



# WWTPs as sink for pollutants

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# Pollutants in wastewater



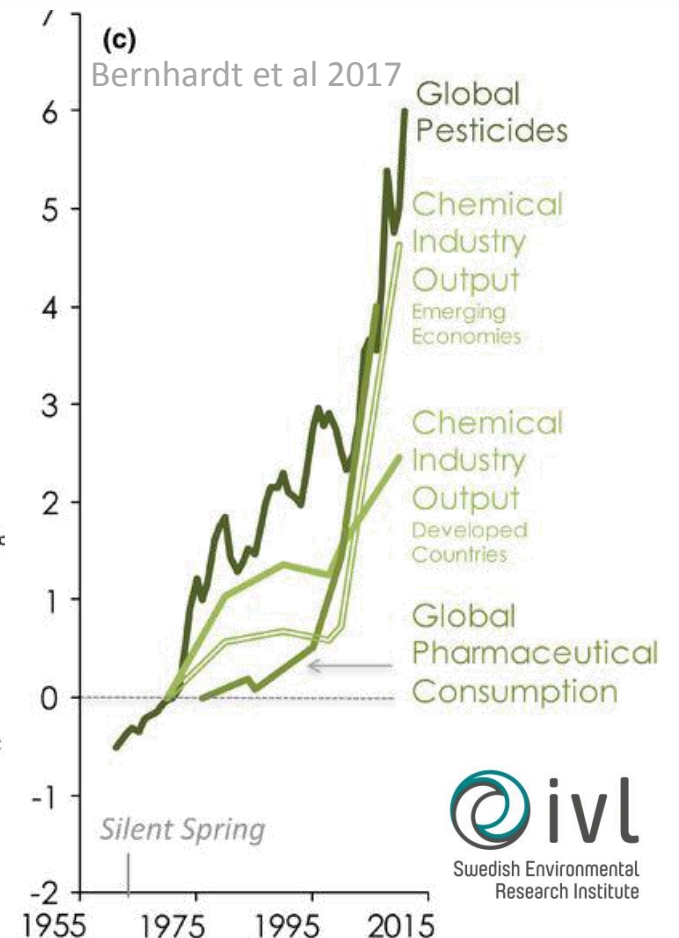
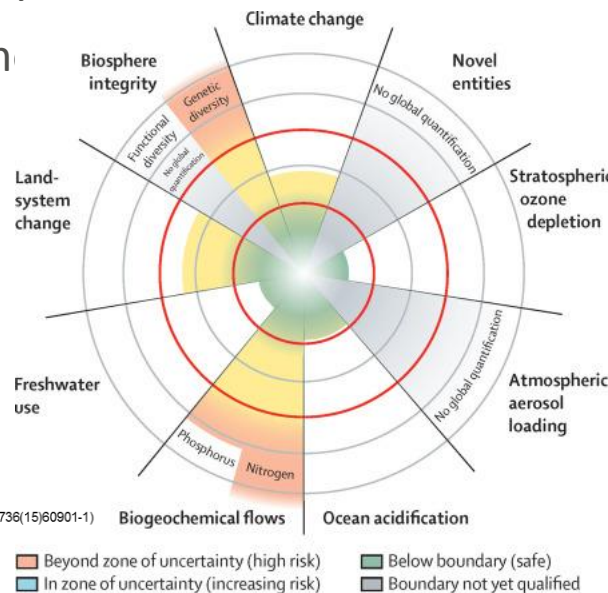
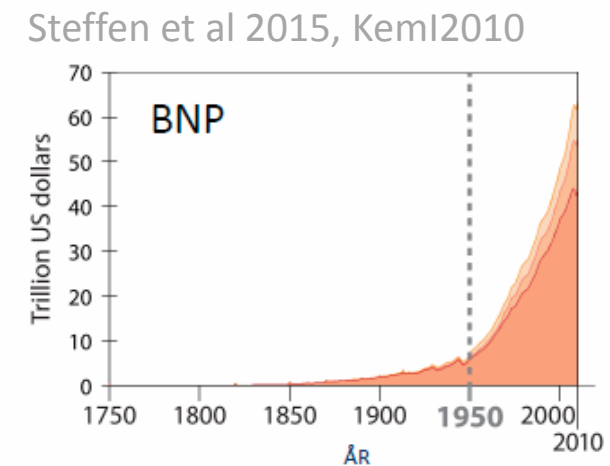
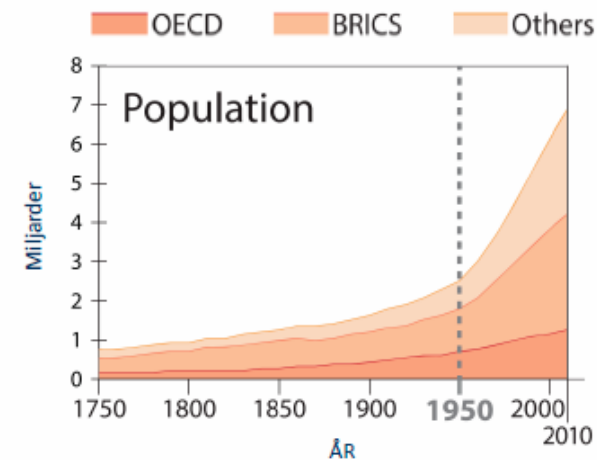
- **Traditional ones:** Sand, fat, grease, larger particles, easily degradable organics, P, partly N, (heat)
- **Pharmaceutical residues** (incl. antibacterial, anti-inflammatory and antidepressants, neuroleptics and sedatives, anesthetics, cardiac medications, sex hormones, blood thinners, cytostatic, etc.)
- **Disease spreading** Pathogens including bacteria, parasites and viruses from human faeces. (today found in the effluent of more or less all WWTPs.)
- **Antibiotic resistance** Classified as one of the greatest threats to world health by the WHO. ABG? “naked DNA”? resistance may persist for long periods of time even if antibiotic residues have been removed.
- **Other micropollutants** Total toxicity, Flame retardants, Softeners, Phenols, Per- and polyfluorinated alkyl substances (PFAS), Dioxins and PCB, Heavy metals, Anionic surfactants (constituents of cleaning products), synthetic sweeteners (e.g., sucralose), pesticides, trichlorobenzene, chloralkanes, siloxanes, etc.
- **Effects** Total toxicity, acute and chronic toxicity, cocktail effects?
- **Microplastics**
- **Non-target**

