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Groundwater management in the Netherlands

Some successes worth sharing

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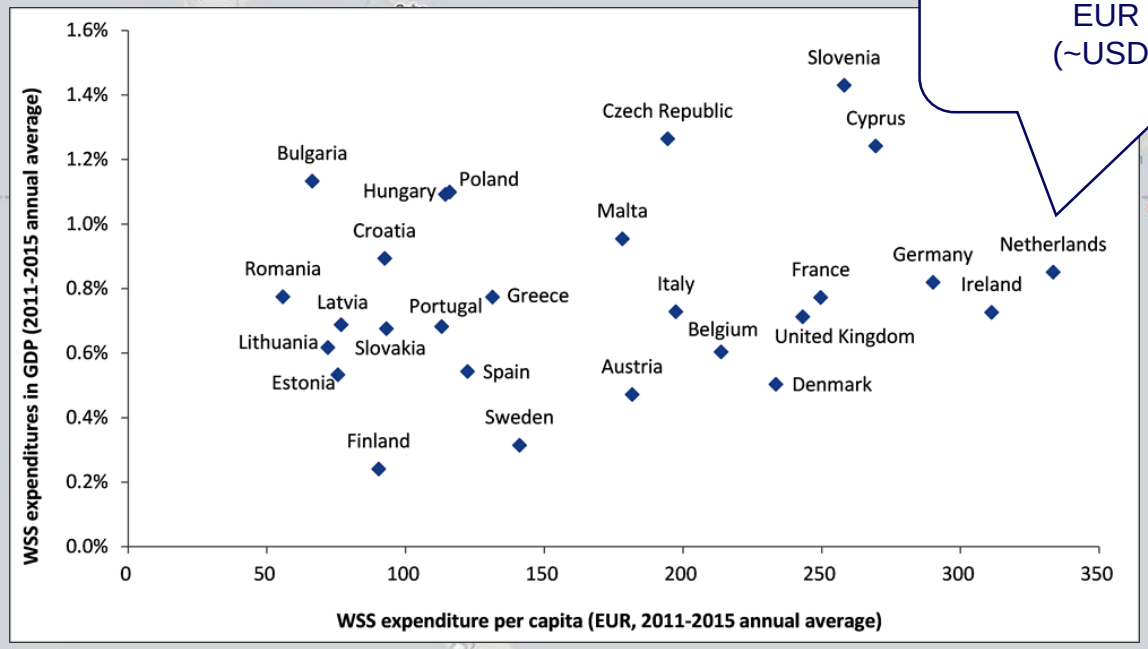
IWRA Groundwater webinar series 30 June 2021

	Size [km2]*	Population (2019)** [million]	Population density [inhab/km2]
Netherlands	41850	17.3	414
California	423970	39.4	93
India	3166414	1366.4	432

* map and size: http://thetruesize.com/
** California: http://census.gov Netherlands and India: https://data.worldbank.org

Annual expenditure on water management in Netherlands
EUR 7.700.000.000
(~USD 9.171.000.000)
Source: Staat van ons water 2020



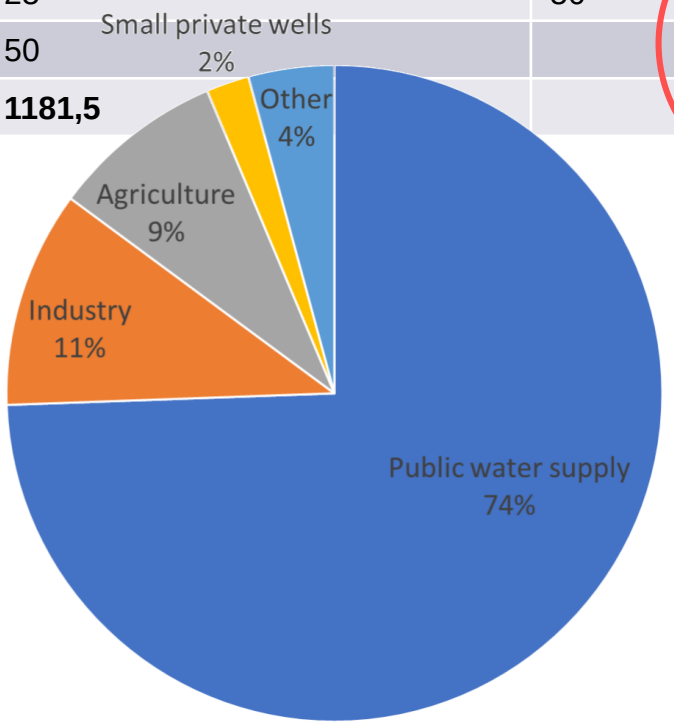
Source: OECD (2020) Financing Water Supply, Sanitation and Flood Protection)

