Field evaluation of the performance of nitrogen reducing onsite sewage treatment and disposal systems: a compilation of Florida studies

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Outline

- Background
- Specific aims/objectives/hypothesis
- Materials/methods
- Analysis
- Results
- Discussion/conclusion
- Summary
- Future studies
- Acknowledgements

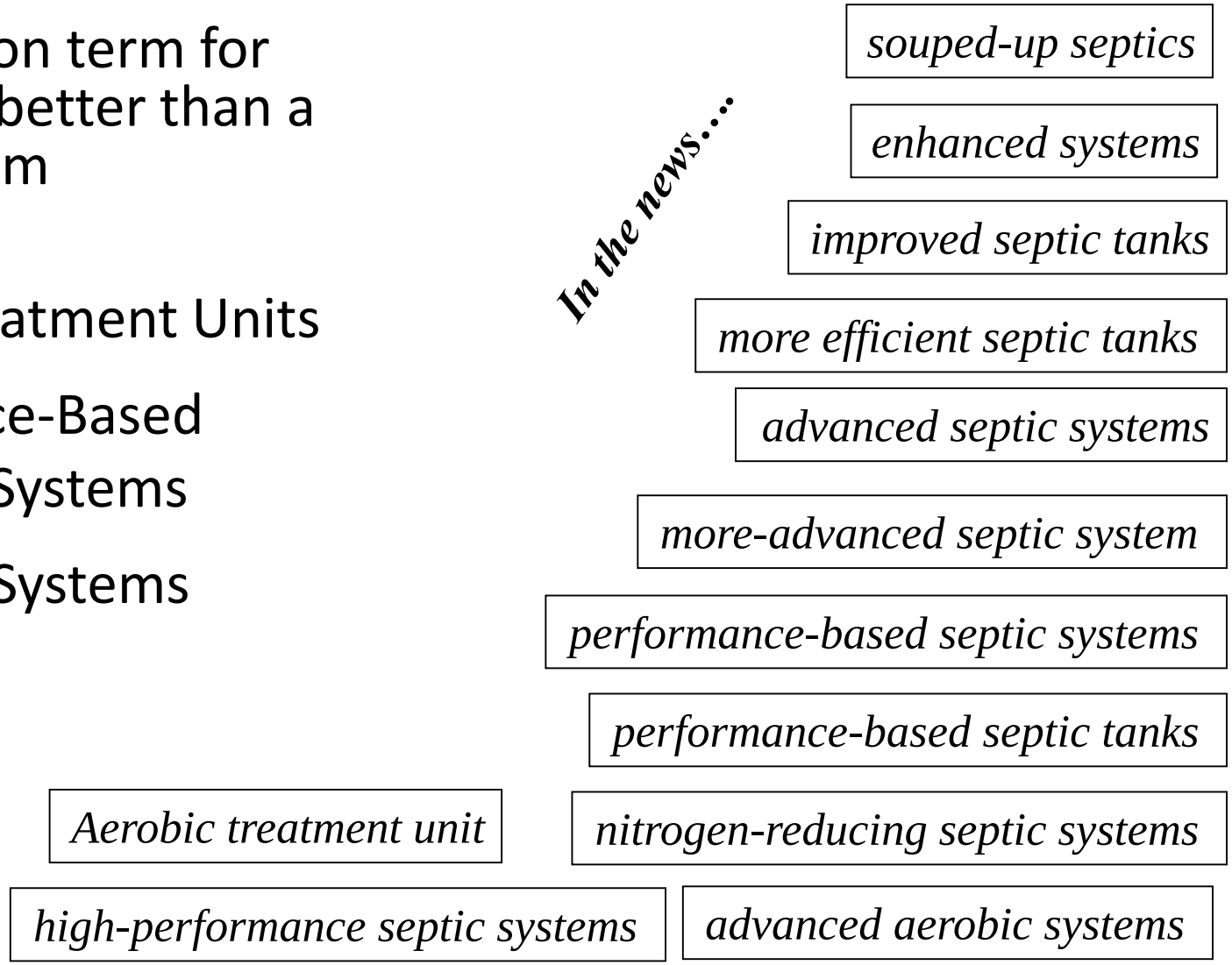
Background

- Nitrogen
  - Nutrient, necessary for life
  - Too much, human health (e.g., methemoglobinemia)and environmental effects (eutrophication)
  - Several watersheds in Florida are considered impaired by nutrients, in particular nitrogen
- Onsite sewage treatment systems
  - Conventional onsite systems (also known as septic systems) have limited nitrogen removal capacity (~10-50%)
  - Need for something “advanced”