Don't forget!

Removing pollutants from wastewater means  
that they often end up in the sludge!

# Pollution in change

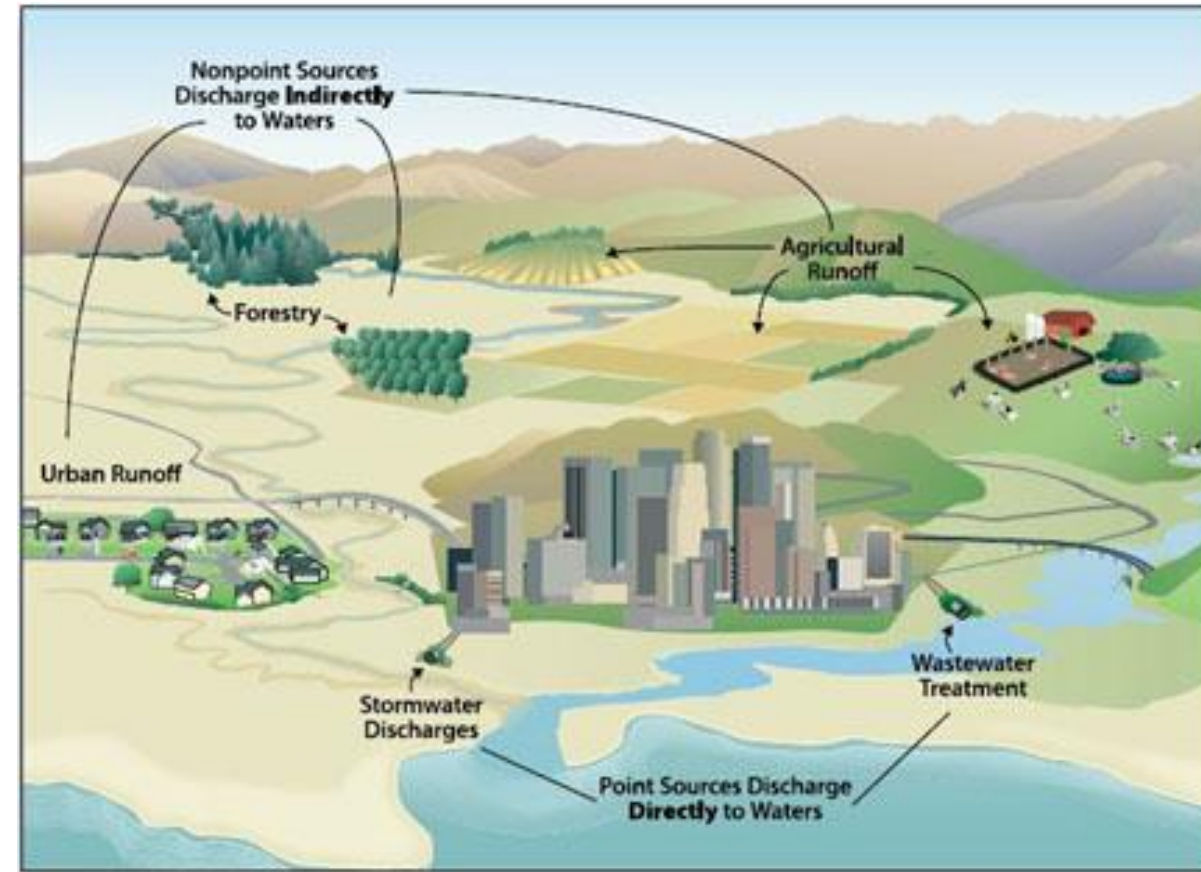
- Population increase
- Consumption increase  
→ increase of load and stress on aquatic environment
- Society changes, challenges change, priorities change, human health highest priority no matter pollution?
- New substances are constantly added to our society and the environment
- Anthropogenic accumulation? Effects delayed or not effective for long time (see example P)
- Old sins (partly unknown)
- Effect studies? Limitation? Too late?
- Complexity of nature and pollution: population, biodiversity, cocktail effects, measurability?



# WWTPs as one transport path/source

- Atmospheric deposition
- Livestock
- Urban Runoff/Storm water
- Agriculture (partly WWTP-sludge)
- Industries, landfills
- Untreated wastewater (incl. SSO)
- Etc.

