

1. Introduction & Objectives

Per- and polyfluoroalkyl substances (PFAS), called forever chemicals, can be found in various products worldwide. These compounds contain fully (per-) or partially (poly-) fluorinated carbon chains with various functional groups. They have low water surface tension, exhibit amphiphilic behaviour, and have high thermal, chemical and biochemical stability.

These chemicals are associated with adverse health effects such as low birth weight, reduced immune responses, effects on the hepatic, reproductive, cardiovascular, and endocrine systems, and cancer.

They have been used in electronics manufacturing, metal plating, textiles, lubricants, cookware, fire fighting foams, carpeting, and food packaging materials worldwide since the 1950s.

They survive in the environment for a long time and eventually reach humans.

The Objectives of this study are to:

- Identify major PFAS sources using literature information,
- Determine possible major PFAS sources in Istanbul, and
- Create a qualitative risk Map for PFAS contamination in Istanbul

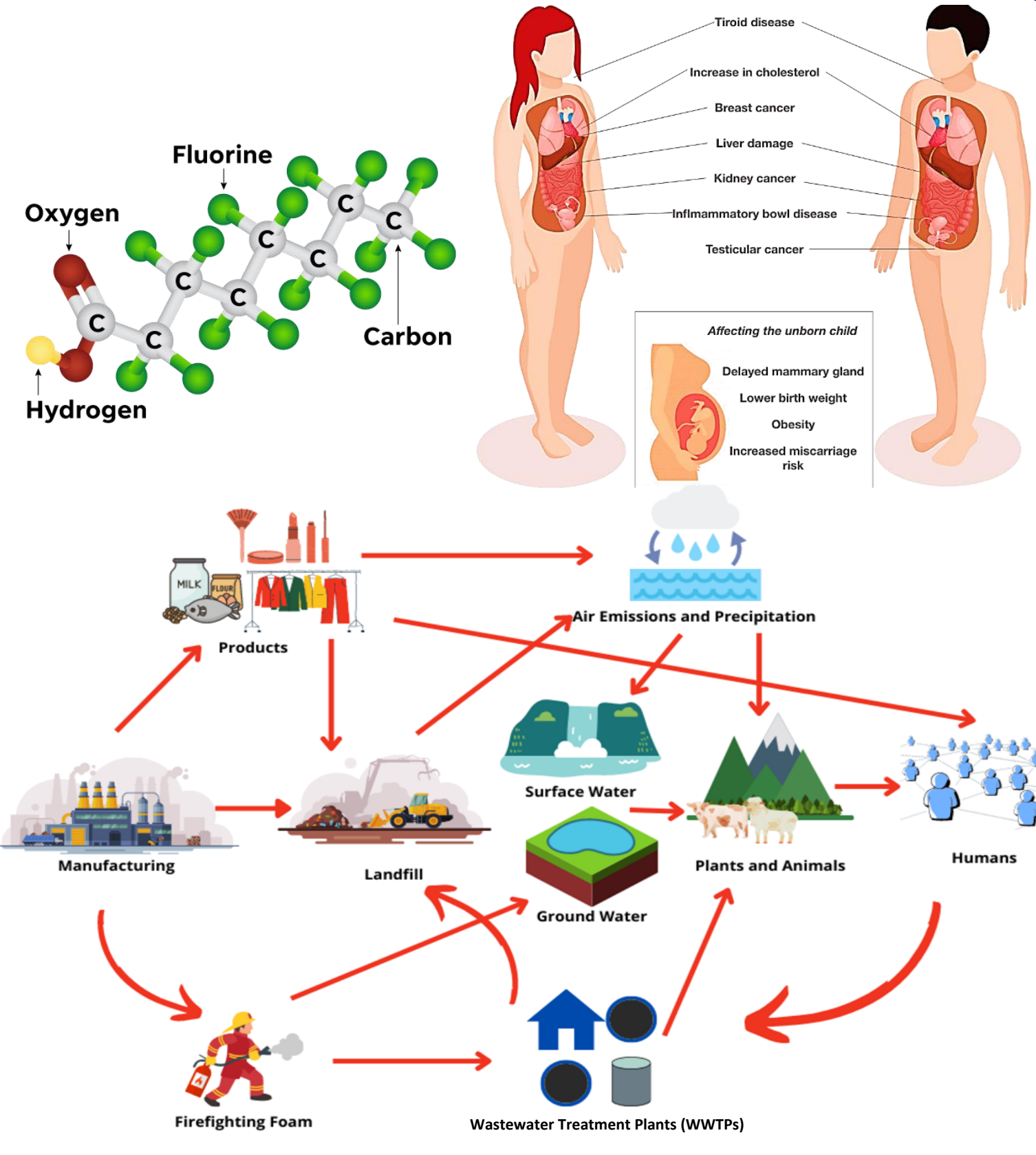


Figure 1. Chemical Structure and Health Effects and Routes of Exposure to PFAS

2. Methods



3. Results

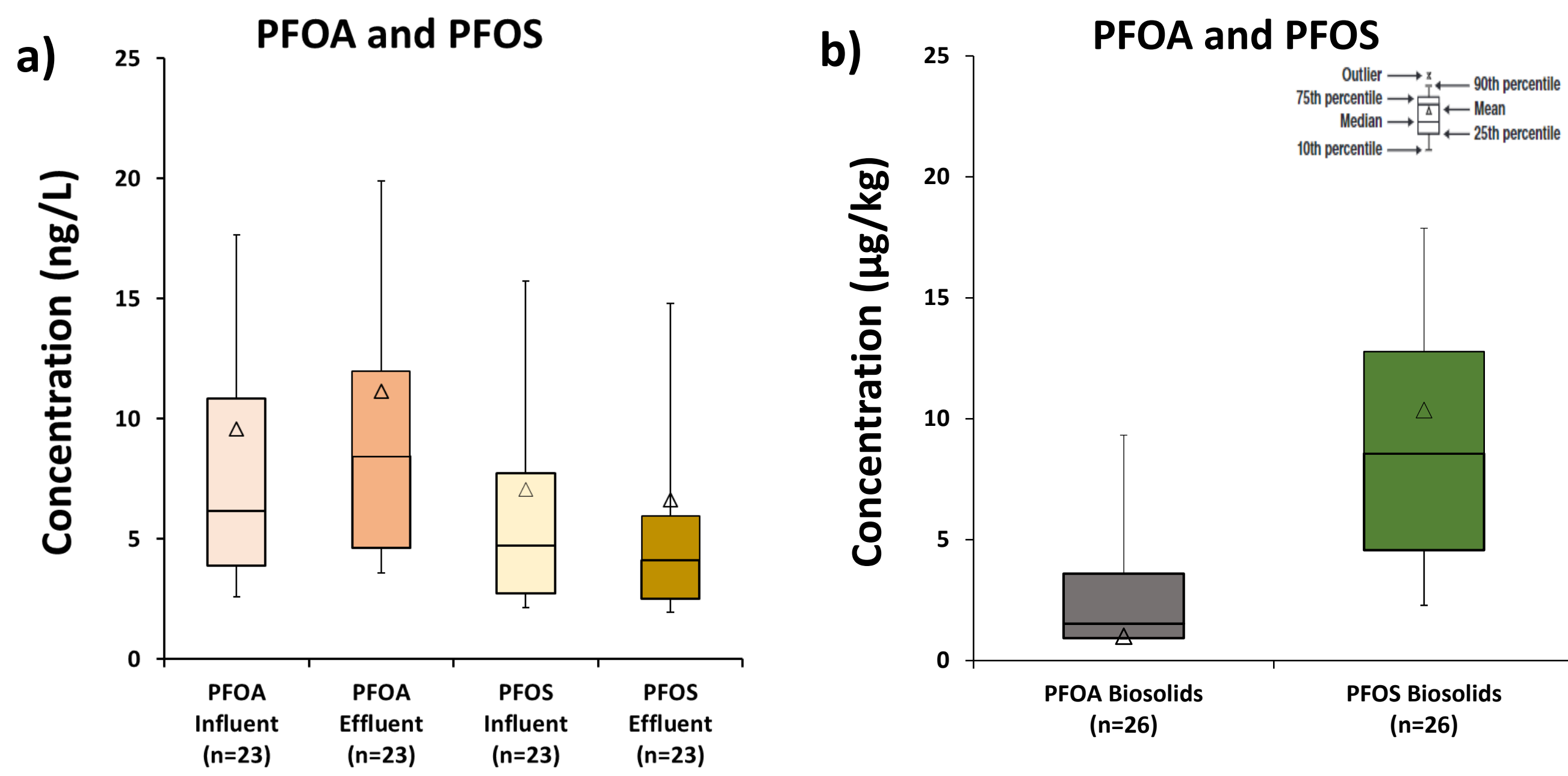


Figure 2. PFAS Concentrations in a) Influent and Effluent Waters, and b) in Biosolids.

