The impact of EXtreme weather events on MINing operations

TEXMIN

European Commission

Research Fund for Coal & Steel

Case study 3
Effects of extreme infiltration conditions in the southern Ruhr area on pumping and pump management

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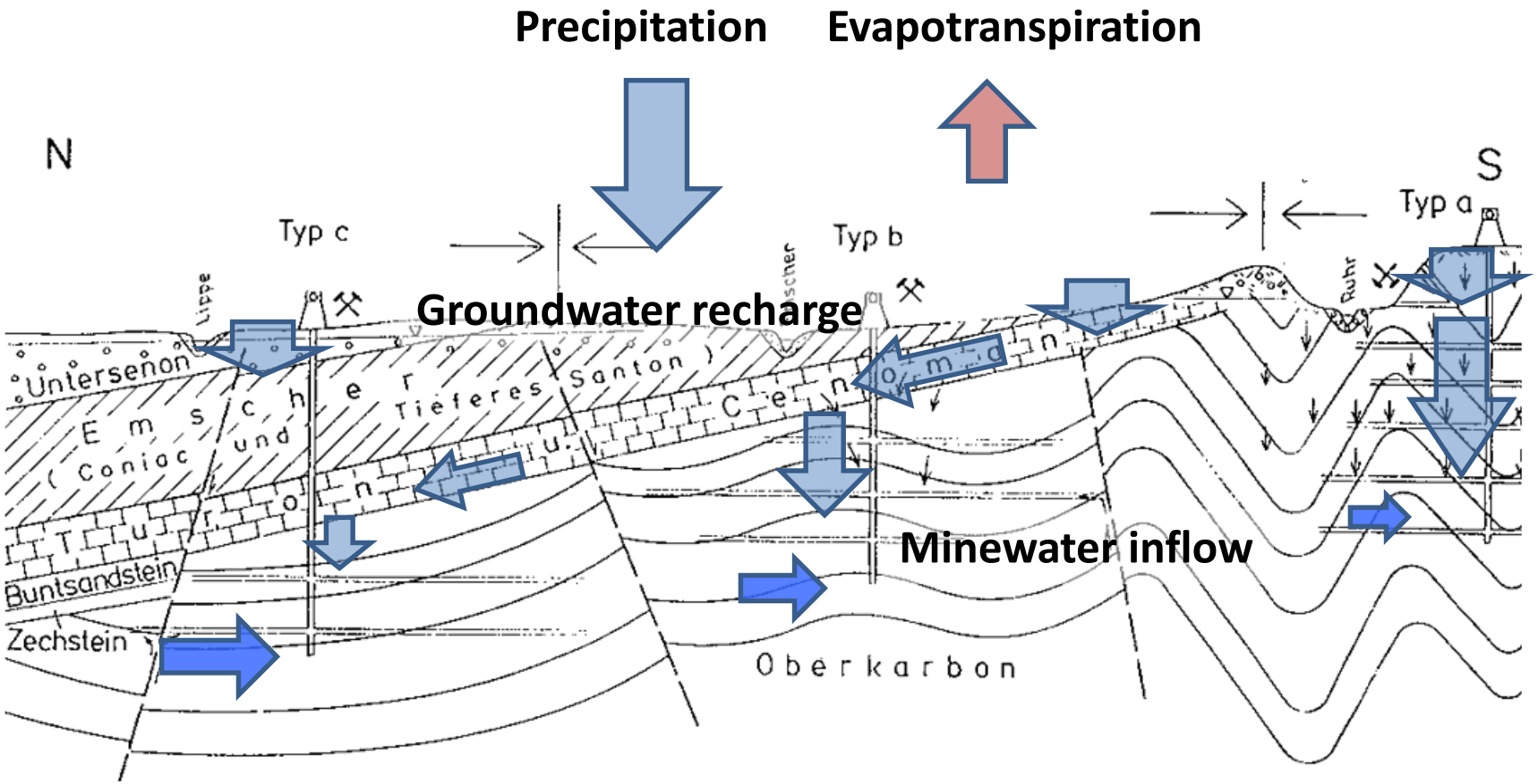
Hydraulic conditions of deep mining