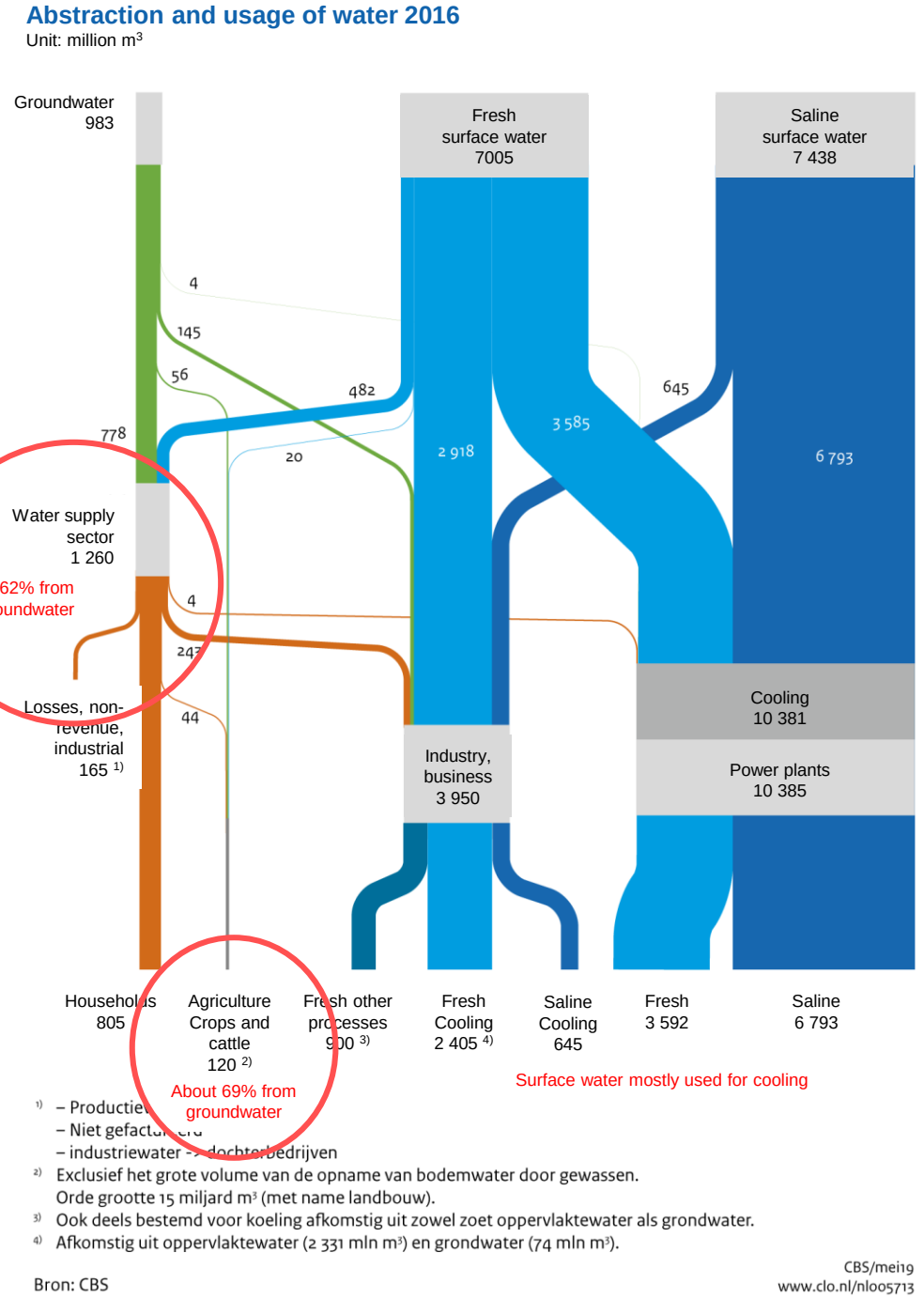
thetruesize.com

Water usage in the Netherlands

	Annual groundwater abstraction (million m3)	Dry year
Industry	126,3	
Public water supply	880,2	
Agriculture (irrigation)	101	200
Small private wells	25	50
Other (e.g. construction pits, remediation)	50	
Total	**1181,5**	

Source: Unie van Waterschappen & IPO (2021)
Overzicht grondwateronttrekkingen





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The successes?

