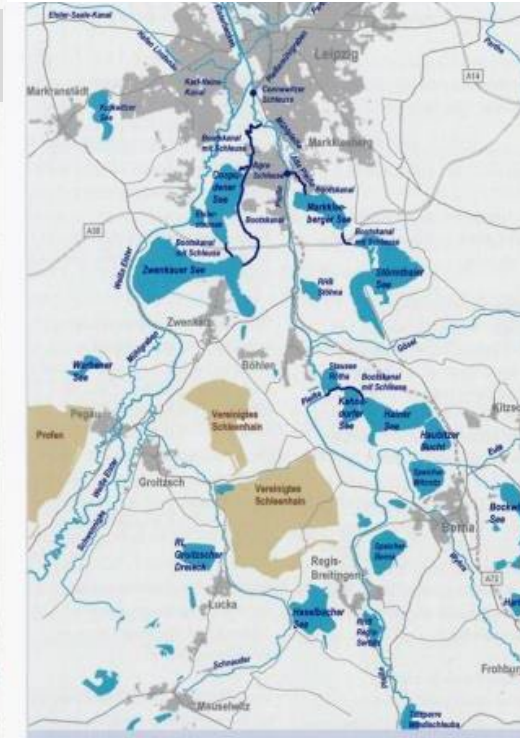
Rivers before mining in 1850



Situation in 1990
(maximum extension)