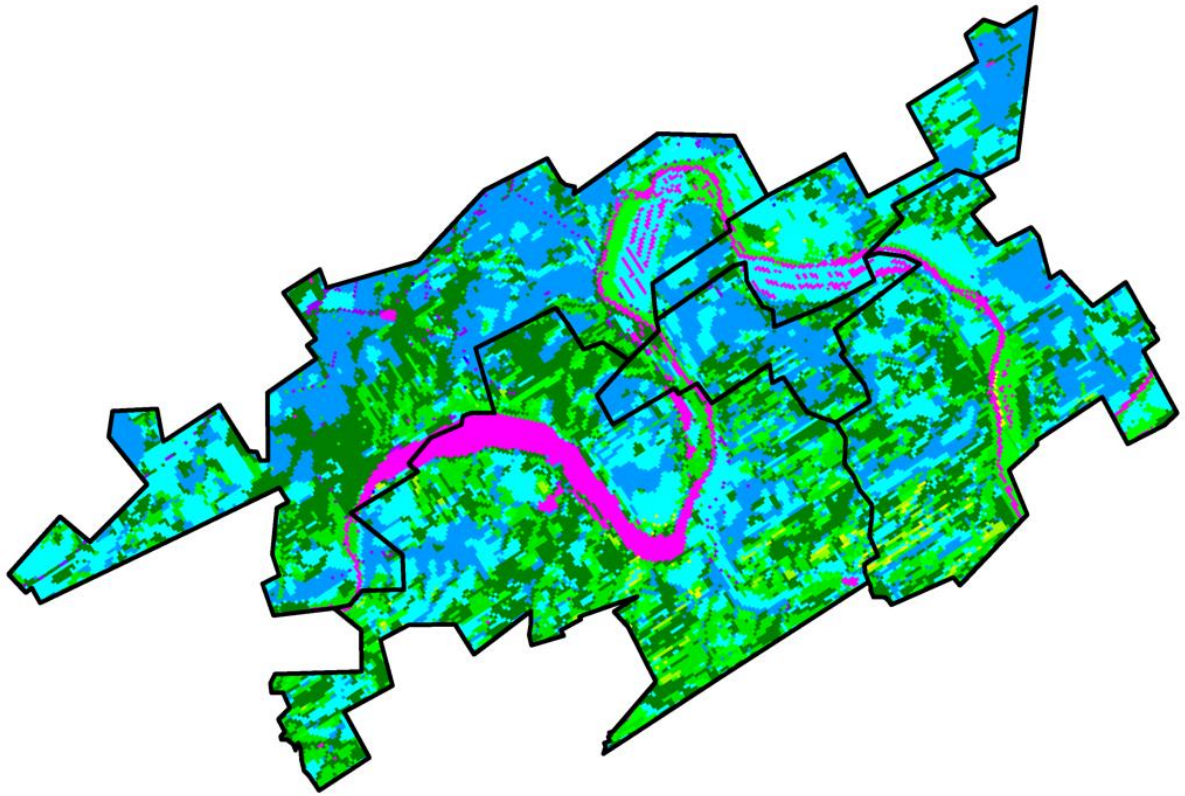


Climatic impact

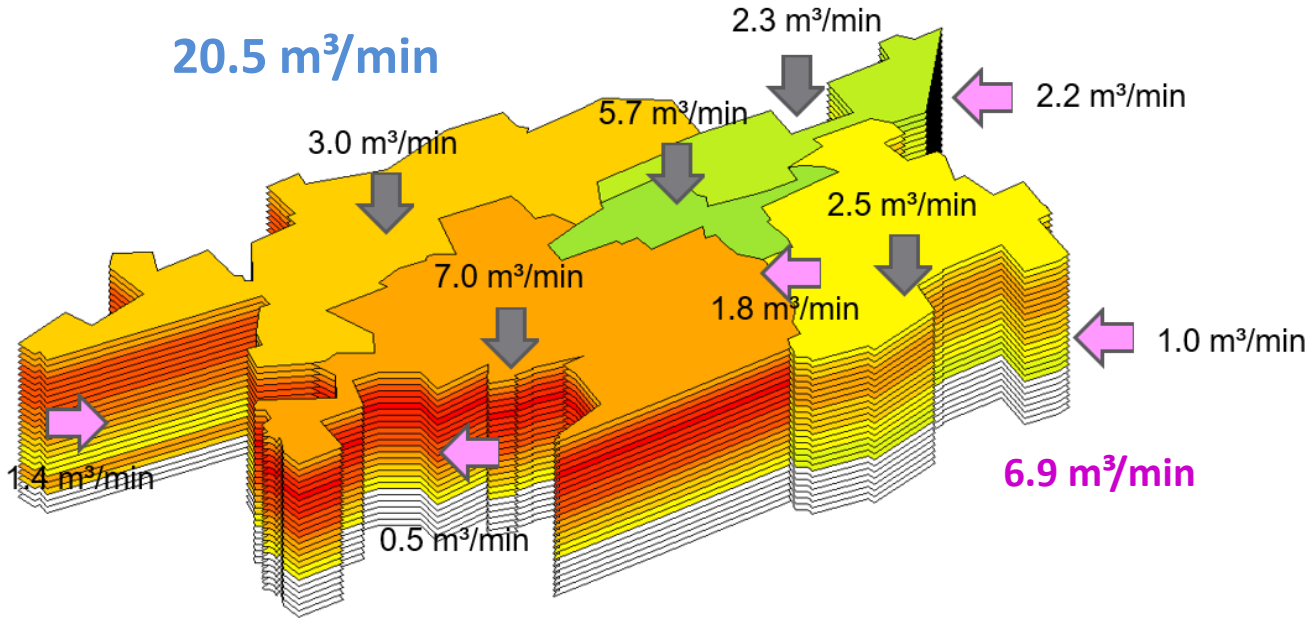
very low | low | present to intense

Site conditions Southern Ruhr

Groundwater recharge
(SPRING Groundwater model code)

