Balancing drinking water production and sustainability: a case study of the groundwater extraction site ‘Kastanjebos’ near Leuven, Belgium

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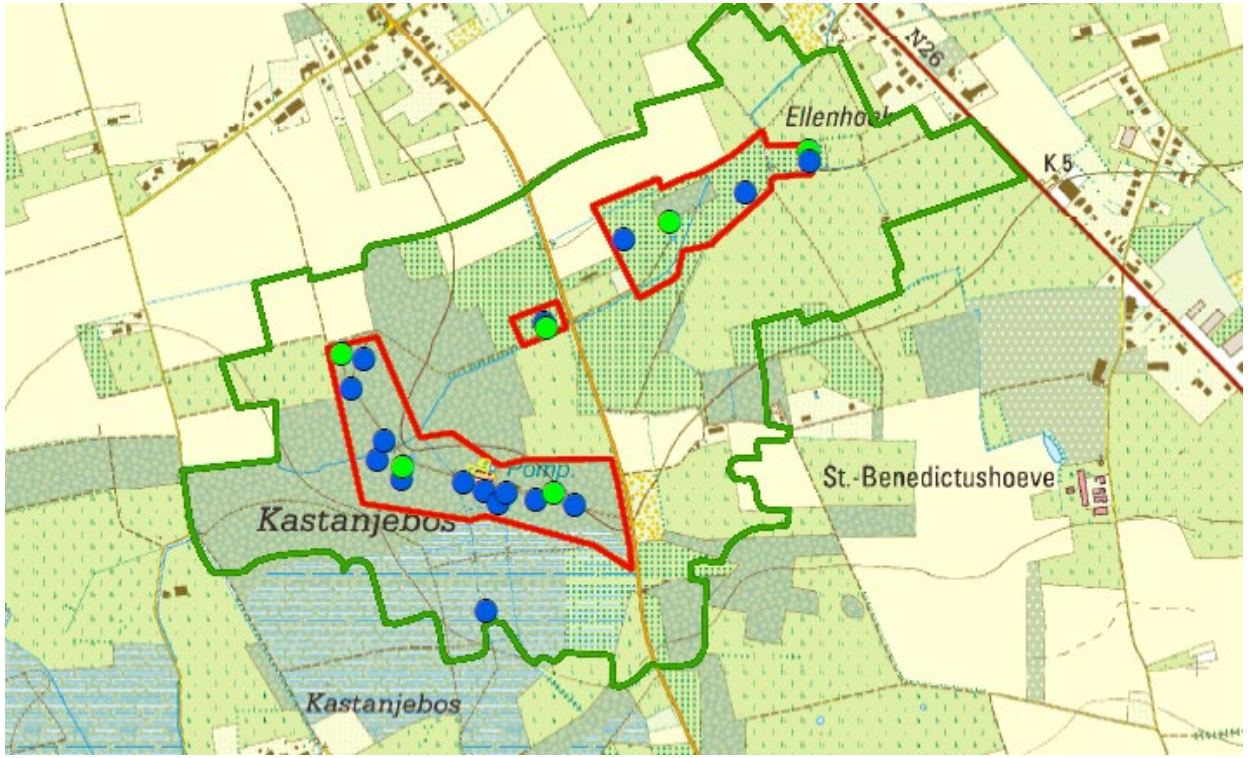
Location of ‘Kastanjebos’

- A small forest north-west of Leuven (central-Belgium)