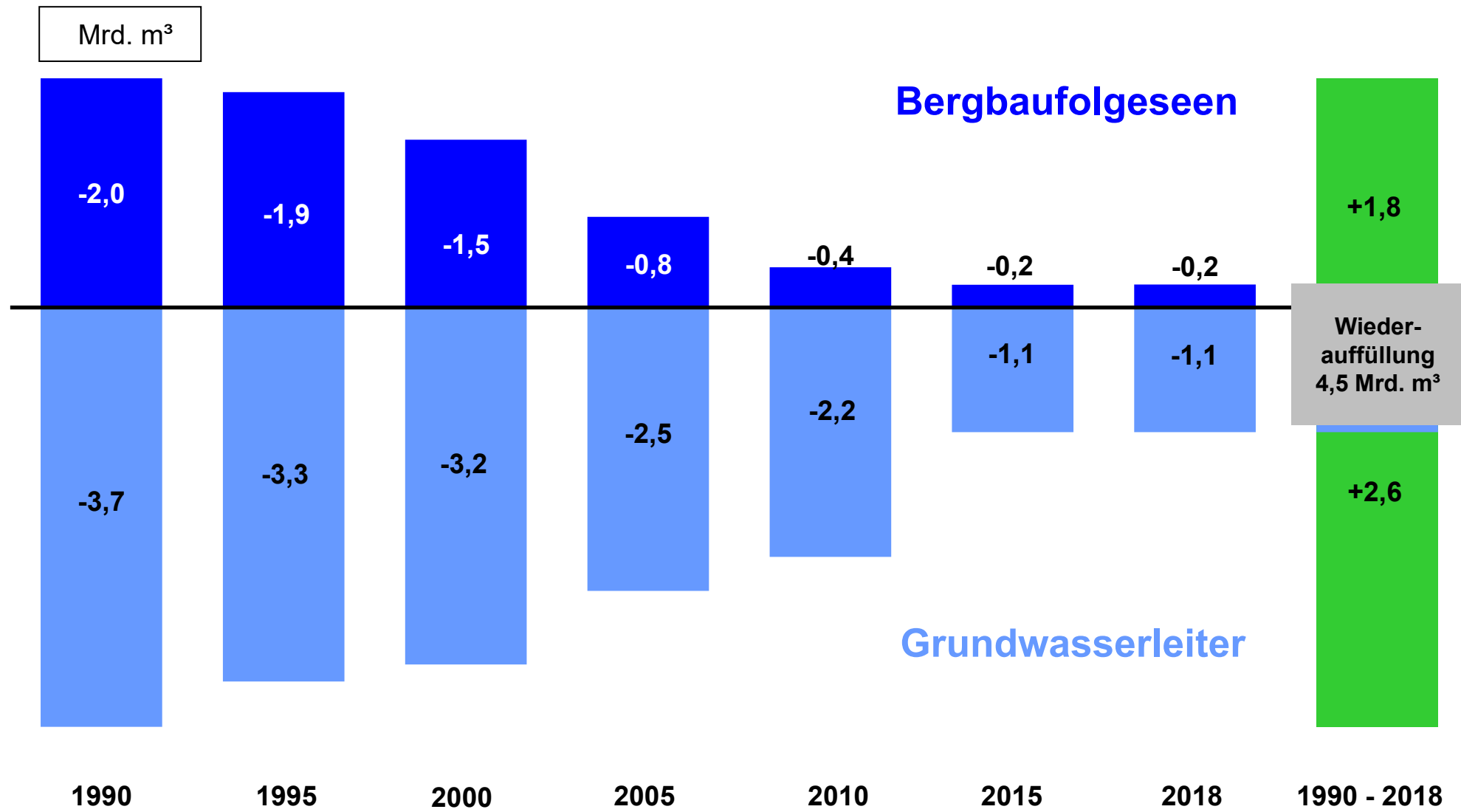


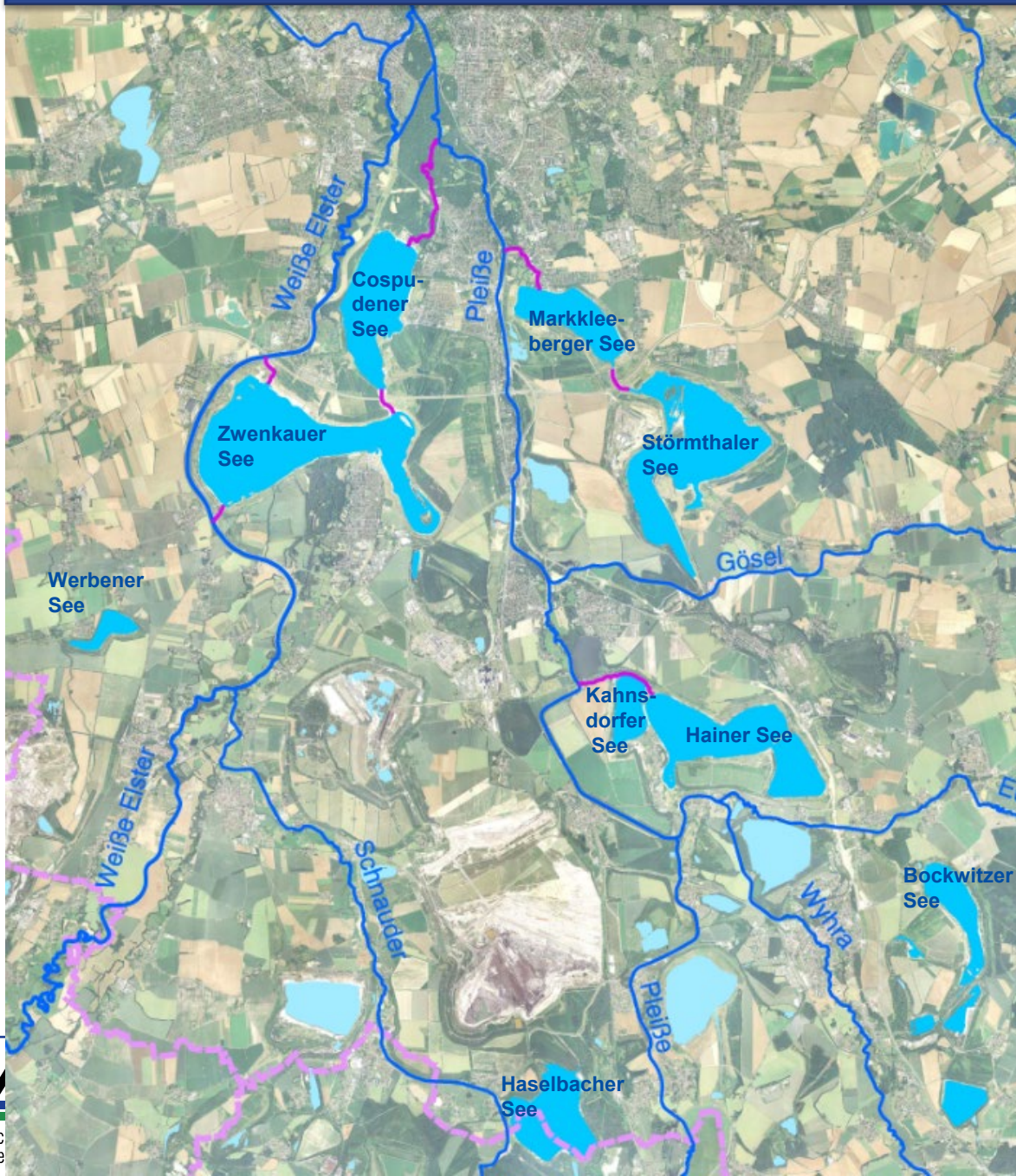
Water network after flooding in 2015



37

Entwicklung des Wasserdefizits





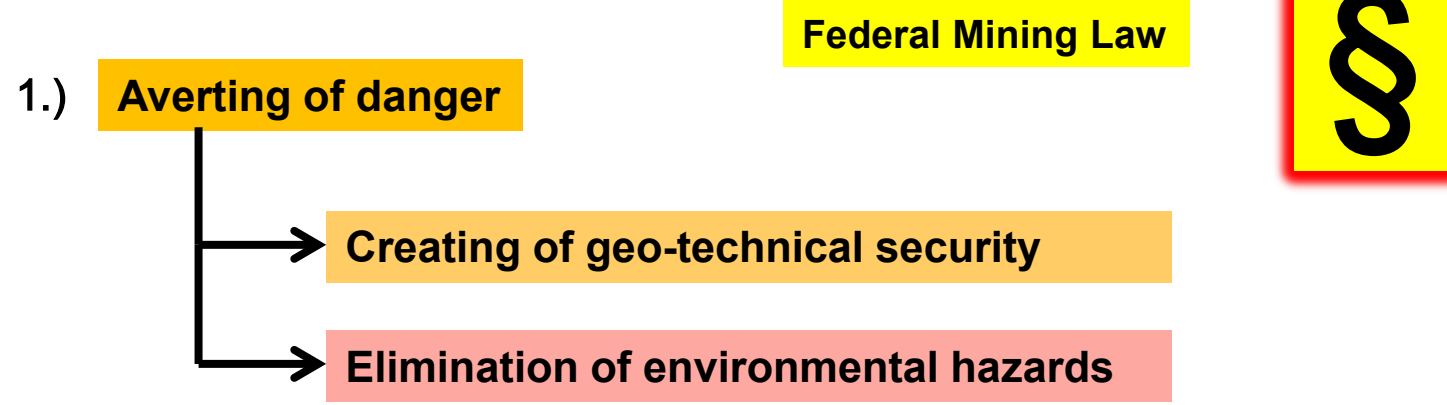
Wasserwirtschaftliche Aufgaben

Steuerung Vorgaben aus **bergrechtlichen Abschlussbetriebsplänen (ABP)** und **Wasserrechtlichen Planfeststellungsbeschlüssen (PFB)** bei der Herstellung, Unterhaltung und Übertragung der Bergbaufolgeseen

- **Gewährleistung der Mengen- und Güteparameter**
 - Erreichen und Halten Wasserstände
 - Erreichen und Halten pH-Werte
 - Sicherung ökol. Mindestabfluss
- **Duldung von Zwischennutzungen**
- **Übertragung Bergbaufolgeseen**