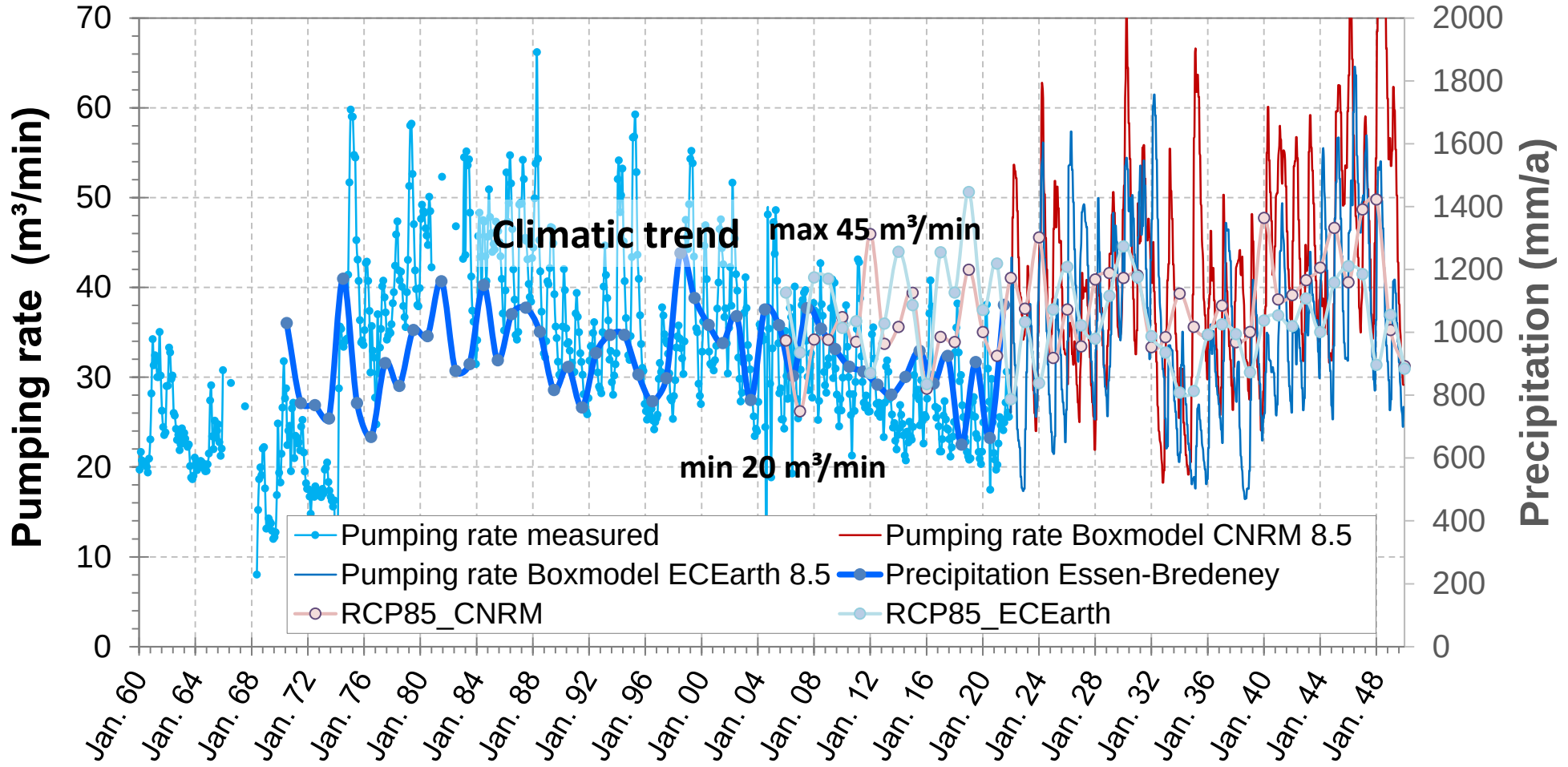


Distribution of inflows
(BoxModel for mines)