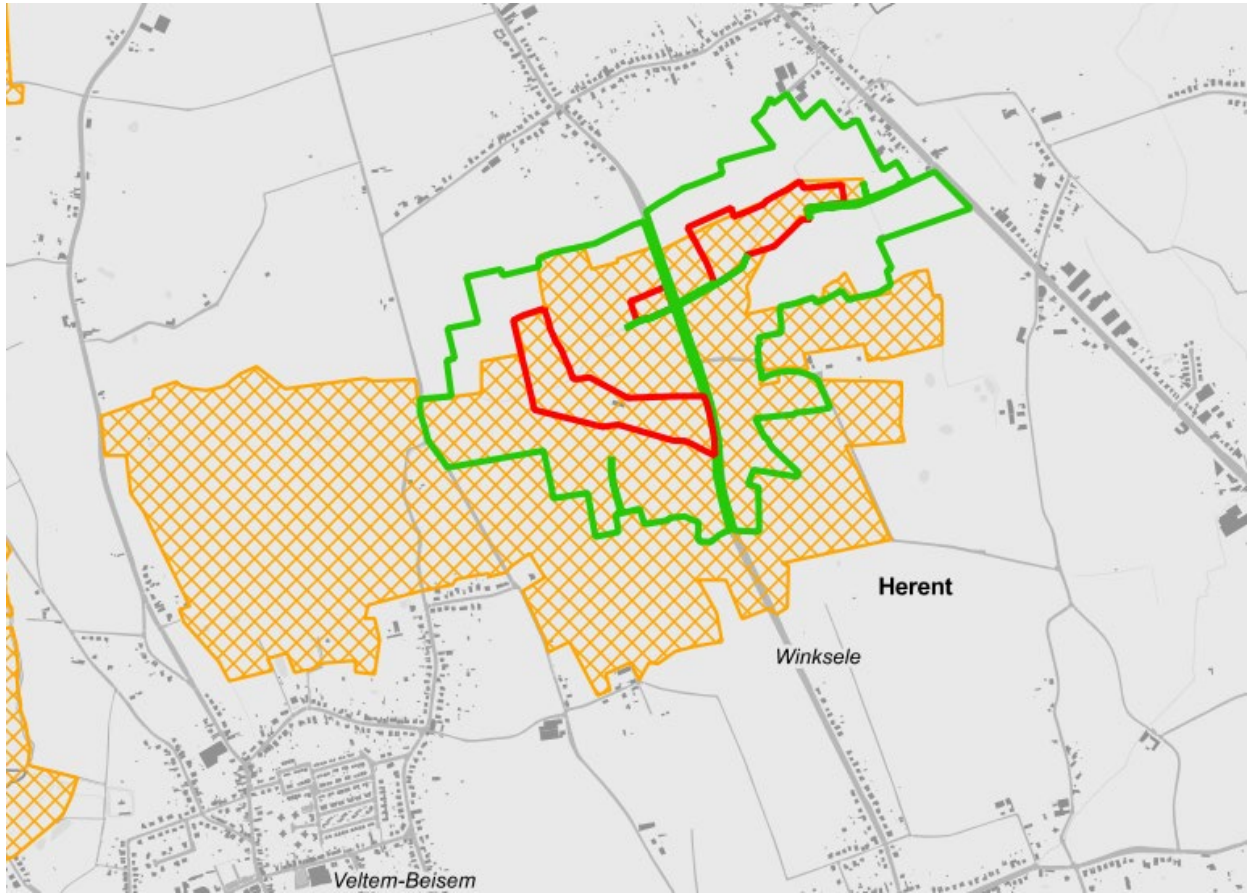


History

- Operational since 1969 for drinking water production 
  - Initially 22 wells, all in the Brussel sand formation
- In 1988 the old wells were taken out of production and replaced by 6 deeper wells
  - Reduce the impact on the water levels
  - Reduce well clogging
- The 6 remaining wells are still exploited
  - Permit for 3 300 m^3/day and 1 200 000 m^3/year (with a peak up to 4 800 m^3/day)