- The average PFOA concentration was ~10.6 and ~11.1 ng/L (~15% increase) in the influent and effluent of wastewater treatment plants (WWTPs), respectively.
- The average PFOS concentration was ~7.1 and ~6.6 ng/L in the influent and effluent of WWTPs, respectively.
- Biosolids' average PFOA and PFOS concentrations were ~8.9 and ~10.7 µg/kg.

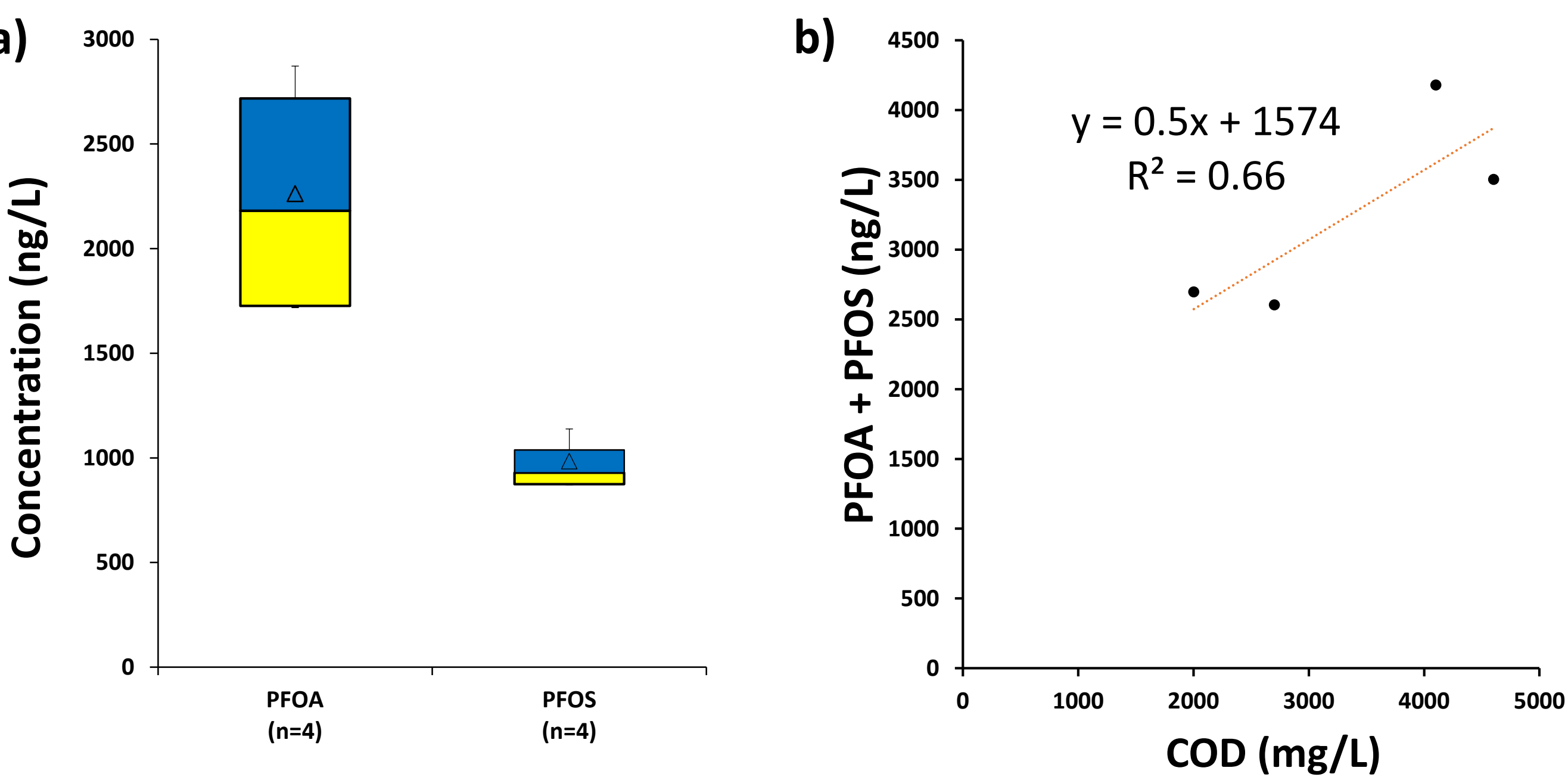


Figure 4. The concentration levels of PFAS (PFOA and PFOS) in a) Landfill Leachate, and b) Correlations of PFAs with COD.

- Landfills produce leachate containing excessive (1000-3000 ng/L) amounts of PFAS.
- Total PFAS (PFOA + PFOS) vs chemical oxygen demand (COD) shows a moderate ($0.50 < R^2 < 0.75$) correlation.
- Leachate from PFOA was significantly ($p < 0.05$) higher than PFOS from leachate waters.