1981 Groundwater Law
(since 2009 incorporated into Water Law)

1970's: Increased awareness on (potentially) negative impacts of groundwater abstraction

1981: Groundwater law

Regulation of groundwater abstraction through licensing

Objective: protect quantity of groundwater resources, prevent negative impacts on such as on nature and prevent salinization.

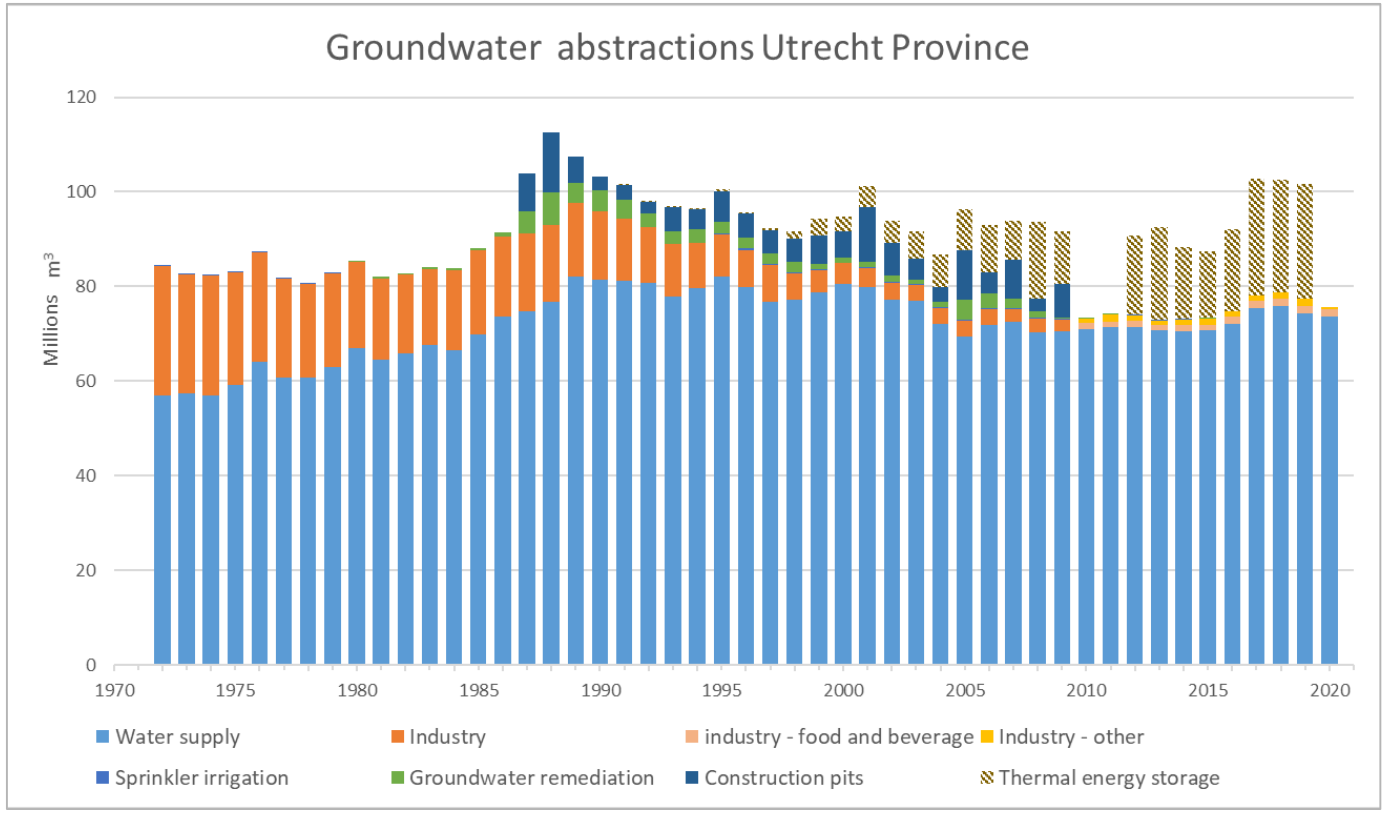
Abstraction in principal only allowed

- if abstraction doesn't cause any harm
- for purposes in which surface water is no alternative
- groundwater use is prioritised for domestic use and/or industrial use that requires high quality water

Instruments include:
Registration, licensing, financial compensation

Responsibility with provincial governments, who can impose a tax that may only be used for groundwater research, measures to prevent or mitigate negative impacts from abstraction, etc.