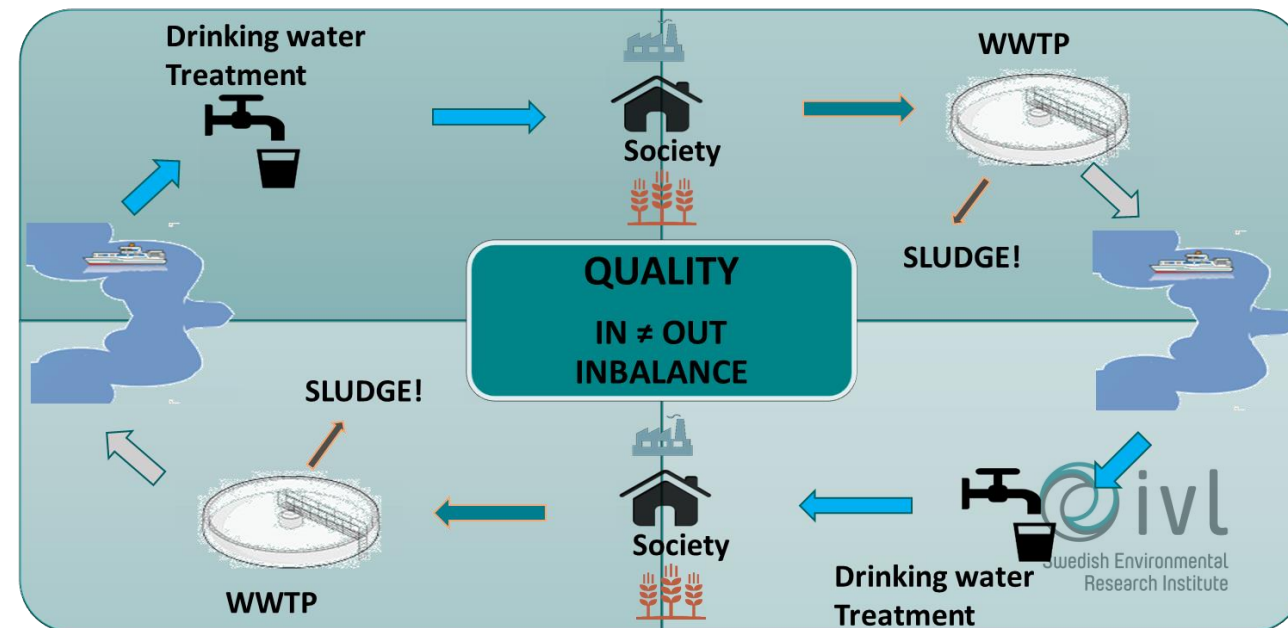
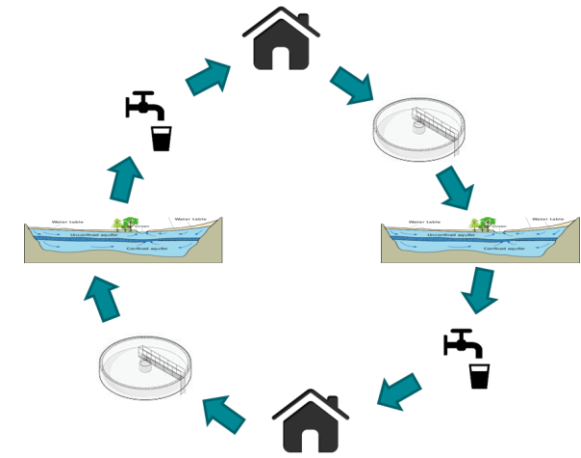
**BUT:** WWTPs often treat most of above, unintentionally or intentionally!