4. Key Findings

- In developed cities, WWTPs and Landfills have proven to be one of the most important sources of PFAS.
- Removal of PFAS in WWTPs is minimal, and most of the PFAS species accumulate in the system, and therefore biosolids are also potential PFAS sources.
- PFAS found in landfill leachate is higher than that found in the effluent of WWTPs, and even with small amounts of leachate, more PFAS can be released into the environment compared to WWTPs.
- Landfills, WWTPs (especially near the Bosphorus), and industries in OIZs must be carefully screened for PFAS (quantitative monitoring required).

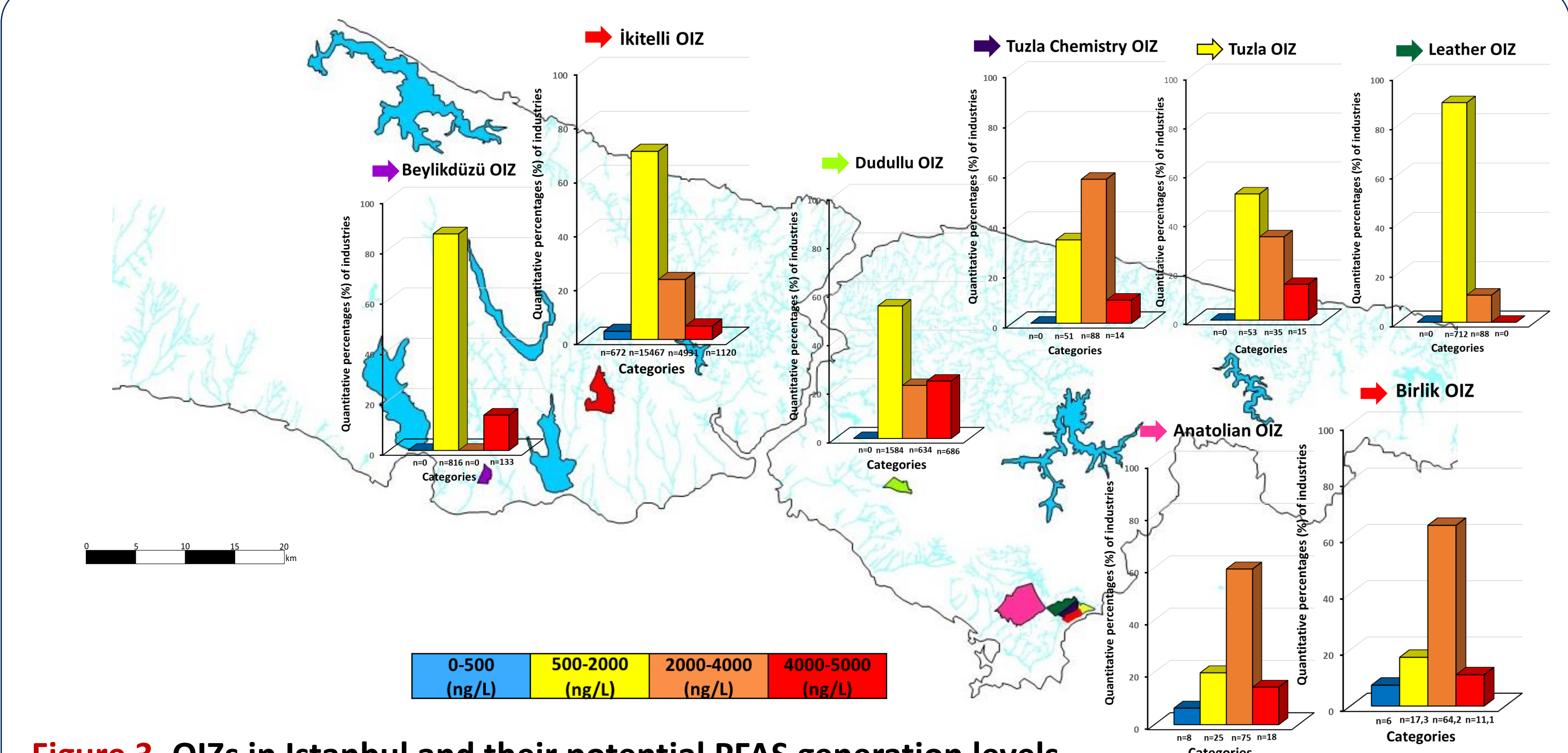


Figure 3. OIZs in Istanbul and their potential PFAS generation levels.