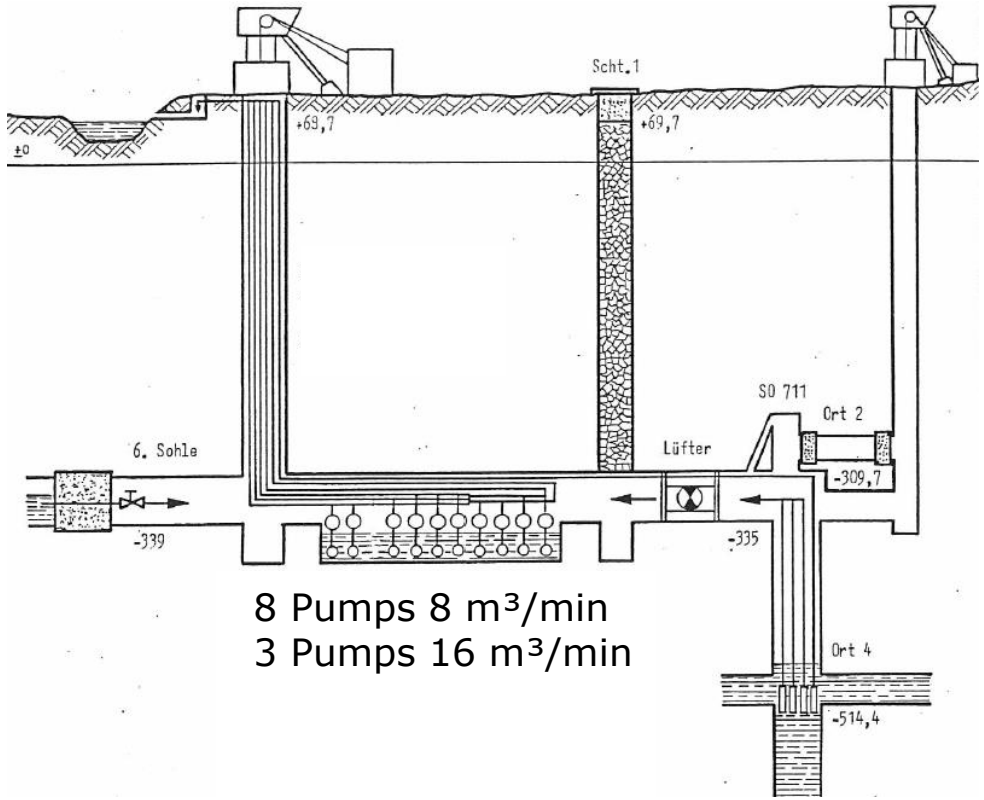
- Thin rock cover
- Large proportion of infiltration from the surface

What is extreme ? Minima or Maxima ?



- Climatic influenced minewater discharge Ruhr
- Reduction in flow rates in the last decades – future trend ?

Mine water pumping



8 Pumps 8 m³/min
3 Pumps 16 m³/min

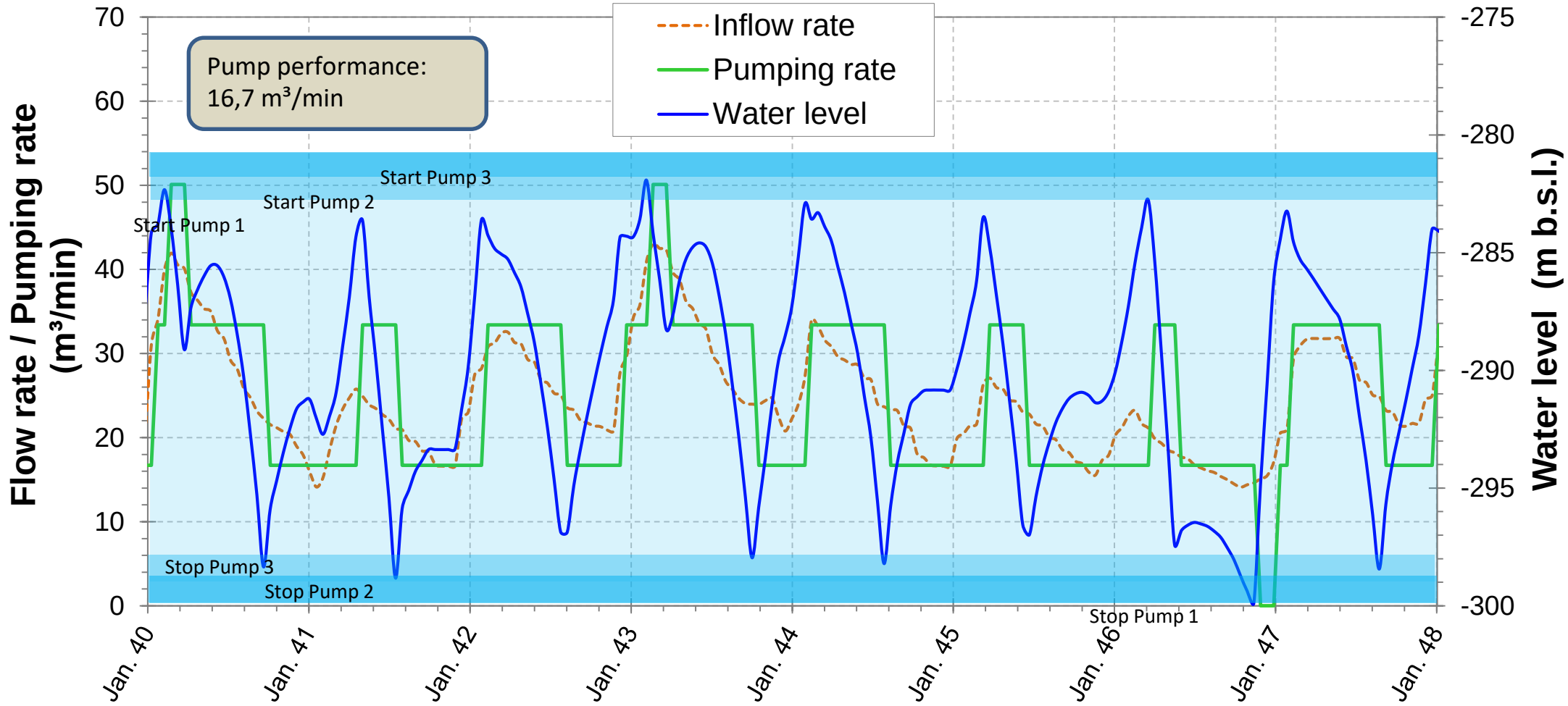
Flow rate 20-60 m³/min

- **Large flow rates are not the technical challenge**

Currently: underground centrifugal pumps
Water tank for storage
Pumping rate ≈ inflow rate
Overall pump capacity **112 m²/min**