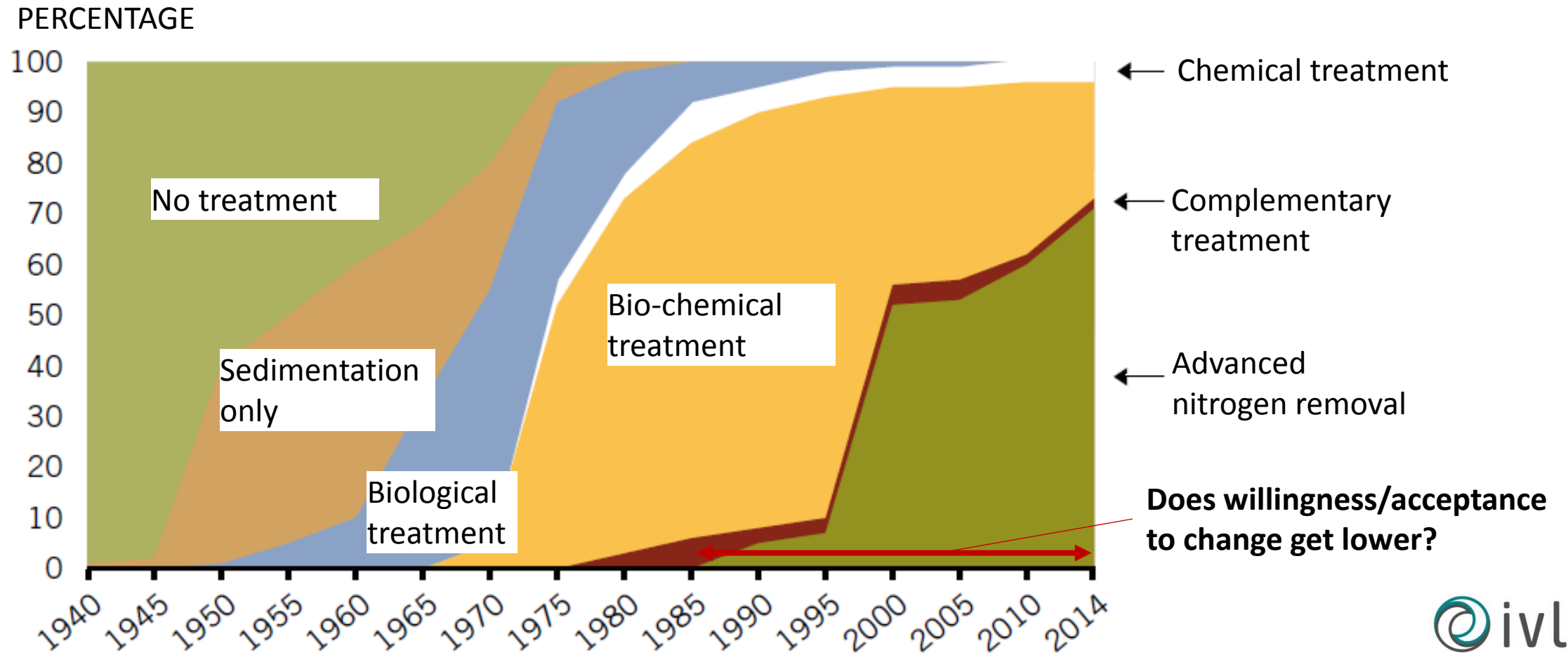


# WWTPs as key sinks?

- Nothing just disappears!
- Sinks for some incoming pollutants
  - MP/heavy metals/microplastic/etc → partly to sludge emissions
  - N → partly to  $N_2O$  emissions
  - C → partly to  $CH_4$  (biogas & emissions)
- Circular flows!
- Key collection/passing point of societies pollutants!
- Key source/supply for aquatic ecosystems/food chains!
- More focus on sinks in terms of removal/destruction/degradation/decontamination!

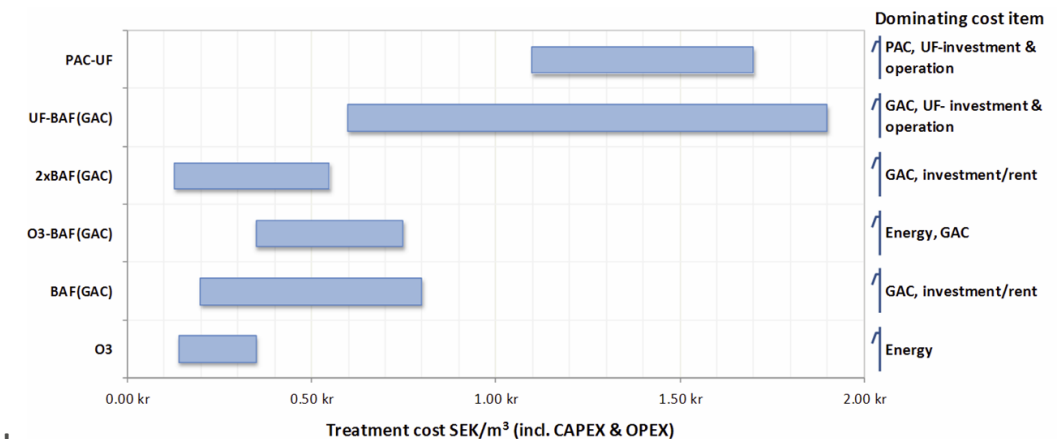


# What does history tell us?



# Do we have effective treatment alternatives

- YES!
  - Or in fact, a variety of technologies and treatments systems!
  - Incl. membrane-based systems, anaerobic systems, granule processes, oxidation, adsorption, high-efficient and specialized biological systems, etc.
- Overall and specific removal efficiency of WWTPs can be increased to include other pollutants than considered today!
- What about cost-efficiency?
  - Compared to what?
  - Simultaneously with plant renewal cheaper
  - Consider treatment at several locations today (savings)!
  - Consider remediation cost for (to large extents hidden) damages!
  - Consider cost of irreversible damage (e.g. biodiversity?)!
  - Willingness to pay (50 000 SEK/m<sup>3</sup> for bottled water; needed for proper treatment < 2 SEK/m<sup>3</sup>)?
- What about environmental impacts caused by more advanced treatment?



# Advanced treatment vs. Cost & environmental impacts



**An extra treatment also implies an additional environmental impact\* that we can quantify with Life Cycle Assessments (LCA).**

Most known are, for example, energy use (climate impact), chemicals and materials.

\* Not necessarily for new plants!