- There are eight OIZ in Istanbul. As a possible source of PFAS, plastics and rubber, electronics, coatings and paints, metal fabrication, printing, and textiles are manufactured with a possibility of generating PFAS with different levels (4000-5000 ng/L, 2000-4000 ng/L, 500-200 ng/L or <500 ng/L).
- Especially Dudullu, Birlik, Tuzla (OIZs), and Anatolian OIZs play an important role in the production of PFAS, which is a by-product of production and a source of pollution.

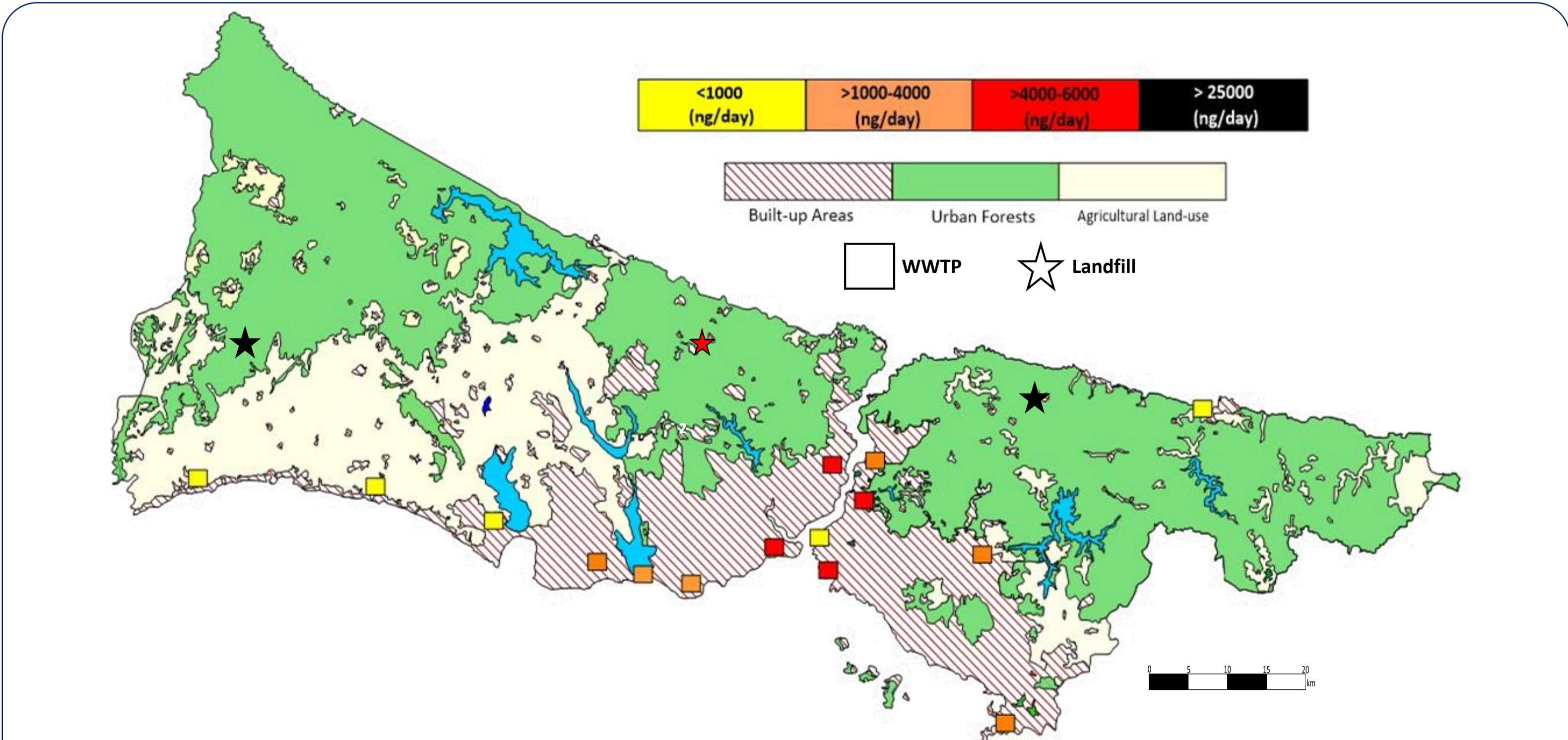


Figure 5. Land Use and Land Cover Map of Istanbul and PFAS Generation Potentials of WWTPs and Landfills.

- Although leachate flow rates in landfills are low, PFAS concentrations are significantly higher than in WWTPs.
- Among WWTPs, the possibility of PFAS including water discharge poses a major risk, especially WWTPs that were installed near the Bosphorus.

5. Acknowledgement

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6. References

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