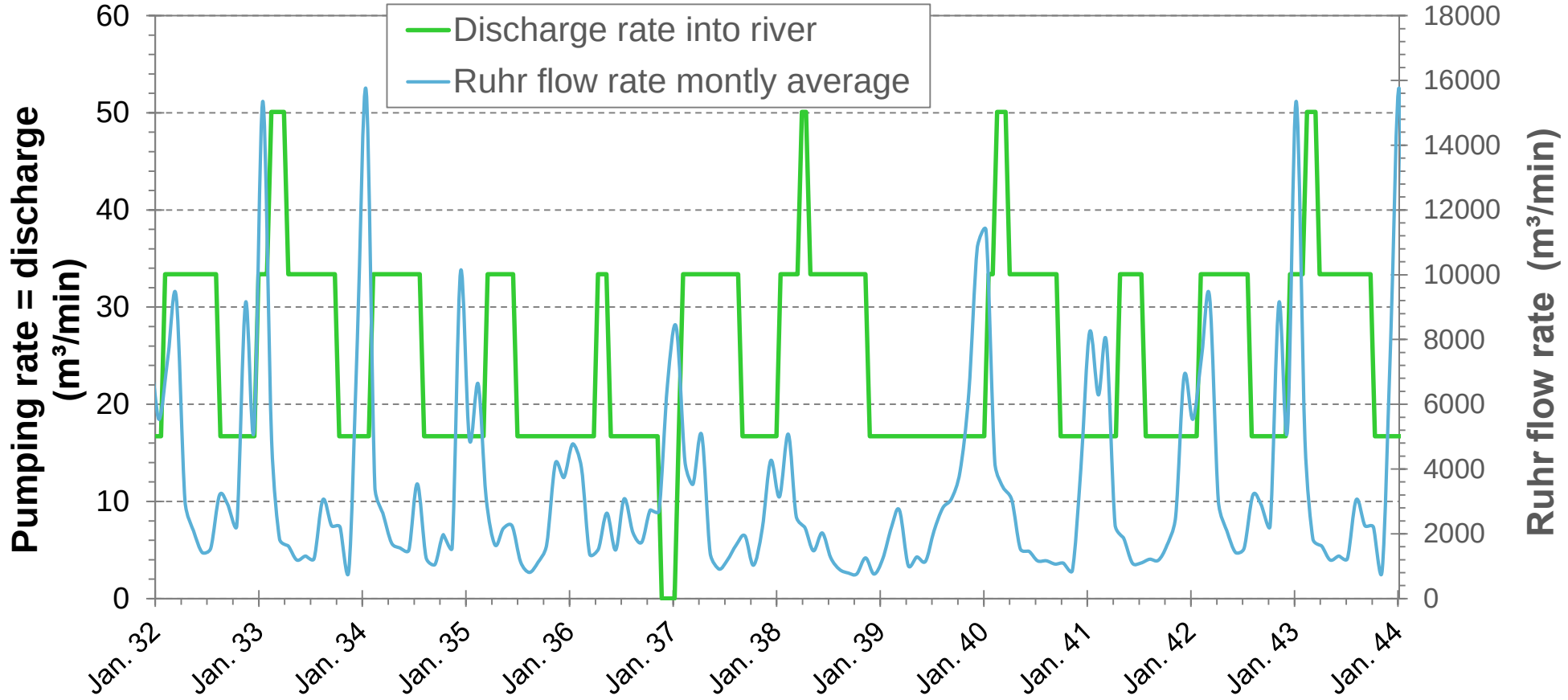
Plan: Submersible pumps
Staggered pumping rates
0 - 17 - 34 - 51 - **68 m³/min**

