# Minutes of public meeting of the PFAS Scientific Advisory Panel on Teams

## 10:00 on 25 September 2025

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| Panel Members present: | Dr Steve Hajioff – Independent Chair |
| | Dr Tony Fletcher – PFAS and Health member |
| | Professor Ian Cousins – PFAS and Environment member |
| In attendance: | Standing Observer (Regulation) - Kelly Whitehead - Group Director of Regulation, Infrastructure and Environment Department |
| | Various Subject Matter Experts |
| | Programme support team from I&E |

### Welcome:

The Chair welcomed everyone to the Panel meeting and reminded people the meeting was being recorded.

### Introductions

The Chair and Panel members introduced themselves.

Dr Steve Hajioff, Independent Panel Chair: A retired Director of Public Health from an area of London with two major international airports and a variety of other environmental hazards and challenges, with 35 years in clinical medicine. An expert on translating science into policy, he has worked with Nice, the Greater London Authority, the EU, WHO and World Bank, several UK government departments and several international governments. Dr Hajioff has also worked extensively in the pharmaceutical industry.

Dr Tony Fletcher, PFAS and Health Panel Member: Environmental Epidemiologist at the London School of Hygiene and Tropical Medicine, working on PFAS since 2006 and member of the panel with experience of epidemiological studies on the health effects of PFAS in contaminated communities in West Virginia in the United States, in the Veneto region, in Italy, and in Ronneby, and is the health expert on the panel.

Professor Ian Cousins, PFAS and Environment Panel Member: A Professor in Environmental Chemistry at Stockholm University, an expert on PFAS, appointed as the environmental expert on this Panel and whose expertise on PFAS is on the sources, transport, fate, and exposure of PFAS.

Kelly Whitehead, Group Director for Regulation in the in the Infrastructure and Environment Department, leading on the Water Quality and Safety Programme, coordinating Government's response.

### Declaration of Interests

- No new interests declared.

## Minutes

- Minutes from 24 July 2025 meeting approved as a true and accurate record by the panel.

## Matters Arising

- Nothing to report

## Additional Findings Since the Last Meeting

Steve Hajioff began by referencing a recent public meeting held a few weeks prior, which was not a formal panel session but rather a presentation of the panel's third report. This report focused on PFAS testing in the human population, the consequences of PFAS exposure, and potential interventions to reduce PFAS levels in the body. The meeting also included the government's response to the report. Steve noted that the discussions during this public meeting were in-depth and, at times, heated, prompting the need for clarification on certain points.

One major concern raised was the panel's recommendation of the drug Colesevelam for certain population groups, despite the published research at the time focusing on Cholestyramine. Although both drugs belong to the same pharmacological class, they are not identical, and this discrepancy caused discomfort among some community members. Steve outlined three key reasons for the panel's recommendation of Colesevelam over Cholestyramine:

1. Forthcoming Research: At the time of the recommendation, the panel was aware of ongoing research involving Colesevelam that had not yet been published. This research has since been released, and the panel intends to update Report 3 to reflect this and provide traceability to the relevant study.
2. Tolerability and Side Effects: Colesevelam is significantly better tolerated than Cholestyramine, which often causes patients to discontinue use after only a few doses due to adverse effects. The panel believed that recommending a drug with fewer side effects would result in better outcomes for affected individuals.
3. Pharmacological Class Considerations: In clinical practice, it is common to prescribe drugs within the same class based on shared mechanisms of action. Steve explained that this is standard behaviour in medicine, citing examples such as the substitution of ampicillin with amoxicillin due to convenience, despite differences in trial data. Since Colesevelam and Cholestyramine belong to the same class, the panel deemed it appropriate to recommend Colesevelam.

Steve confirmed that these justifications would be incorporated into the updated version of Report 3, which he hoped to complete in the coming days. He invited Ian Cousins and Tony Fletcher to add any further points. Tony contributed an important clarification regarding ethical concerns. He confirmed that the Colesevelam trial conducted in Sweden had received full ethical approval and had been properly scrutinised. He emphasised that Colesevelam is not a novel drug—it has been used and trialled extensively for other purposes, such as lowering cholesterol, and is considered safe.