Impacts of policies on groundwater abstraction



1981 Groundwater law

1993 Policy on domestic and industrial water supply

- Decrease industrial use (cooling)
- Stabilise abstractions for water supply in the year 2000

Impacts:

- Industrial use: steady decrease
- Water supply: 1990 and onwards: Stabilising and even decreasing abstraction despite population growth (water savings technologies)

2009 new Water law

Impact:

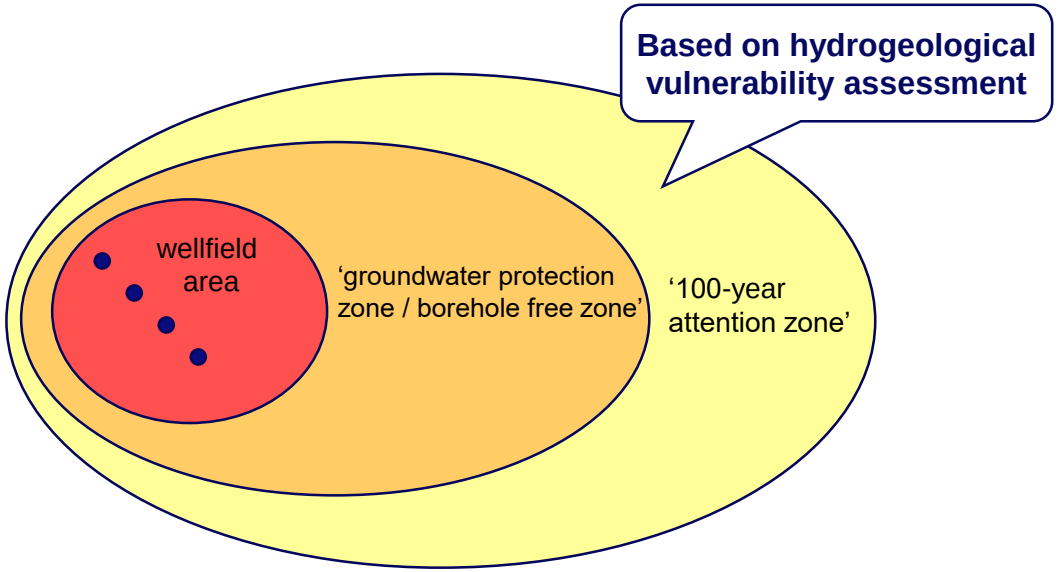
- shift in responsibilities complicates registration of abstraction data

Externalities: Reduction greenhouse gas emissions

Impact:

- Thermal energy storage: new technology (net abstraction very small)
- Geothermal energy: new technology under mining law, potentially competing with groundwater resource management…