Mine water pumping



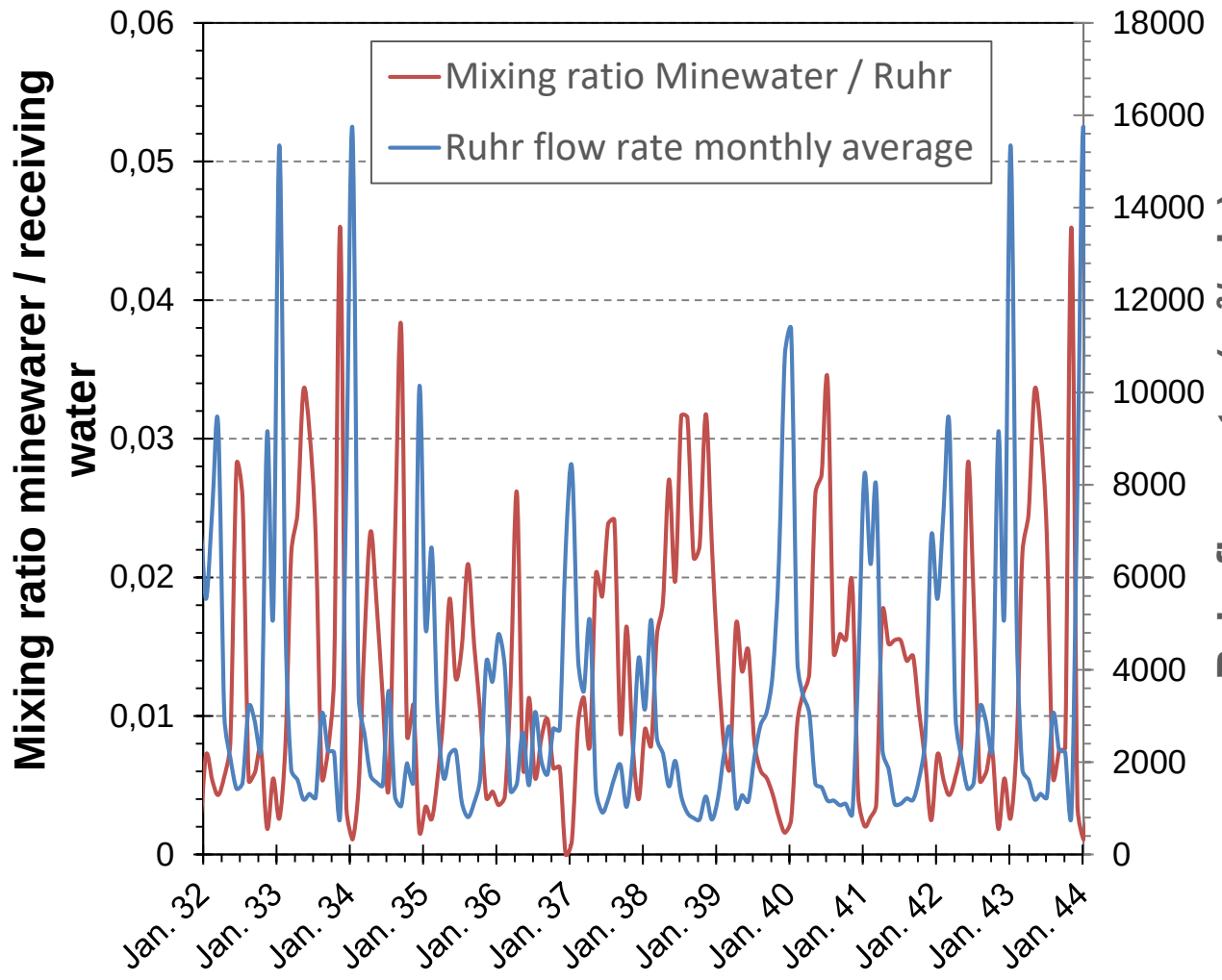
- Seasonally changing pump rates
- The water level determines the pump activity