“Advanced Systems”

- Common term for something better than a septic system

- Aerobic Treatment Units
- Performance-Based Treatment Systems
- Innovative Systems



Permitting Categories

- Aerobic Treatment Unit
- Performance-Based Treatment System
- Innovative System
- (Sand Filter…)

Permitting Approaches

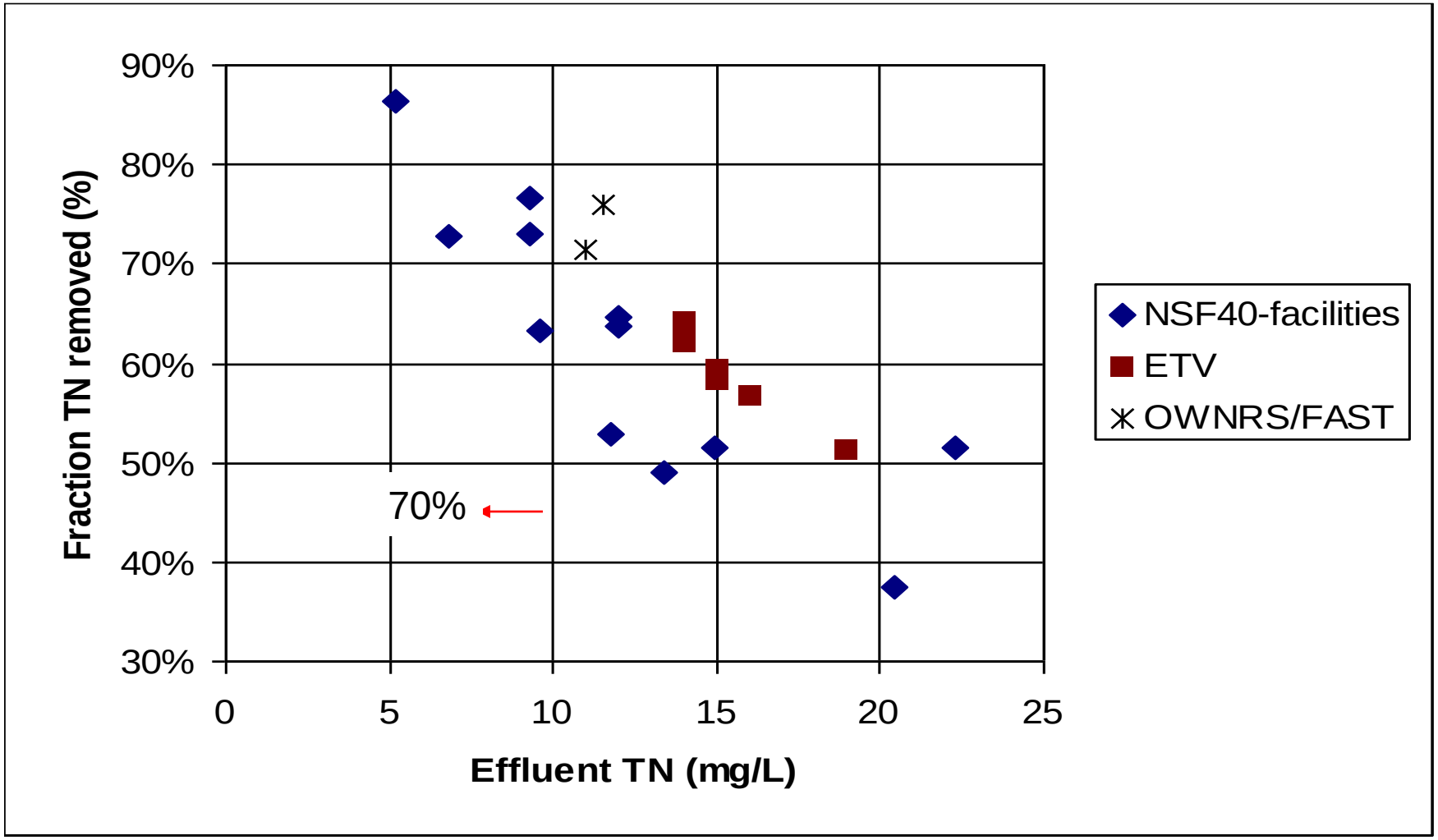
- **PRESCRIPTIVE STANDARDS**
  - **If you build it this way, we believe that it will work for normal operations.**