Steve reiterated that the recent study focused specifically on Colesevelam's application in reducing PFAS levels, but the drug itself is well-established. He then asked if there were any other developments in the PFAS field since the last meeting.

Tony shared that he had recently attended the International Society of Biological Monitoring meeting in Milan, which focused on biomonitoring in environmental and occupational settings. At this event, Axel—the lead author of the Colesevelam trial—presented the study, and Tony summarised the conclusions of Report 3. The audience was receptive, and no challenging questions were raised. However, one occupational specialist cautioned against using the drug as a substitute for controlling PFAS exposure at the source. Tony reassured the individual that the panel prioritises reducing exposure and that the drug is intended only for those already exposed, to help manage body burden.

## Subject Matter Experts Introductions

Jelena Rejanovic is an ICREA research professor at the Catalan Institute for Water Research in Girona, Spain. She leads a group focused on developing nanostructured materials for electrochemical water treatment and recovery systems. She included a brief introduction about herself for the livestream audience and expressed hope that the evidence she prepared for the session would be useful.

Steven Chow is a scientist at the Swiss Federal Institute of Aquatic Science and Technology in Zurich, Switzerland. He specialises in the fate, transport, and treatment of PFAS in water systems, and currently leads a study focused on PFAS behaviour in wastewater treatment. Originally from the United States, he has a background in applied PFAS treatment in drinking water.

Linda Lee is a professor at Purdue University with a joint appointment in agriculture and engineering. She has been researching PFAS for about 20 years, focusing on its fate, transport, and remediation. Her work includes collaborations with farmers and sanitation districts to address PFAS-related challenges.

## Presentation from Subject Matter Expert Jelena Rejanovic

Jelena Rejanovic, delivered a comprehensive presentation on PFAS treatment technologies, particularly focusing on electrochemical water treatment and resource recovery systems. She began with a brief personal and institutional introduction, outlining her academic journey from Serbia to Spain and Australia, and her current leadership of a research group at ICRA. The institute, though relatively small with around 120 staff, conducts research across the entire continental water cycle, including conventional and next-generation water and wastewater treatment technologies.

Jelena provided an overview of PFAS (per- and polyfluoroalkyl substances), referencing the broad OECD definition and highlighting the structural diversity of PFAS compounds. She noted the increasing regulatory attention and public concern surrounding PFAS contamination, particularly in Europe, where directives such as the Drinking Water Directive, Urban Wastewater Directive, and Water Framework Directive set stringent limits and monitoring requirements. She emphasised the challenge posed by ultra-short chain PFAS like trifluoroacetic acid (TFA), recently added to the European Council's priority list due to its extreme persistence and difficulty of removal.

The presentation then shifted to available PFAS removal technologies, which she categorised into separation and destruction methods. Mature separation technologies include granular activated carbon (GAC), ion exchange resins, reverse osmosis, and foam fractionation. While effective, these

methods generate PFAS-laden residuals requiring further treatment and are associated with high operational costs. Jelena detailed the limitations of each, such as frequent replacement needs, brine generation, and energy-intensive processes.

She then explored destruction technologies, including electrochemical oxidation, supercritical water oxidation (SCWO), hydrothermal alkaline treatment, and plasma oxidation. These methods aim to break down PFAS molecules but face significant challenges, particularly high energy consumption and the formation of toxic byproducts. Using electrochemical oxidation as a case study, she explained the technical bottlenecks, such as non-selective oxidation leading to chlorinated byproducts and mass transfer limitations due to the need for PFAS molecules to interact directly with electrode surfaces.

To address these issues, Jelena's group developed a novel graphene sponge electrode under the European Research Council's "Electrochem4Water" project. This material showed promise in avoiding toxic byproduct formation while effectively degrading contaminants. The team secured patents in the US and Europe and progressed to developing scalable reactors and system-integrated units under the "Forever Water" project, funded by the European Innovation Council. Collaborating with partners in Germany, France, and Spain, they aim to validate their technology through pilot trials treating PFAS-contaminated wastewater from semiconductor manufacturing, groundwater affected by firefighting activities, and landfill leachate.