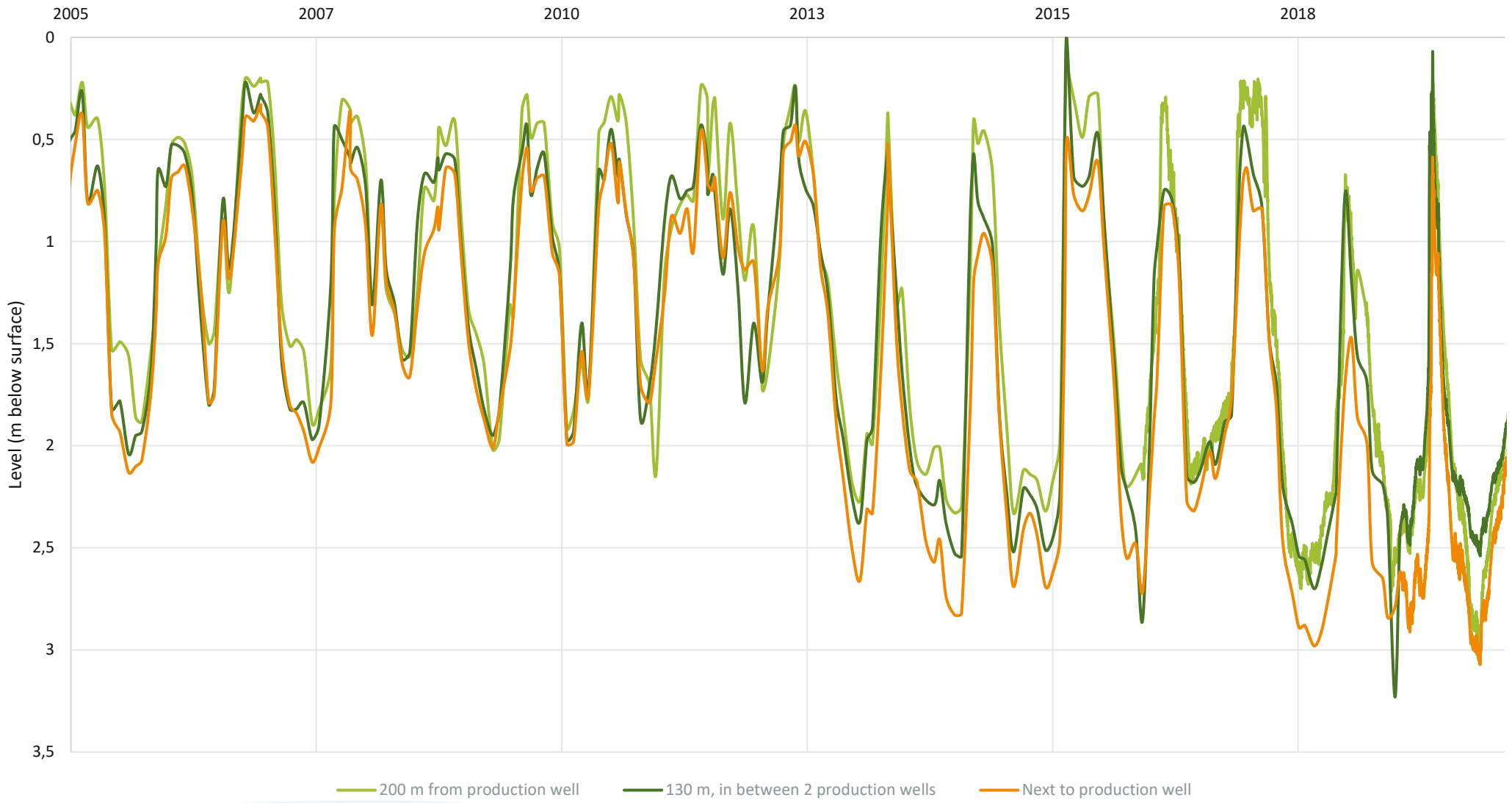
Balancing the Natura-2000 goals

- Kastanjebos encloses several habitat types(wet and alluvial forests and wet grasslands) with different abiotic characteristics
  - Most importantly the GxG's are below the minimum values (= GW level is too low)
- Actions are needed to reach the European goals



Orange: Important habitats (Natura-2000) in de vicinity of the production site

A view on the water levels (2005-2020)



How do we deal with the decreasing GW levels?