Protection of groundwater quality



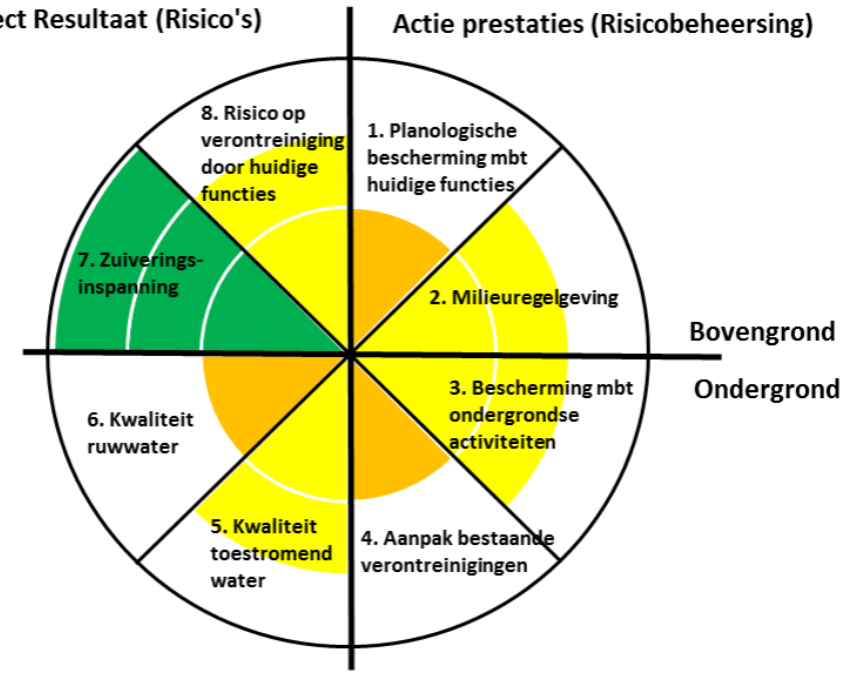
Groundwater protection zones

- '**Welllfield area**': 60 days travel time.
  Highest level of protection: no other activities allowed
- '**Groundwater protection zone**': 25 years travel time
  strict regulation of activities with specific activities being prohibited
- '**Borehole free zone**': prevent piercing of protective clay layers (for wellfields under semi-confined conditions)
- **'100-year attention zone**' 100 years travel time. Defined for vulnerable wellfields: suasive measures & due care and diligence