Jelena emphasised the difficulty of scaling up PFAS destruction technologies from lab to market, citing the long timelines, regulatory hurdles, and lack of industry partnerships typical in the conservative water sector. She illustrated the concept of Technology Readiness Levels (TRLs), noting that her team's technology is currently at TRL 4–5, with the goal of reaching TRL 7 for commercial deployment. She also discussed the formation of a spin-off company to support commercialisation and compared her group's approach to other PFAS destruction technologies, many of which rely on commercial anodes and are still in early development stages.

In closing, Jelena reflected on the broader challenges facing PFAS remediation: the extreme persistence of PFAS compounds, the need to meet ultra-low concentration limits, and the difficulty of bridging the gap between innovative lab research and real-world application. She highlighted the importance of pilot-scale trials and industry collaboration to demonstrate the value of new technologies and cautioned against overpromising results without validated destruction data. Her presentation concluded with acknowledgements to her research team and an invitation for further discussion, noting that she had intentionally kept the technical depth moderate for the panel audience.

## Discussion

Following Jelena's presentation, the panel engaged in a technical and exploratory discussion on the implications and challenges of PFAS destruction technologies, particularly electrochemical oxidation. Steve initiated the conversation by asking whether the presence of chloride ions in electrochemical oxidation systems could lead to the formation of new, potentially harmful compounds when interacting with fluorinated organics. Jelena responded that such reactions could occur, especially if the PFAS molecules have aromatic structures, which are highly reactive with chlorine. She noted that while this is theoretically plausible, it has not yet been thoroughly investigated in the literature.

Tony then raised a related concern about the fate of fluoride released during PFAS breakdown. Jelena explained that fluoride is typically present in trace concentrations and, in some cases, may be incorporated into the electrode material without affecting performance. However, most fluoride is released into the treated water stream. She emphasised that electrochemical processes are

inherently non-selective, with multiple reactions occurring simultaneously, making it difficult to control byproduct formation.

Steve followed up with a question about hydrothermal alkaline treatment (HALT), asking whether sodium hydroxide used in the process effectively neutralises hydrofluoric acid, a toxic byproduct. Jelena confirmed that this is indeed one of HALT's advantages over supercritical water oxidation (SCWO), which requires extreme conditions and can generate corrosive HF. However, she cautioned that both technologies are complex and energy-intensive, and may not be suitable for continuous, scalable operation.

Ian then shifted the discussion to the broader application of destruction technologies. He asked whether the ultimate goal was to integrate electrochemical oxidation into drinking water treatment plants as a replacement for conventional methods like granular activated carbon (GAC). Jelena clarified that her team is not currently testing their technology on drinking water due to safety concerns and regulatory constraints. Instead, they are focusing on contaminated groundwater and industrial wastewater. She explained that their system integration approach involves pre-concentration of PFAS to improve energy efficiency, with the potential to add GAC as a polishing step if needed.

Ian further noted that, to his knowledge, no PFAS destruction technologies are currently deployed in drinking water treatment globally. Jelena agreed, stating that despite significant investment and commercial interest, she is unaware of any full-scale implementation for drinking water. She speculated that some companies may be piloting systems for industrial wastewater, which poses lower risks, but expressed scepticism about the effectiveness of commercial anodes in avoiding toxic byproducts like chlorate and perchlorate.

The conversation concluded with a reflection on the maturity of available technologies. Jelena reiterated that absorption methods, such as GAC and ion exchange resins, remain the only widely adopted and reliable solutions. Ian agreed and raised a final question about the best methods for destroying PFAS-contaminated absorption materials. Jelena acknowledged the importance of this issue but suggested it be addressed later in the plenary session, as others on the panel may have insights to contribute.