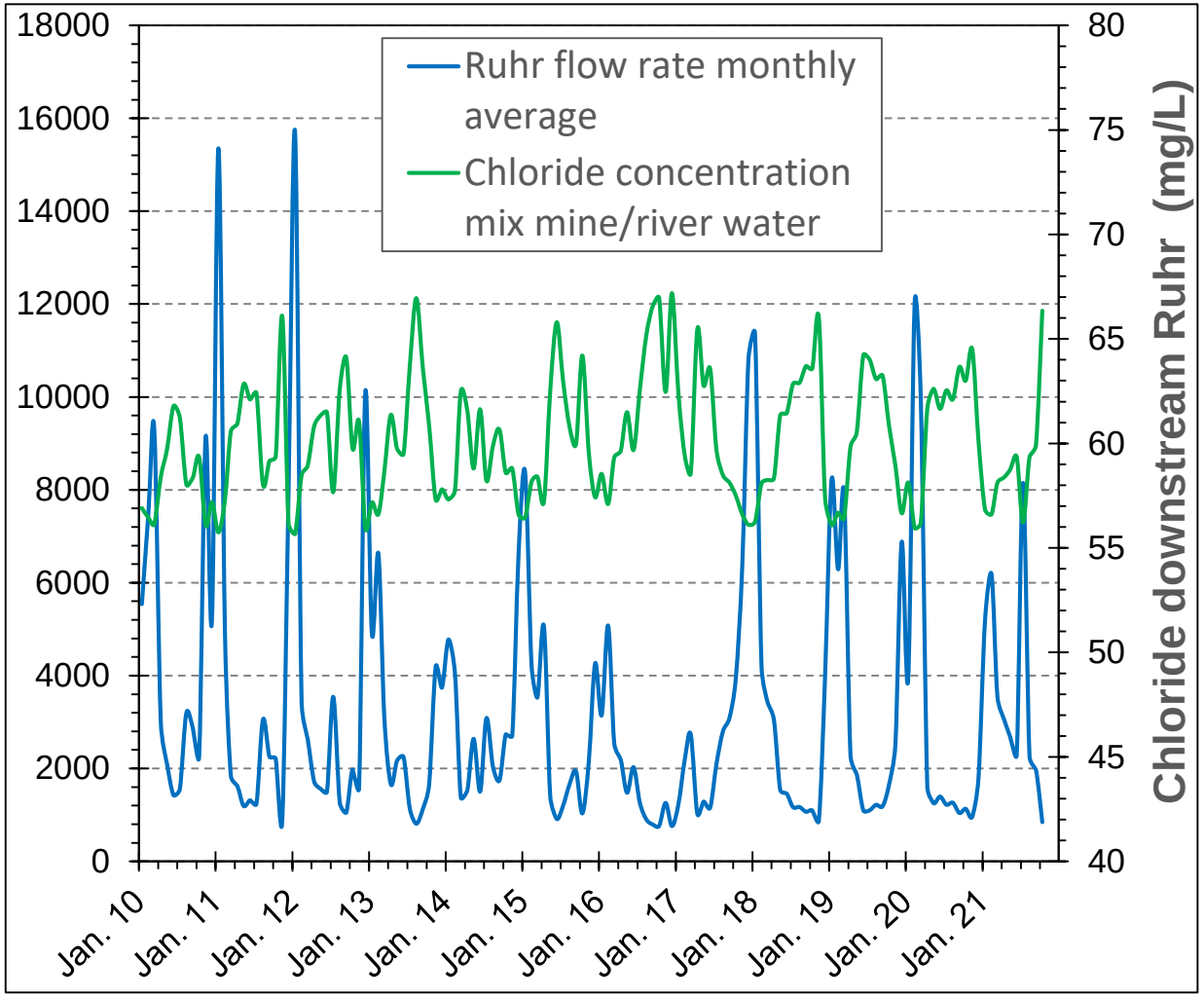
Interaction with the receiving water



- The discharge maxima follow the discharge maxima in the receiving water
- Intensive discharge of mine water occurs when there is little water flow in the receiving water