    Versus

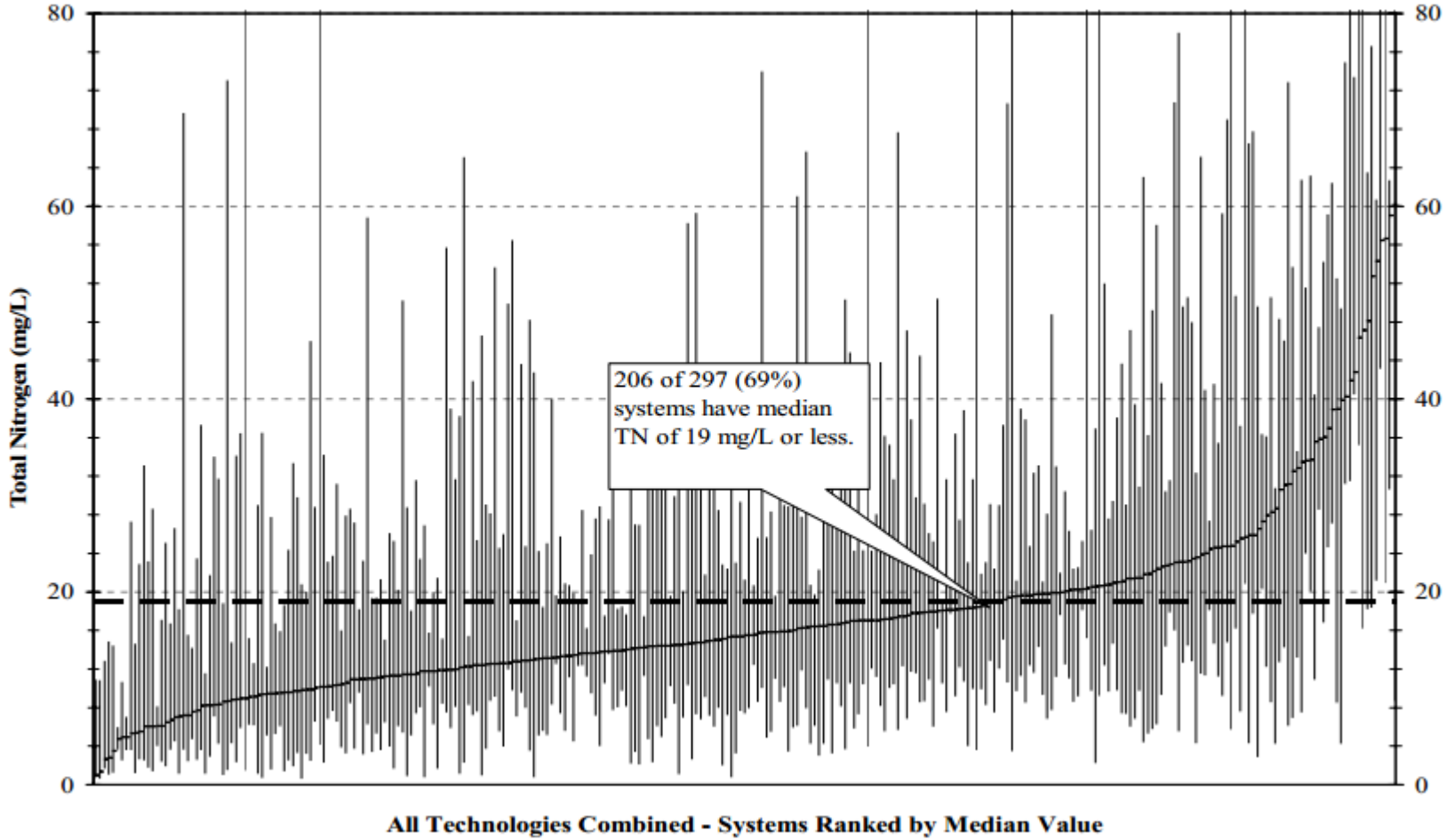
- **PERFORMANCE STANDARDS**
  - **Design and Build it to achieve specific enhanced discharge requirements.**

  - **Requires:**
    - **Assurance that it can work (application of sound engineering principles, and data)**
    - **Confirmation that it does work (Monitoring)**

Performance: Test Center
Results of nitrogen reduction during test center testing



Performance: Field Testing
Installation monitoring example Massachusetts



- Summary of monitoring data by installation, characterized by treatment technology, facility, etc.