## Presentation from Subject Matter Expert Steven Chow

Steven Chow, presented on the fate and transport of PFAS in wastewater systems, with a particular focus on sludge management and incineration practices in Switzerland. He began by contextualising PFAS contamination within wastewater treatment plants, which act as aggregate sources due to inputs from households, industry, and commerce. These contaminants settle into sewage sludge—a byproduct of wastewater treatment—which is often land-applied in many countries to recycle nutrients like nitrogen and phosphorus. However, PFAS contamination poses risks of accumulation in soil, crops, livestock, and water sources, especially in inland regions where treated wastewater may enter potable water systems.

Steven explained that PFAS partitioning occurs during wastewater treatment: short-chain PFAS (typically fewer than eight carbon atoms) tend to remain in the liquid phase, while long-chain PFAS (eight or more carbon atoms) accumulate in sludge. In a Swiss national study of 21 wastewater treatment plants, approximately 90% of measurable PFAS mass was found in the wastewater, and 10% in the sludge—though the sludge contained more bio accumulative long-chain compounds like PFOS, which was found to partition 75% into wastewater and 25% into sludge.

He then discussed the widespread practice of land application of sludge, particularly in the United States, where 60% of sludge is land-applied, 14% incinerated, and 24% landfilled. While this method is cost-effective and supports nutrient recycling, it raises concerns about contaminants such as heavy metals, pathogens, pharmaceuticals, microplastics, and PFAS. Several countries have begun restricting land application due to PFAS risks. For example, Germany plans to phase out land application for large treatment plants by 2032, and U.S. states like Maine have banned PFAS-contaminated sludge from being land-applied. Denmark has introduced action levels for PFAS in sludge ranging from 10 to 50 ppb.

Switzerland presents a unique case, having banned land application of sludge since 2006 due to concerns over pathogens and heavy metals. The economic impact was minimal, as only a small fraction of nitrogen and phosphorus from sludge was used in agriculture. Today, nearly all Swiss sludge undergoes thermal treatment, primarily incineration, although there are no specific PFAS limits in sludge.

Steven provided a detailed overview of sludge incineration, describing it as a high-temperature combustion process that produces flue gas, bottom ash, and heat. The ash, containing inorganic materials, is typically landfilled, while the heat is recovered for energy. Incineration reduces sludge volume by over 95% but also results in nutrient loss and requires significant capital and operating costs. Effective pollution control—particularly for flue gas—is essential, often involving particle removal, acid gas scrubbers, and activated carbon filters.

He described the operational flow of a sludge incineration facility, emphasising the need for pre-drying sludge to increase solids content for efficient combustion. Incinerators operate at temperatures above 650°C, with air pollution controls and energy recovery systems in place. In Switzerland, sludge is treated in dedicated incinerators, municipal waste-to-energy plants, or cement kilns. Zurich, for example, has a centralised sludge facility co-located with its wastewater plant. Starting in 2026, Switzerland will mandate phosphorus recovery from incineration ash.

Regarding PFAS destruction, Steven explained that successful incineration breaks PFAS into HF gas and $CO_2$. HF is corrosive and must be scrubbed using alkaline bases. Incomplete combustion can result in short-chain PFAS and volatile fluorinated compounds escaping into the air. Effective PFAS destruction requires high temperatures (above 1000°C), sufficient residence time (over 2 seconds), and homogeneous heating. Cement kilns and hazardous waste incinerators meet these criteria better than older sludge or municipal waste incinerators.

He reviewed literature from Sweden and the U.S. showing that while incineration can reduce PFAS, residual short-chain PFAS often remain in ash and rinse water. A recent USEPA study using advanced monitoring confirmed high PFAS destruction in hazardous waste incinerators but cautioned that performance varies by facility type.

Steven concluded by discussing the broader implications of sludge management. He emphasised that incineration may offer high destruction of long-chain PFAS but could increase short-chain PFAS, requiring careful risk assessment. The USEPA recommends high-temperature treatment but acknowledges no current method is ideal. He stressed the importance of considering PFAS precursors, other pollutants, and the need for upstream source reduction.

Finally, he highlighted emerging sludge treatment technologies, including supercritical water oxidation and gasification/pyrolysis. These offer potential advantages such as carbon sequestration and energy recovery but remain costly and underdeveloped at scale. Steven ended his presentation by inviting questions from the panel.