Verbindung Bergbaufolgeseen mit Fließgewässern

— Zu- bzw. Ableitung




2.) Creating of the possibility for a re-use in public interest

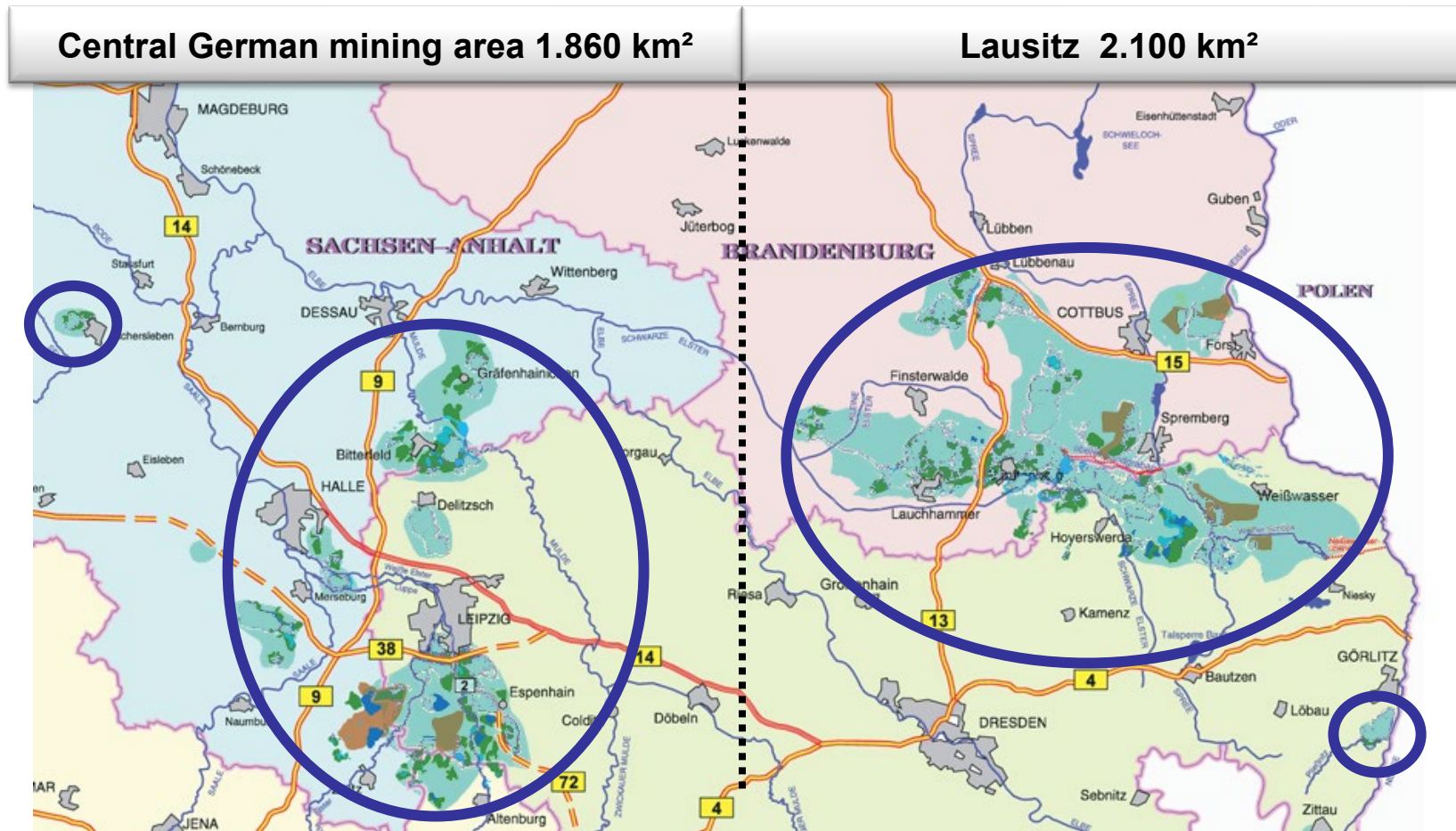
The owner of the mining licence shall fulfil these two duties.

The mining authority is exclusive responsible for the approval of fulfillment.

