PFAS Challenge – Edition

CHALLENGE 1

Gemeente Leeuwarden

CEN

PFAS removal from water.
From water treatment to a controlled PFAS residual stream.

The water system surrounding Leeuwarden Air Base is affected by widespread PFAS contamination. PFAS have been detected in surface water, sediments, dredged material and vegetation removed from ditches and waterways. Continued leaching from contaminated soils into groundwater and surface water means that PFAS keep entering the water system, where they are subsequently taken up by sediments and vegetation and end up in materials generated through routine maintenance.

This is not a single contaminated hotspot that can be addressed with a stand-alone remediation measure. The affected area covers approximately 1,100 hectares and includes around 80 kilometres of waterways. Restrictions are currently in place on activities such as swimming, fishing and irrigation. In parts of the area, routine maintenance activities such as dredging and aquatic vegetation removal are also constrained or require specific handling because of PFAS contamination.

Water plays a central role in this challenge. It is not only a major pathway for PFAS transport, but also a recurring process stream in the treatment of dredged material and aquatic vegetation. Both contain significant amounts of water. Dewatering these materials generates PFAS-containing pressate, drainage water and other process waters that cannot be returned to the waterway untreated.

Treatment of these water streams is therefore an essential step within a broader treatment train and should be applicable to different water streams generated within the area, including:

- PFAS-contaminated surface water;
- Water generated during dewatering of dredged material;
- Pressate, wash water or process water generated during the treatment of aquatic vegetation;
- Other PFAS-containing residual water streams generated by upstream treatment steps.



Existing technologies remove PFAS from water, but not from the chain

Several technologies can capture PFAS from water, including activated carbon, ion exchange resins and membrane-based processes. These technologies reduce PFAS concentrations in the treated water, but at the same time concentrate PFAS in spent media or other residual streams. Without a suitable downstream treatment route for these PFAS-containing residual streams, the contamination is transferred rather than eliminated.

Addressing a broad spectrum of PFAS

PFAS comprise a large and diverse group of compounds, with substantial differences in mobility and treatability. Longer-chain compounds such as PFOS and PFOA are generally easier to capture than shorter-chain, highly mobile PFAS. We are therefore looking for technologies that can demonstrate meaningful removal across a broad range of relevant PFAS compounds. Promising technologies do not need to have every technical limitation fully resolved at the time of application: there is scope to further investigate and validate performance and operating limits together with the Centre of Expertise Water Technology (CEW).

The challenge

How can PFAS be removed from surface water and other PFAS-containing water streams and concentrated into the smallest practicable residual stream for final treatment or destruction?

Call for solutions

The Municipality of Leeuwarden is choosing to take action now to address PFAS contamination, even though scientific, technical and regulatory questions remain. Knowledge of individual PFAS compounds, their behaviour and potential degradation products continues to evolve, but the scale of the challenge calls for concrete, evidence-based action now. The long-term ambition is to restore safe and responsible use of the water system and reduce the persistent restrictions and uncertainty faced by farmers, residents, recreational users and water managers.

Pilot-ready technologies and treatment-train solutions

The Municipality of Leeuwarden wants this Innovation Challenge to go beyond identifying promising ideas. Technologies with strong potential may be considered for a follow-up phase focused on further validation and testing under relevant conditions. Technologies may be assessed individually or, where relevant, integrated as component technologies with solutions for dredged material and aquatic vegetation or with technologies for the destruction of concentrated PFAS residual streams within the wider treatment train.

The **Centre of Expertise Water Technology** (CEW) is the technical knowledge partner for this challenge and will remain involved throughout the programme. CEW can support applied research, pilot design, monitoring and validation. This creates an opportunity within the Municipality of Leeuwarden to develop and test innovative PFAS removal, concentration and treatment technologies under relevant conditions.

Disclaimer

This challenge is a non-binding invitation to submit ideas and does not constitute a public procurement procedure. Participation does not create any entitlement to an award, compensation or further collaboration. The Municipality of Leeuwarden reserves the right to amend, suspend or terminate the challenge. All intellectual property rights relating to submitted proposals remain with the submitting party unless otherwise agreed in a separate agreement.

Evaluation criteria

Strong proposals should meet as many of the following criteria as possible.