## Discussion

Following Steven's presentation on PFAS fate and sludge incineration, the panel engaged in a technical discussion focused on the feasibility and implications of thermal treatment options, particularly in the context of Jersey's infrastructure. Steve (Hajioff) opened the floor for questions, prompting Ian Cousins to note that Jersey has a waste-to-energy incinerator but lacks other thermal treatment facilities such as cement kilns or hazardous waste incinerators. Kelly Whitehead confirmed this, explaining that Jersey operates two incineration facilities: a waste-to-energy plant burning at 850°C and a small clinical waste incinerator operating at 1100°C. However, there are no dedicated hazardous waste incinerators, and the island's hazardous waste containment cells have limited capacity—estimated at only 20 to 30 years under current usage.

Steve (Hajioff) posed a follow-up question to Steven (Chow), asking whether it would be technically feasible to use a two-stage incineration process: first reducing sludge volume at a lower temperature (e.g., 850°C), followed by complete PFAS destruction in a higher-temperature facility (e.g., 1100°C). Steven (Chow) found the idea intriguing and plausible, noting that while the ash produced has no energy value, the concept of staged treatment could be viable depending on how the waste is mixed and managed.

Ian added that one of the Swedish researchers involved in PFAS incineration studies had been invited to the meeting. He referenced a study that performed a mass balance on PFAS at a waste-to-energy facility, noting that while volatile PFAS compounds were not measured, the detected levels of PFAS in emissions were low. Interestingly, the study found that the largest environmental emission source was not the incinerator itself but the leachate from stored solid waste piles prior to combustion, which contaminated nearby streams.

Steven (Chow) agreed, stating that most PFAS emissions from incineration appear to be minimal and that the majority of PFAS mass is either retained in ash or released via wastewater effluent. He emphasised that while PFAS are not completely destroyed, the residual levels in ash are relatively low and comparable to those found in untreated municipal sludge. Importantly, incineration achieves a 95% reduction in sludge volume, making the remaining waste more manageable for disposal or export.

Tony raised concerns about incineration temperature, noting that previous discussions had suggested 850°C might be sufficient, but recent comments implied that temperatures above 1000°C may be necessary for complete PFAS destruction. He questioned whether sludge could be cost-effectively added to waste-to-energy streams, given its organic content and potential calorific value. Steven (Chow) responded that the most significant cost in sludge incineration is the drying process. Sludge must be actively dried to increase its solids content before incineration, which adds to operational costs. However, once dried, sludge does contribute to the heating value of the process.

Steven (Chow) cautioned against overinterpreting trace PFAS findings in research studies, noting that comprehensive mass balance data for PFAS in municipal incinerators is still lacking. He added that the Swiss government has no plans to change its policy of incinerating sludge, viewing it as a less problematic exposure pathway compared to land application.

Tony then returned to the topic of land application, asking whether Switzerland had concerns about the loss of organic matter in agricultural soils due to the removal of sewage sludge from the fertiliser stream. Steven (Chow) acknowledged that maintaining soil organic matter is a general agricultural concern but explained that the contribution of sewage sludge to soil nutrients in Switzerland was minimal. Farmers often rely on manure and composting for soil amendment, which more than compensates for the absence of sewage sludge.

## Presentation from Subject Matter Expert Linda Lee

Linda Lee, delivered a comprehensive presentation on PFAS in biosolids, drawing from over two decades of research and numerous field sites across the United States. Linda focused specifically on the fate of PFAS during biosolids processing and after land application. She began by emphasising that wastewater treatment plants—now often referred to in the U.S. as “water resource recovery facilities”—receive PFAS from a wide range of sources, including domestic, industrial, and commercial inputs. These compounds either remain in the effluent or adsorb to solids, which are then processed into biosolids and often land-applied.

Linda explained that biosolids vary widely in moisture content and physical form, ranging from liquid-like materials to dry, pelletised solids. The treatment processes used—such as anaerobic or aerobic digestion, thermal hydrolysis, centrifugation, filtration, composting, and drying—affect the final form and handling of biosolids but do little to degrade PFAS. In fact, water removed during processing (centrate) often contains high PFAS concentrations and is recycled back into the treatment plant, perpetuating contamination. Some emerging technologies are being tested on this centrate to break the cycle.