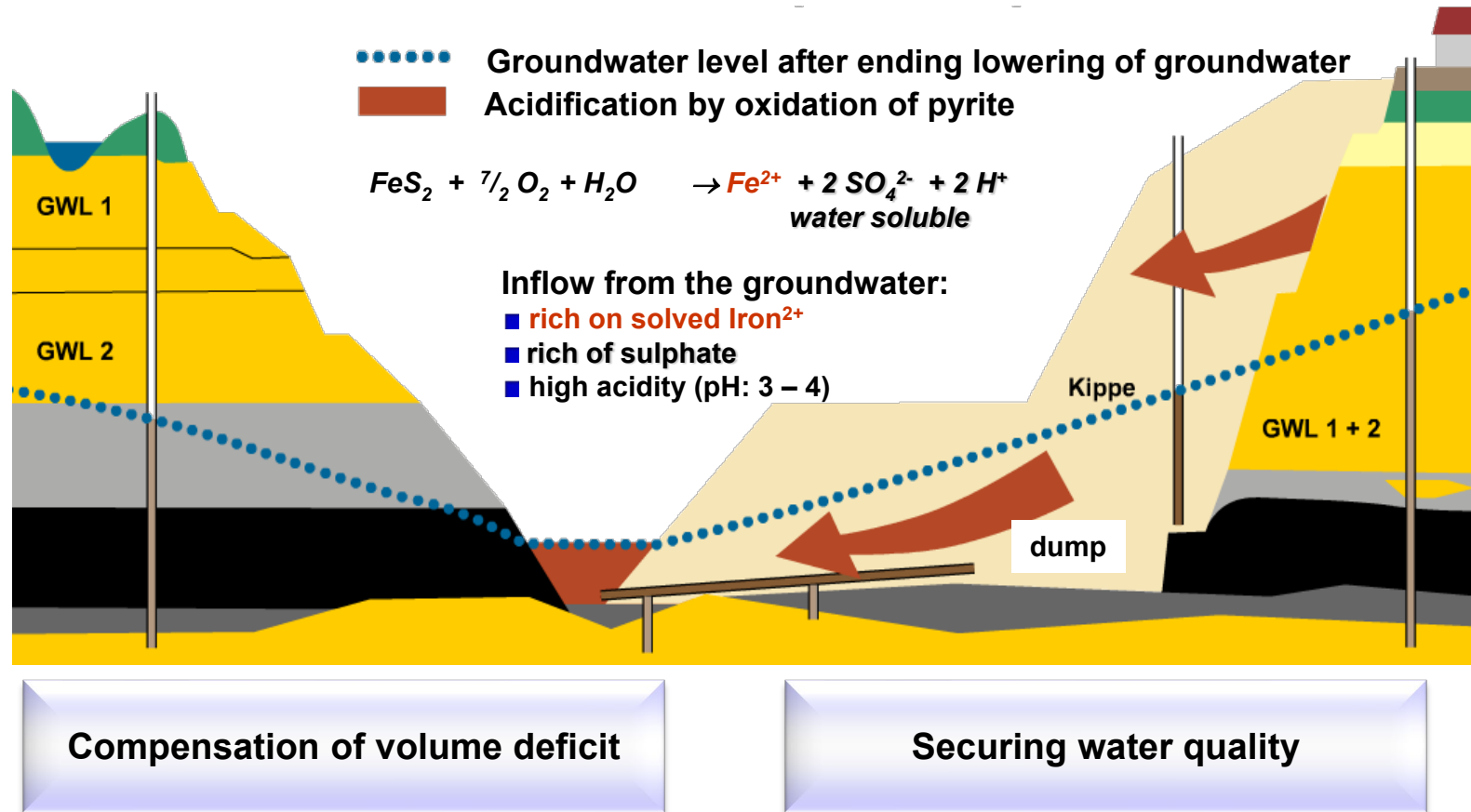
Business segments LMBV

Closing down Lignite Mining until 1999	<i>Orderly and fast closing down of business units which can not be privatized</i>	
Rehabilitation-/ Backfilling & Maintenance of underground mines	<i>Acting as a mining company in the fields of rehabilitation of lignite industry and securing underground mines of potash-spade-ore mining</i>	
Utilization	<i>Use and sell of assets , property and real estates of the company</i>	