Heufelder et al. 2007

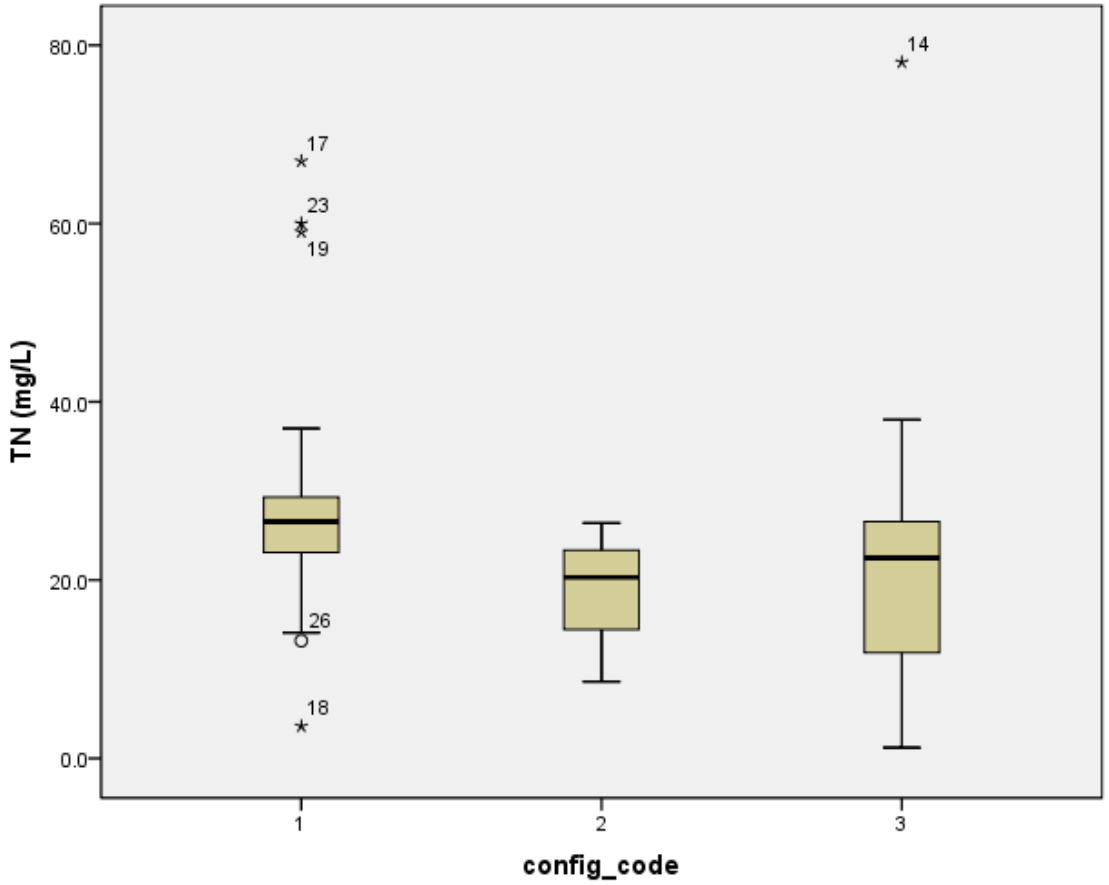
Objectives

- bridge the gap between performance expectations during permitting and available performance data after installation
- pool study data for three most common treatment technologies from available data
- assess the impact of an additional tank on treatment performance (should this effect be separated out?)
- describe distribution of results from sampled systems, assess normality of distribution for raw and log-transformed data
- describe average performance
- assess variation between and within sites
- estimate confidence interval for average performance (of samples or of systems)

Data: Previous Florida studies

- Sample of nitrogen-reducing systems in Wakulla County (sampled when not obviously not functioning) (Harden et al., 2010)
  - Influent estimated ~ 70 mg/L
  - Effluent eight repeatedly sampled systems: average 29 (stdev=9) mg/L, median 31 mg/L
  - Effluent one sample each from 27 systems: average 29 (stdev=21), median 23 mg/L;
- Sample in the Florida Keys (Roeder 2011)
  - Influent average 81 mg/L median 76 mg/L ; 38 composite samples from eight systems
  - Effluent average 37 (stdev 34) median 23 mg/L (110 composite samples)
- Random sample of advanced systems in Florida (sampled when judged to be functioning) (Roeder and Ursin 2013):
  - influent median TN= 45.3 mg/L average =51.4 mg/L (n= 42)
  - effluent median TN=30.3 mg/L average =38 mg/L (n=309)