**An extra treatment also provides an extra environmental benefit that we CANNOT quantify in the same way as the treatment impact!**

Most importantly, cleaner water and its positive effects on the environment, biodiversity, ecosystems, our health, etc.



# What are the alternatives?

- **Upstream measures – source control:** limits, time frame, cost-efficiency, etc.
- **Phasing out:** competing interests, time frame, replacements, etc
- **“Green” products:** 100% not realistic, long-term activity
- **Behavior changes:** Impact/potential unclear
- **Other sources:** separate treatment of storm water, manure, industries, SSO, etc
- **Example REACH:** SLOW | LOW DATA QUALITY | FEW CONTROLS | NO PUNISHMENT  
REACH refit: The data gaps or quality issues in dossiers hamper the identification of priority substances for SVHC identification or other regulatory action.

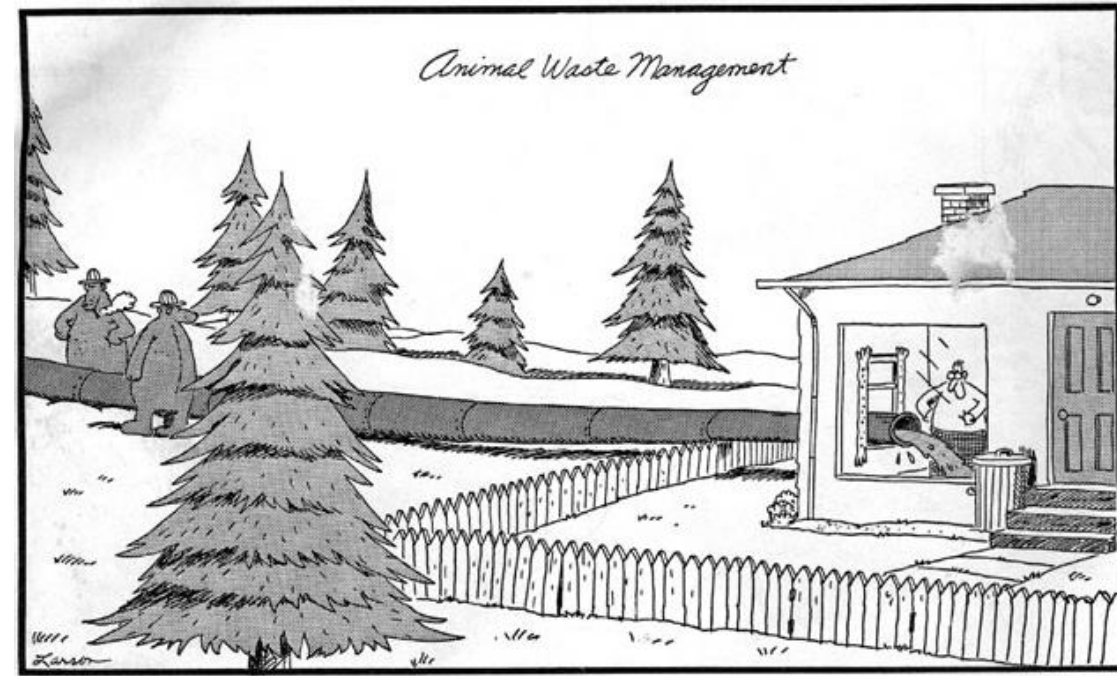


**Competing activities in society! Activities at all possible locations are necessary (alternatives above).**

**Some sources can never be removed and compensating sinks are necessary! Analogy to climate change!**

# Outlook please?!

- Focus on **WASTE** (pollutants) or **RESOURCE** (water)?
- Technology advancements are continuously going on!  
There will never be a final ultimate treatment technology!
- Cost for specific treatment will go down when they are used/developed (e.g. MBR)!
- Many WWTPs in need of renewal anyhow!
- Society will continue to change!
- We will never have complete knowledge/understanding!
- Compromises will always be necessary, important to be on the save side/precautionary principle?)!
- **REUSE OF WATER** a crucial and inevitable for a sustainable society
  - ➔ WWTPS as sink of pollutants
  - ➔ WWTPS as part/link in circular economy/a natural system in balance



# WWTPs as sink for pollutants

THANKS!

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