In the U.S., biosolids are classified as Class A, Class B, or Exceptional Quality (EQ), based on pathogen and metal content—not PFAS. Linda noted that regulatory success in reducing metals in biosolids came from enforcing pretreatment requirements (prior to discharge into wastewater treatment plants), a model that could inform PFAS management. She also highlighted that PFAS concentrations in biosolids are reported on a dry weight basis, which can make levels appear deceptively high given the low solids content.

Linda reviewed the limitations of current disposal options. Landfilling is increasingly costly and perpetuates PFAS cycling via leachate. Incineration is not widely accepted in the U.S. due to concerns about incomplete destruction and emissions. Alternative thermal treatments like pyrolysis and gasification are being piloted but face technical and economic challenges. She emphasised that no treatment method is problem-free, and even promising technologies like alkaline hydrolysis and supercritical water oxidation face issues such as equipment corrosion and scalability.

A key theme in Linda’s presentation was the growing contribution of domestic wastewater to PFAS loads, especially as industrial and AFFF (aqueous film-forming foam) discharges are more tightly regulated. She noted that most PFAS from domestic sources exit both in the effluent and the sludge. Her research coupled to others research in the past few years has shown that biosolids processing can reduce PFAS concentrations by up to 80%, likely due to volatilisation rather than degradation. This opens the possibility of capturing and treating PFAS in off-gas streams.

Linda warned against assuming that biosolids are the only source of PFAS in composted materials, noting that paper waste—a common compost input—contains high PFAS levels. She stressed the value of biosolids as a resource, citing their nutrient content, slow-release fertilisation properties, and ability to improve soil health and productivity. However, she acknowledged that legacy PFAS contamination from historic biosolids and compost applications remains a major challenge.

She presented data from her research showing wide variability in PFAS concentrations across biosolids samples, driven by input sources and analytical scope. Many studies only measure a few compounds like PFOS and PFOA, missing the majority of PFAS mass, which often consists of unmonitored precursors. These precursors can transform into the more commonly regulated PFAS during treatment or after land application, creating the illusion that PFAS are being “created” in the process.

Linda reviewed state-level regulatory responses in the U.S., ranging from interim strategies to outright bans on biosolids use. She criticised the narrow focus on PFOS and PFOA in some

regulations, arguing that many precursors are being overlooked. She also highlighted the problem of industrially impacted biosolids, which include several types of industries, but she noted in particular paper mills which have been overlooked. Paper mill wastes can contain extremely high PFAS levels and have been linked to contamination of farmland and water supplies.

She presented several case studies illustrating PFAS behaviour after land application. In one long-term disposal site, biosolids increased soil organic carbon significantly, but PFAS—especially long-chain compounds—remained in the upper soil layers, while short-chain PFAS leached into groundwater. Another site showed how soil type affects PFAS mobility, with sandy soils allowing deeper leaching. She also discussed atmospheric deposition of PFAS, noting that rainwater near military and airport sites in the U.S. has exceeded drinking water limits for PFOS.

Linda emphasised the importance of considering runoff and tile drainage as major PFAS transport pathways. She shared data showing high PFAS loads in runoff following heavy rainfall and noted that closed water bodies like ponds can accumulate PFAS, posing risks to wildlife and livestock. In one case, fish in a pond near a former biosolids application site had PFOS levels exceeding 1,200 ppb, more than 2 decades after application had ceased.

Despite these concerns, Linda concluded on a cautiously optimistic note. In her own county in Indiana, extensive well testing near biosolids application sites showed low PFAS levels, suggesting that with proper management, risks can be minimised. She reiterated that PFAS concentrations in biosolids are generally decreasing and that innovation in treatment technologies is ongoing. However, she stressed the need for better monitoring of precursors, more comprehensive analytical methods, and a shift toward source reduction and treatment trains rather than reliance on any single solution.