Cooperative process of planning, executing and monitoring

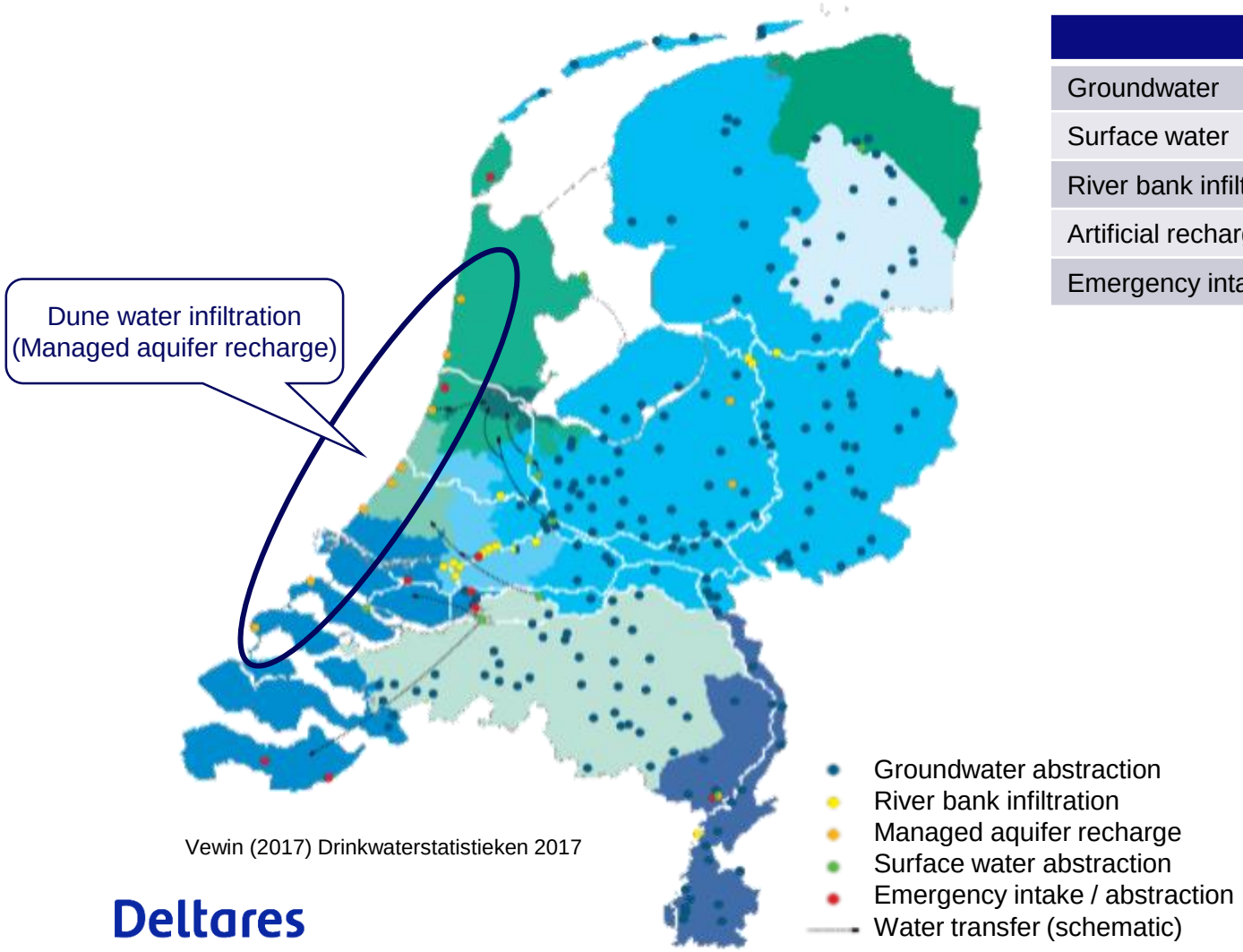
Drinking water protection files

- File on each wellfield to compile all relevant information related to the groundwater quality of that particular wellfield.
- Cooperation between all relevant governmental stakeholders (national, provincial, municipalities, waterboards, environmental agency, etc.)
- Communication tool for area-specific groundwater quality protection, including planning of preventative or risk-reducing interventions



Source: Gebieddossier Waterwinning Bethunepolder

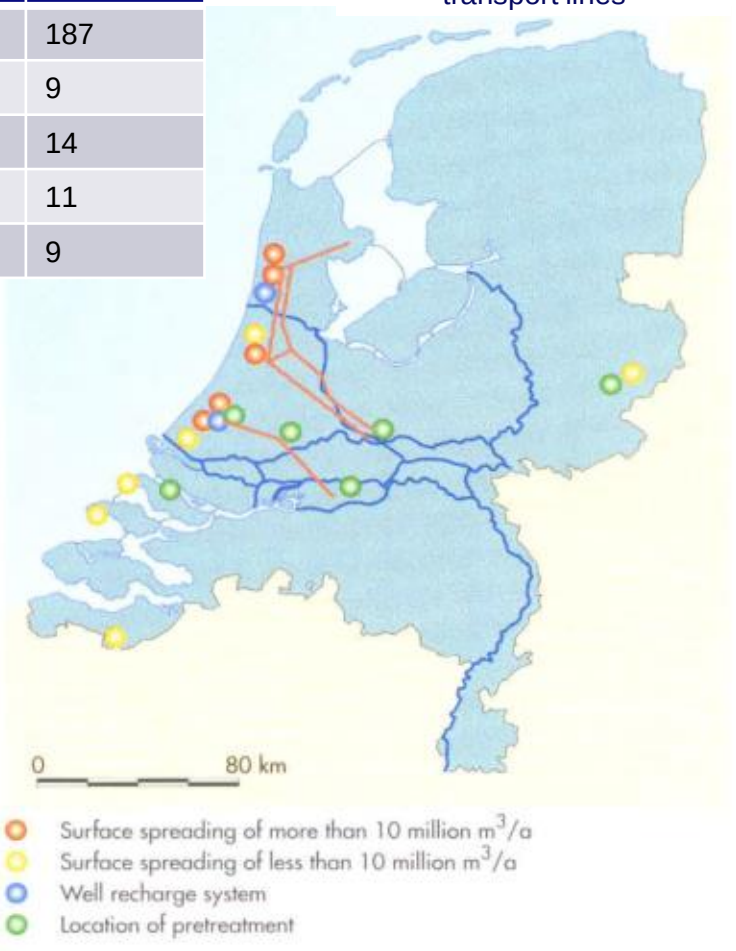
Water supply in the Netherlands
Groundwater dominated



Vewin (2017) Drinkwaterstatistieken 2017

	locations
Groundwater	187
Surface water	9
River bank infiltration	14
Artificial recharge	11
Emergency intake / abstraction	9