1. Effective removal across a broad PFAS spectrum

The technology demonstrates removal of multiple relevant PFAS compounds and clearly describes its performance for both long-chain and short-chain PFAS. Performance on short-chain and highly mobile compounds, including TFA, is considered a significant advantage, but limited performance on these compounds should not rule out otherwise promising progress on other relevant PFAS. The technology does not need to achieve complete removal of all PFAS from the outset, but applicants must provide clear, evidence-based information on which part of the PFAS spectrum is effectively treated.

2. Validated performance and a realistic scale-up pathway

The technology should be capable of treating representative water streams containing organic matter, suspended solids and other relevant matrix constituents. Applicants should define the operating envelope of the technology, including relevant ranges of water quality, PFAS concentration and flow rate or treatment capacity, as well as any pretreatment requirements. Laboratory data may be used as supporting evidence, but performance demonstrated only under favourable or simplified conditions is not sufficient. The technology should be ready for validation through a relevant pilot and should offer a credible pathway towards stable operation at larger treatment volumes.

Surface-water monitoring data from the Jelsumer Feart covering 2024 through June 2026 are provided as supporting background information.

3. Efficient use of energy and consumables, with minimal secondary waste

Energy use, chemicals, filter media and other consumables should be proportionate to the treatment performance achieved. Where available, applicants should report the energy demand of the technology under representative operating conditions and specify the scale on which the figures are based. Information on the carbon footprint should also be provided. Regeneration and reuse of treatment media are considered important advantages. The technology should avoid generating unnecessarily large PFAS-containing waste streams, regeneration streams or associated transport requirements.

4. Integration with downstream PFAS destruction

Applicants may focus specifically on PFAS removal and concentration from water, provided they

clearly identify all streams leaving the process, characterise their composition and demonstrate how they can feed into a credible downstream treatment route. The resulting PFAS-containing residual stream should be sufficiently characterised and suitable for a subsequent treatment step in which PFAS can be irreversibly destroyed. Conversion into shorter-chain PFAS does not qualify as final destruction. Solutions that combine removal and concentration with demonstrated PFAS degradation or irreversible elimination from the treatment chain are considered an additional advantage. The downstream destruction step does not need to be provided by the same company.

Applicants should provide a PFAS mass balance showing the amount of PFAS entering the process and the fractions remaining in the treated water, transferred to residual streams or destroyed.

Where a complete fluorine balance is not yet available, applicants should explain how this could be established during a pilot. Where PFAS degradation or transformation occurs during treatment, applicants should identify potential intermediate and end products and explain how these are managed, removed or further treated within the process.

5. Integration with routine waterway maintenance

The technology should be compatible with routine waterway management activities, including dredging, aquatic vegetation removal and dewatering. The proposed system should take account of fluctuating volumes and feed characteristics, temporary peak loads, available space, operation, maintenance, safety and logistics. The required installation footprint and any supporting infrastructure should also be described.

Implementation of the treatment technology should not structurally delay or obstruct essential waterway maintenance activities.

6. Compliance with Dutch regulatory frameworks for PFAS-containing streams

The technology must not only be technically effective; it must also produce treated water that can be discharged or reused within the applicable Dutch regulatory framework, as well as residual streams for which a legally viable downstream route exists. For treated water, the relevant requirements under the Water Framework Directive apply. Assessment is based on the sum of 25 PFAS compounds, including TFA (trifluoroacetic acid) and Capstone B (6-2 FTAB). The solution should at minimum meet the applicable environmental quality standard of <4.4 ng/L, expressed as the sum of these 25 PFAS compounds in PFOA equivalents.

Applicants should also explain how the treated water and all resulting residual streams can be reused, discharged, stored, transported or processed in accordance with the applicable Dutch water, environmental, waste and ZZS (Substances of Very High Concern) requirements. Where no direct route exists under current regulations, applicants should identify the permits, experimental provisions or site-specific regulatory arrangements that would be required.

7. Economic viability

Where available, applicants should provide indicative operating expenditure (OPEX) and capital expenditure (CAPEX) and clearly state the scale, treatment capacity and underlying assumptions on which these estimates are based.

The technology should offer a credible pathway towards economically viable operation at larger treatment volumes.

Ready to apply?

Before submitting your proposal, please also review the **Application guide** to make sure you include the technical and operational information we need to assess your solution.