**Discussion**

Steve Hajioff opened the discussion by highlighting a key insight from her talk: the importance of distinguishing between PFAS concentrations reported on a dry weight basis versus the actual wet weight of sludge applied to land. He noted that the panel had been calculating PFAS loads based on lab-reported dry weight concentrations without correcting for water content, potentially leading to overestimations of PFAS mass applied per volume of sludge. Linda confirmed the significance of this correction and offered to share an additional slide to further illustrate the point.

Linda elaborated that biosolids are typically applied based on their nitrogen content, and the amount applied can vary significantly depending on the nutrient density of the product. She cited the example of Milorganite, a commercially available biosolid product from Wisconsin, which has relatively high PFAS concentrations but, due to its high nitrogen content, is applied in smaller quantities—resulting in lower overall PFAS loads to soil compared to other biosolids with lower PFAS but also lower nutrient content. She also emphasised that when biosolids are mixed into soil, the PFAS concentrations are diluted significantly—often by a factor of 30 to 100—resulting in final soil concentrations of less than 1 part per billion (ppb), even when the biosolids themselves contain measurable PFAS.

Linda further explained that land application strategies, such as rotating fields and applying biosolids only every five years, can help manage PFAS accumulation. She advocated for such management approaches as alternatives to outright bans, especially if PFAS concentrations in biosolids can be reduced at the source.

Ian Cousins then commented on the situation in Jersey, stating that the PFAS levels in local biosolids appear to be relatively low and typical of general municipal waste, rather than being impacted by industrial or AFFF (aqueous film-forming foam) sources. Linda agreed, referring to

such materials as “boring municipal biosolids,” and noted that even if precursor compounds are present, they are likely to be at low levels compared to industrially impacted biosolids.

Ian added that although PFOS and PFOA are no longer in use in most parts of the world, including Jersey and the U.S., their persistence means they continue to be detected due to residual contamination in manufacturing equipment and infrastructure. Linda confirmed this, noting how difficult it is to fully remove PFAS from equipment such as fire trucks, where legacy contamination can persist despite cleaning efforts.

Tony Fletcher asked whether PFOS and similar compounds are still being released from precursors and intermediates in the environment. Linda responded that certain precursors, including those found in older AFFF formulations, continue to degrade slowly into PFOS over time. She emphasised that this degradation is influenced by environmental conditions such as temperature, soil type, and microbial activity. Even in healthy soils, the degradation process is slow, and in contaminated or nutrient-poor soils—such as those found at military sites—it is likely to be even slower.

Steve then asked whether it would be possible to model the future PFOS levels in contaminated areas based on the known half-life of these precursors. Linda confirmed that such data exists in the literature and that modelling is feasible, though outcomes would vary depending on local environmental conditions. She added that some precursors are more mobile than others and can leach through soil, as shown in her lysimeter studies, which capture leachate from biosolids-treated soils.

The discussion concluded with a shared understanding that while PFAS levels in biosolids are declining, legacy contamination and precursor transformation remain significant challenges. The panel acknowledged the importance of accurate measurement, source control, and thoughtful land management strategies in mitigating PFAS risks.

## Final Plenary Discussion

The final plenary discussion was opened by Steve (Hajioff), who invited reflections and questions following the presentations by Linda, Jelena, and Steven (Chow). Jelena began by asking Linda about the role of side-chain fluorinated polymers—often used in paper products—as potential PFAS precursors. Ian clarified that the correct terminology was “side-chain fluorinated polymers” rather than “fluoropolymers,” which are chemically distinct. Linda confirmed that side-chain fluorinated polymers are indeed used in paper coatings and are difficult to quantify due to ionisation challenges in mass spectrometry. She shared that her own research projects had attempted to study their degradation but faced analytical limitations. However, early work showed that microbial degradation of these polymers is slow, and extraction processes can artificially break side chains, complicating analysis.

Linda also noted that recycled paper products, such as cereal boxes, are a significant source of PFAS in paper mill sludge. She observed that PFAS concentrations in such sludge have decreased over time, with a shift toward shorter-chain compounds like PFBS, which are more mobile but less bio accumulative than PFOS.