Artificial recharge sites and transport lines



Huisman, P., et al (1998) Water in the Netherlands

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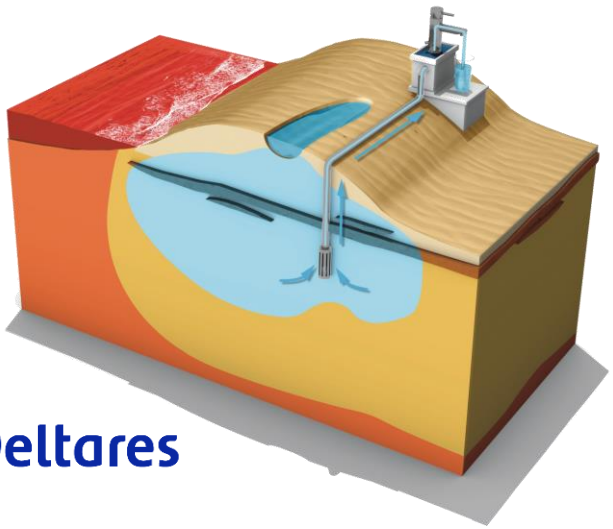
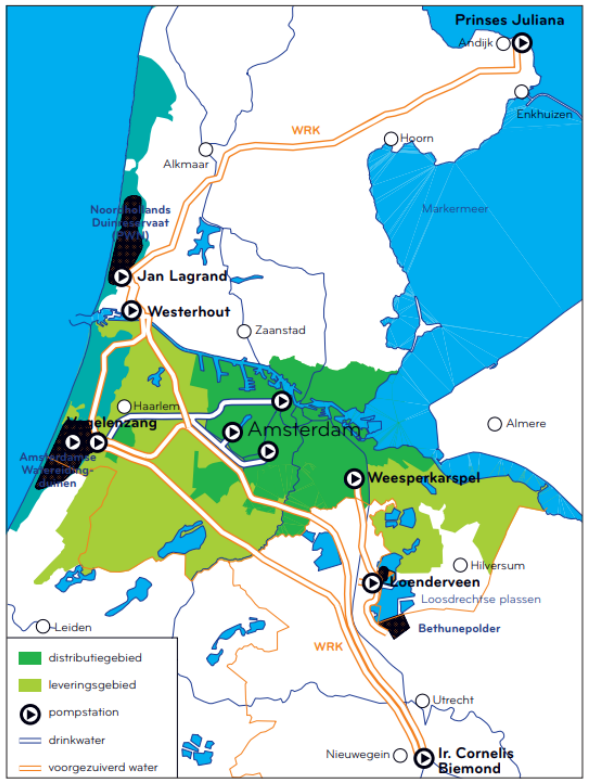
Large scale managed aquifer recharge

Water supply from dune infiltration





Source: Waternet

https://awd.waternet.nl/beleef/geschiedenis

1848 Cholera epidemic, surface water polluted, fresh groundwater only found under the coastal dunes

1853 Start of abstraction and transport of dune water for Amsterdam water supply.

1874 and onwards The Hague, Haarlem, Delft and many other towns start using the fresh water lenses in the dune areas

1905 First scientific notion of lowering of groundwater table

1952 Issues of salinization and lowering of the groundwater table: a 60 km pipeline is constructed to transport pre-treated water from river Lek (Rhine tributary) to the dunes

1957 Infiltration starts, decreasing net abstraction of dune water and halting salt water intrusion

1960's expansion of system & improved pre-treatment of infiltration water to prevent eutrophication of the dune ecosystem

1980's Expansion of dune water use by deep-infiltration (ASR)

1990's (non-MAR) groundwater abstractions in dune areas reduced to restore wet dune ecosystems

present day Dune infiltration in full operation and innovations continue…

Source: Veel, P. https://duinenenmensen.nl/duinen-en-drinkwater-artikel-in-ontwikkeling/