- In 2017 the permit got renewed, with the condition to install an annual commission to follow up GW levels, extraction rates and monitor the evolution of the vegetation
- The commission consists of stakeholders from governmental agencies
  - This has led to improved monitoring with automatic measurements with permanent data transfer
  - 3 actions were taken to improve the groundwater level:
    - Reduce the extraction
    - Drill to a deeper aquifer
    - Reduce the drainage/increase infiltration

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Action 1: Reduction of the extraction rate

- Estimation of de maximum extraction rate to reach the minimum groundwater level
- A ‘GLG’ is calculated over one year to estimate the lowest average GW level that can be expected at a certain extraction rate
  - 600 000 m^3/year is estimated as the ideal maximum

GLG = mean low ground water level, calculated based on the 3 lowest GW levels in a year separated from each other by at least 2 weeks (theoretically it has to be calculated over longer time series >6-8 years, but here we use it as an indicator for the GW level over only 1 year)

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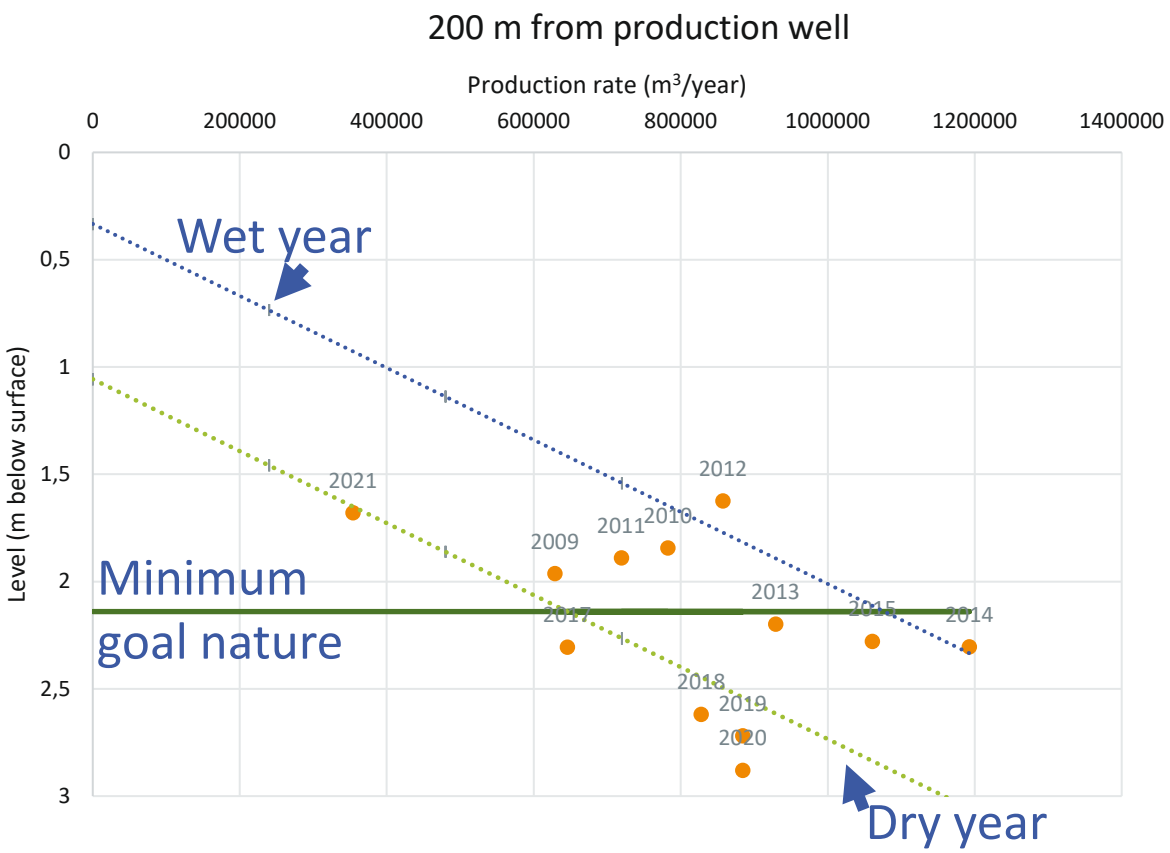
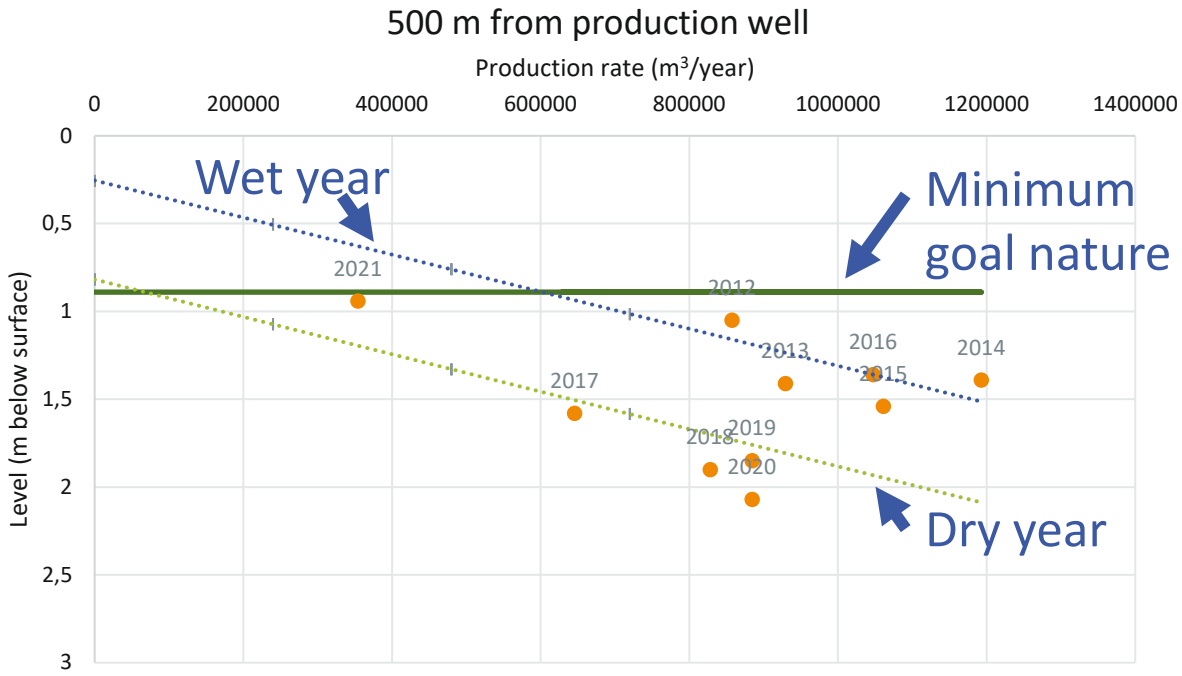