Steve (Hajioff) then asked about the spatial extent of PFAS contamination in rainwater near military sites. Linda responded that elevated PFAS levels had been detected in rainwater up to five miles from an airport, though she clarified that the source was not definitively linked to the airport or military site. She emphasised that PFAS are now being detected in rainwater across many locations, likely due to diffuse sources such as atmospheric deposition from clothing, wastewater treatment plants, and sea spray. Ian agreed, noting that PFAS are ubiquitous in rain globally and

that attributing contamination to a single aerial source is difficult due to atmospheric mixing and dilution.

The conversation then turned to the disposal of PFAS-laden materials such as granular activated carbon (GAC) and ion exchange resins. Ian asked what the best disposal options were for Jersey, given its limited infrastructure. Jelena explained that GAC is widely used in Europe, while ion exchange resins are more common in the U.S. Both technologies are expensive and generate waste streams that require further treatment. She noted that GAC is often incinerated, but the effectiveness depends on the incineration temperature and regulatory allowances. Ion exchange resins produce large volumes of regeneration brine and must be replaced periodically.

Steven (Chow) added that in the U.S., GAC used for potable water is typically virgin material, while GAC used for remediation can be thermally regenerated by manufacturers. However, regenerated GAC is generally not reused for drinking water. Ion exchange resins are often sent to hazardous waste incinerators, though some newer systems allow for in-situ regeneration. Jelena noted that in some cases, such as landfill leachate treatment, used GAC is simply disposed of in landfills due to cost considerations.

Steve (Hajioff) asked whether the temperatures required for PFAS destruction in GAC are similar to those for biosolids. Steven (Chow) confirmed that PFAS can begin to degrade at 600–800°C, but complete mineralisation is uncertain without comprehensive monitoring. Jelena added that cost often determines whether GAC is regenerated or discarded.

The discussion returned to Jersey's specific challenges. Ian noted that Jersey lacks hazardous waste incinerators, making it difficult to dispose of PFAS-laden GAC and powdered activated carbon (PAC). Steven (Chow) explained that whether a facility accepts such waste is often a regulatory decision, and some incinerators may refuse it to avoid future liability. Steve (Hajioff) suggested that a two-stage incineration process—initial volume reduction followed by high-temperature destruction—might be feasible, though Steven (Chow) cautioned that volatile PFAS could escape during the first stage if air pollution controls are inadequate.

Steve (Hajioff) then asked Jelena whether her electrochemical oxidation technology could be used to treat reverse osmosis (RO) concentrate, and whether carbon-based anodes risk fouling from organic matter. She confirmed that electrochemical oxidation is suitable for RO concentrate but warned that high chloride levels can lead to toxic byproducts like chlorate and perchlorate. Regarding fouling, she explained that graphene-based anodes differ from traditional carbon and appear resistant to biofilm formation, possibly due to their antimicrobial properties. However, long-term performance still needs to be validated in pilot-scale trials.

Tony raised a clarification about PFAS concentration units, asking whether measurements in solids were consistently reported on a dry weight basis. Jelena confirmed that her references to concentrations were for water, not solids. Steven (Chow) acknowledged a typo in his presentation and confirmed that PFAS concentrations in biosolids are indeed reported per dry weight, consistent with European soil guidance values.

The session concluded with final reflections. Ian praised the quality of the presentations and discussions, and Steve (Hajioff) echoed his appreciation, especially thanking Linda for joining the meeting at an early hour from the U.S.

## Any other business

Nothing to raise.

## Date of next meeting

Wednesday 22nd October 2025. It will be held 10am - 1pm online.

The Chair thanked everyone for their contributions, those watching the meeting and those offering support throughout the whole process.

A reminder to the public that this meeting has been recorded, and the video will be available online on request by emailing the Regulation Enquiries mailbox on RegulationEnquiries@gov.je. This will take a couple of days to make sure the observers are anonymised.

There being no further business, the meeting was closed.

To note that the Panel can be emailed via PFASpanel@gov.je.

Details of meeting dates and times can be found at PFAS in Jersey (gov.je)