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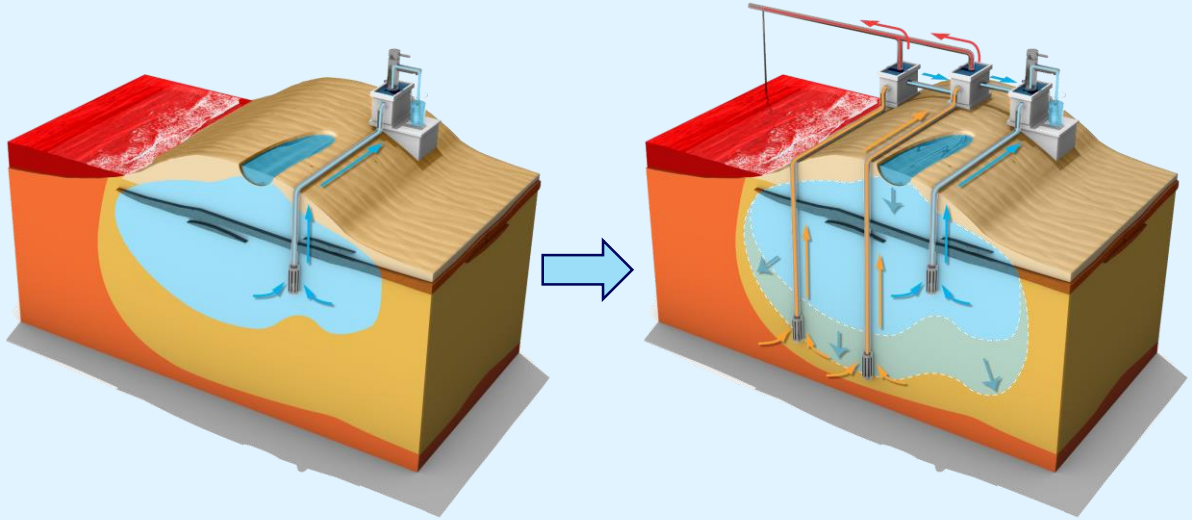
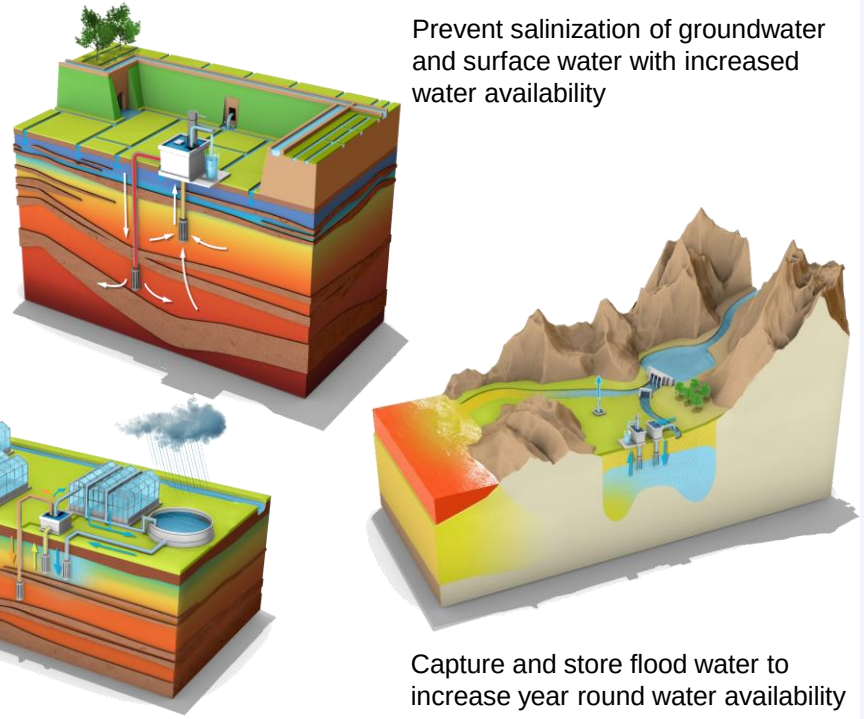
Innovations
COASTAR - COastal Aquifer STorage And Recovery

Subsurface solutions for robust water supply and drought control by
i) closing the water gap between water supply and demand in space and time and
ii) preventing salinization of ground/surface water by using brackish groundwater for fresh water production

Pilot Dunea water supply company:
- Left: Reserves from traditional MAR are at risk of becoming too small during times without infiltration.
- Right: By using brackish water for drinking water production more storage space is created for fresh water





Prevent salinization of groundwater and surface water with increased water availability

Capture and store flood water to increase year round water availability

Prevent flooding and salinization with increased water availability

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Challenges for the future

- Dealing with the effects of climate change
  - Increased frequency and intensity of droughts and floods
  - Impacts of sea-level rise
  - Impacts on water use
- Managing different types of land use and new technological development in a very densely populated country
  - conflicting interests between agriculture and nature
    - Land use changes based on the ‘natural water system’
    - Technological approached
  - new (competing) technologies: thermal heat storage & geothermal energy
- Emerging contaminants
- Developing innovative approaches like COASTAR to increase resource availability
- Maintaining monitoring and registration of relevant groundwater data
- Further integration of environmental and planning laws
- …

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