Estimation of the GW level at different annual extraction rates, while also making a difference between dry an wet years, the minimum goal nature takes the habitat type of the location into account



Orange dots: annual mean low GW level (GLG), calculated over 1 year

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Action 1: Reduction of the extraction rate

- A new connection in the drinking water network allows to reduce Kastanjebos to a maximum rate of 1 500 m^3/day 
  - operational since September 2020
  - From a less vulnerable source
  - Peak volume remains available for a short period (max 3 weeks)

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Action 2: Drilling to the deeper confined Aquifer

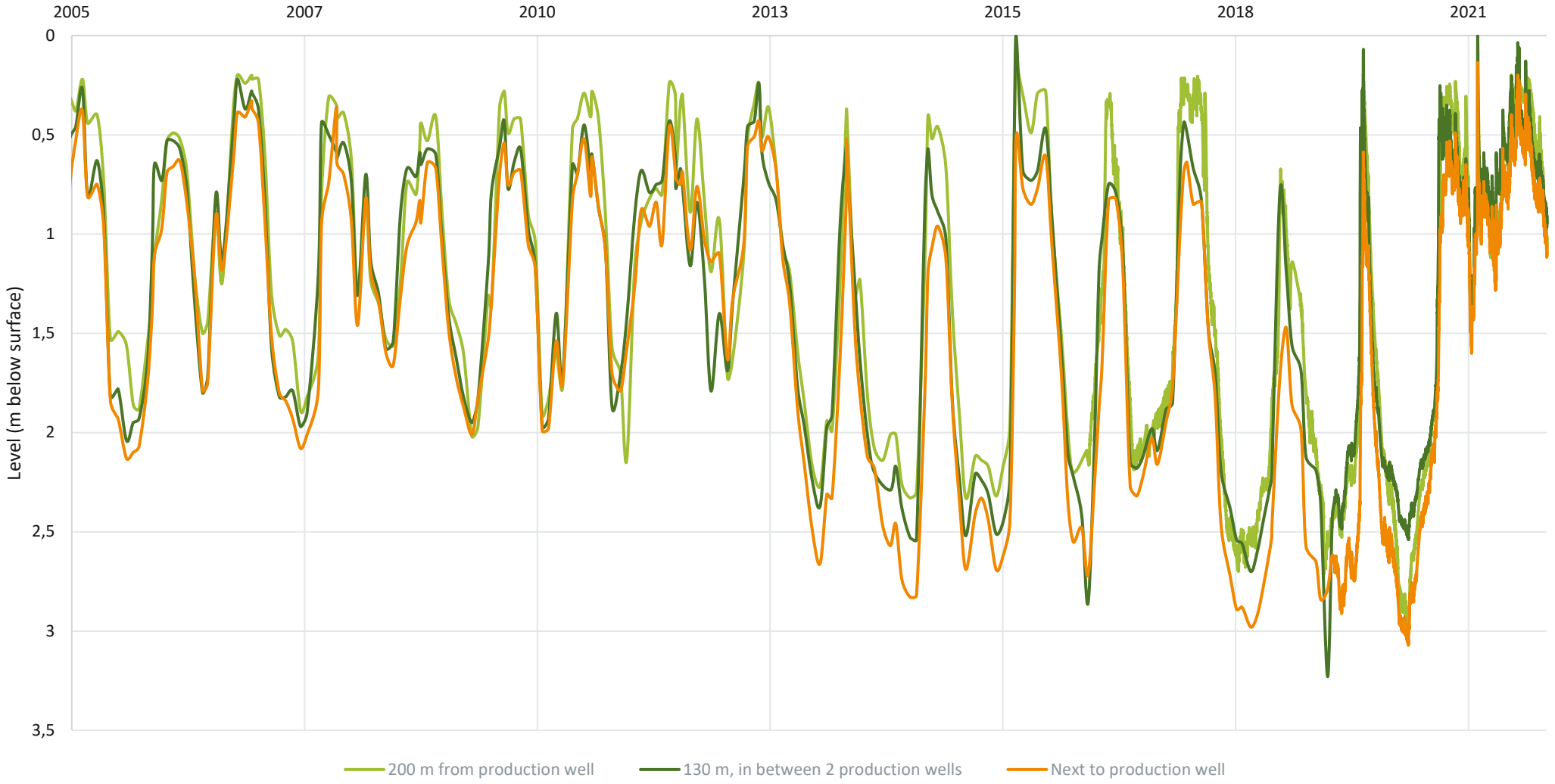
- A pumping test concludes that the deeper well can provide 30 m^3/h 
- This geological layer has a low capacity and is vulnerable to overexploitation which makes it not ideal

- This option is considered not viable in the short term, because Kastanjebos has already been greatly reduced thanks to action 1
  - The well is in place, so when needed this option can be reopened in the future