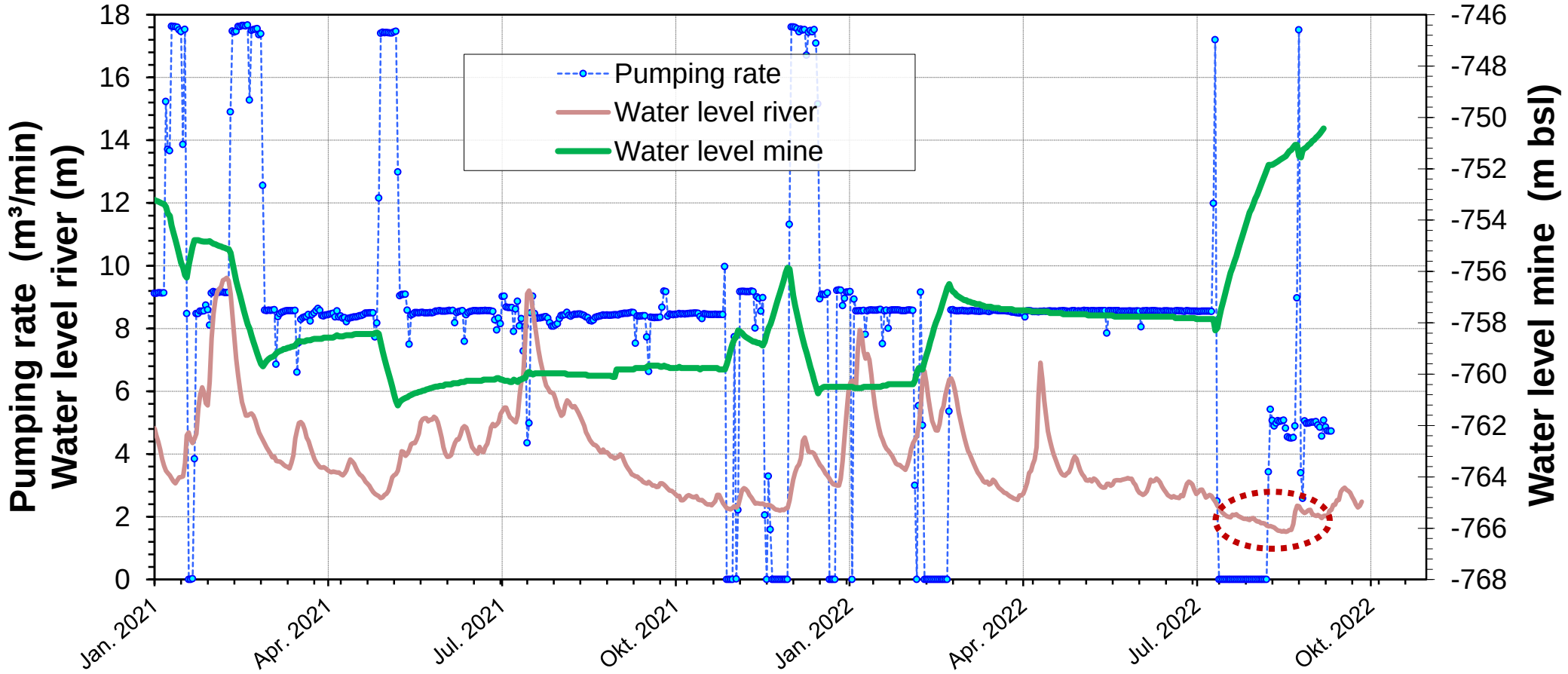
Interaction with the receiving water





- Maximum substance concentrations in the receiving water in the summer months

Interaction with the receiving water

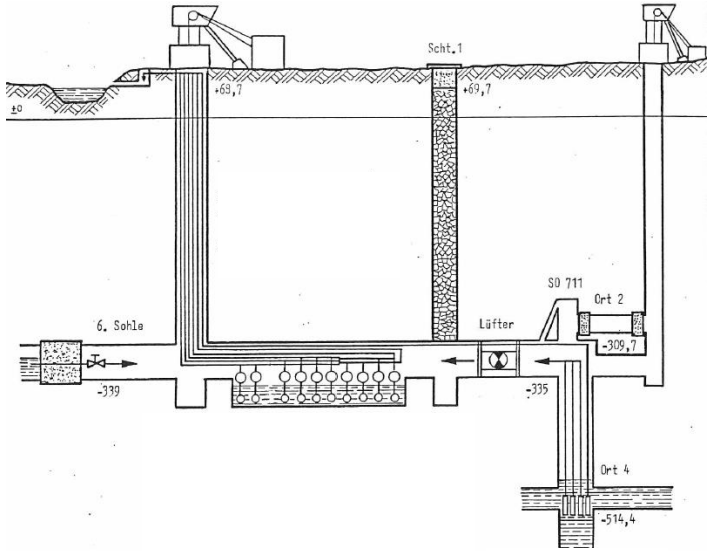


- Very low flow rates in receiving water in very dry summers
- Discharge and pump stops when minimum flow rate in the receiving water is reached
- Consequence: the water level in the mine rises above the approved level

Water management requirements

Adaptation of the mine water pumping to the receiving water conditions

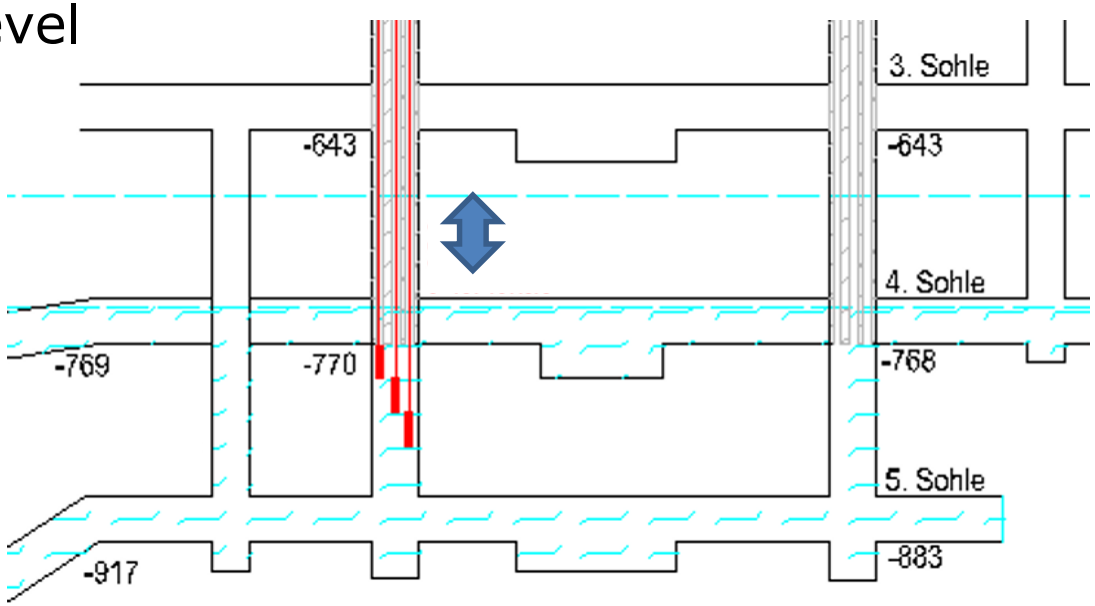
- Homogenization of the mine water discharge
  - Avoidance of discharge stops when there is little water flow in the receiving water
    - Complete relief of the receiving water from salts from mine water (bad for water ecology)
    - Forced rise in mine water
  - Avoidance of maximum delivery rates
    - Increased substance inputs into the receiving water
    - Backup pump operation
  - Operation of 1 - 2 pumps in phases when there is sufficient water flow in the receiving water
    - Keep water level as low as possible at the beginning of summer
- Only possible with deep water drainage using pumps, no retention space with free outlet



Measures and planning

- **Planning of the pump capacity on (future) demand**
  - Smallest pump < as minimum inflow volume
  - Variable pump quantities by speed-controlled submersible pumps
    - ➢ Continuity of pump operation

- **Buffer volume of underground storage**
  - Pump variety minimum - maximum water level as large as possible
  - Water level in a level with high mining activity (void volume)



➢ Consideration of future climatic trends and their impact on mine water **and** surface water and their **interactions**

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