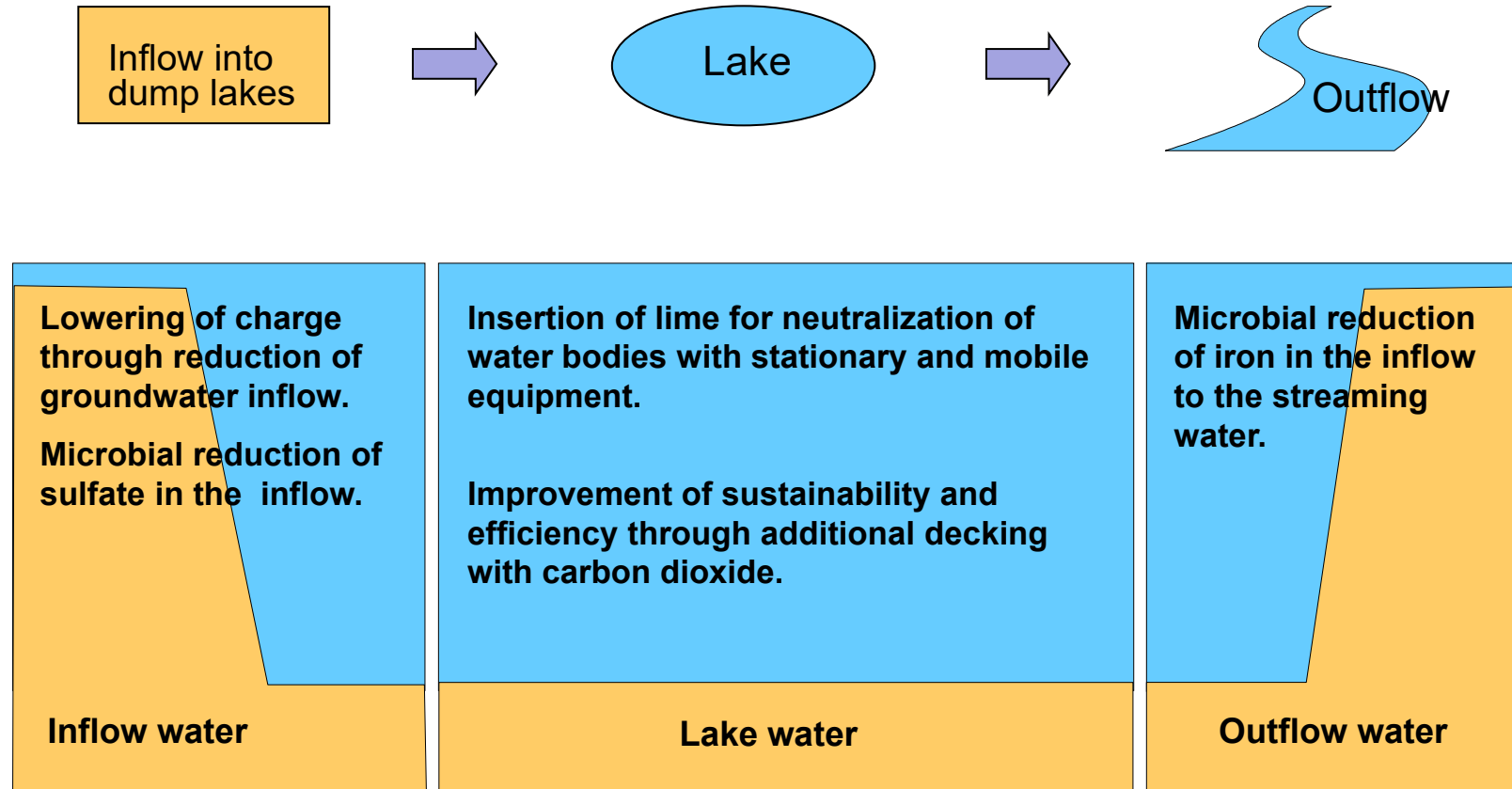
Groundwater lowering in Lusatian and in Central German mining area



Water Management



Procedures of water treatment of lakes



In-Lake Treatment: Liming with boats – post-mining lake most effective way



In-lake treatment

- Different methods and technics
- Different lime substrates

The restoration of self-regulating water balances according to quantity and quality aims is unique.



Apr. 20 Mio. m³ of water were stored inside the pit lake Zwenkau in 6 days in 2013 and rescued by this the city of Leipzig.