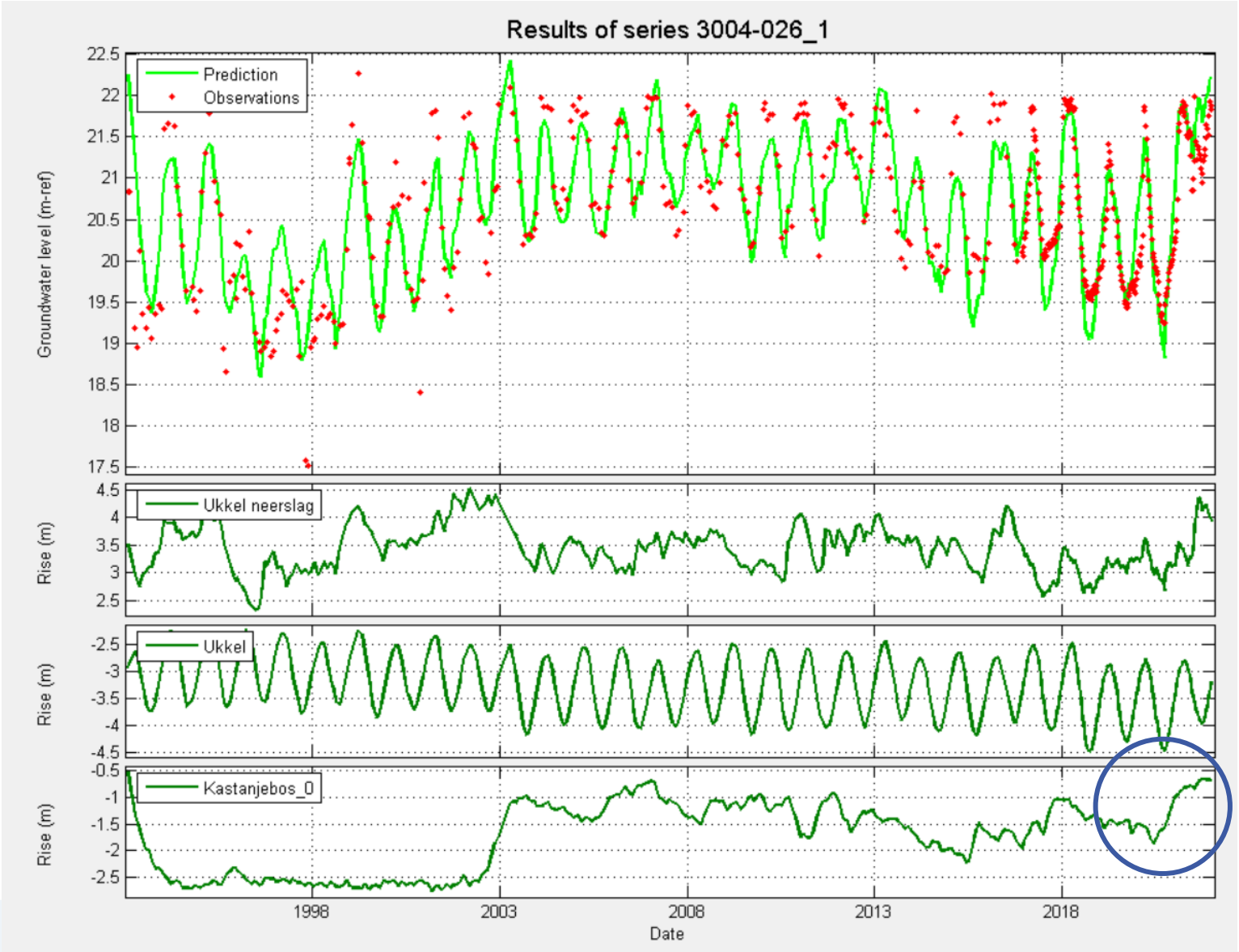
Action 3: Decreasing the drainage

- A hydro-ecological study has been executed by the ANB (Agency for Nature and Forest)
  - The impact of the increased infiltration in combination with a reduced extraction rate has been calculated
- Drainage will be reduced by shallowing the streams in the forest
  - The shallowing is an ongoing project that is currently planned for execution in 2023/2024
- This will have a positive impact on the GW levels by allowing more rainwater to infiltrate

Current state of the water levels (2005-May 2022)



Interpretation of water levels



Time series analysis

Rain

Evapotranspiration

GW extraction

Conclusions

- Working together with the different stakeholders has led to multiple actions to reduce the impact of the GW extraction on Kastanjebos
- We are currently seeing a positive evolution thanks to the first measures that have been implemented
- We expect further improvements of the GW levels in the future when more actions have been executed
- Due to the drought balancing drinking water production and nature protection remains a delicate task

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Long term monitoring, specific actions and cooperating with different stakeholders, have allowed to make the site of Kastanjebos more sustainable, while still maintaining its vital community function as a production site for drinking water in combination with protection of valuable nature.