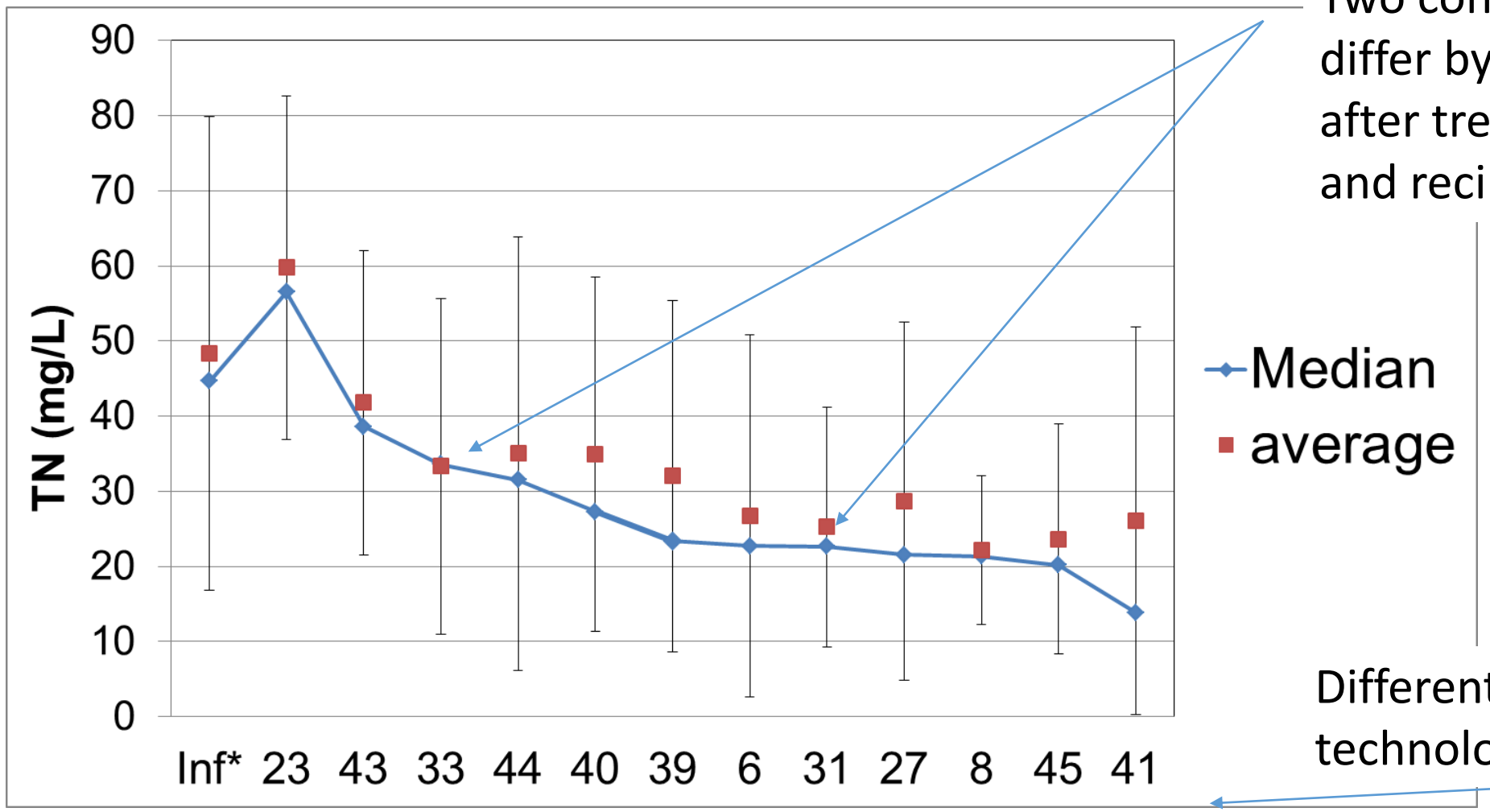
Wakulla observations about additional tank



Config_code
1-without additional tank
2-single compartment with additional tank
3-double compartment with additional tank

Effluent concentration
without additional tank
tends to be higher,
but not significantly (ANOVA P=.233)

Example of random sample of treatment systems



Two configurations, differ by pump tank after treatment unit, and recirculation

Different treatment technologies

at least six samples each

Preliminary Observations

- Influent and effluent data are very variable
- Treatment results by technology overlap
- Differences due to additional (pump) tank could be as big as differences between technologies
  -> consider explicitly as part of the treatment technology?

- Uncertain to define a characteristic effluent concentration for a technology (small sample sizes, high variability)
- Uncertain to define a removal fraction for each technology (calculation based on two high-variability observations, influent and effluent)

Next steps

- Combine data set
- Recode to capture presence of additional tank

References

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