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Expanding PFAS capability for biosolids reuse and risk assessment

ALS has broadened its NATA accredited PFAS analytical capabilities to support biosolids management and beneficial reuse decisions with an extended compound suite and lower limits of reporting.

Biosolids management and beneficial reuse across Australia continue to evolve, impacting organisations across water distribution, utilities and resource recovery as regulatory compliance and risk assessment for PFAS contamination within the region's waste infrastructure remains a key concern.[1]

Growing project complexity and variances in state-based environmental guidelines are driving demand for lower limits of reporting (LORs), more robust margins of safety (MOS) and broader compound coverage under accredited analytical methods.

ALS continues to expand its PFAS testing capabilities for biosolids and other solid matrices, supporting clients with greater analytical sensitivity, expanded analyte coverage and NATA testing services for defensible environmental assessment, water management and beneficial reuse projects.

Biosolid management and PFAS

Biosolids refer to nutrient-rich organic material for the use of soil amendments or conditioning. Deriving from waste streams through processes of wastewater treatments, their contaminant profile typically reflects inputs received by the sewerage or waste network across domestic, municipal, council, commercial and industrial properties.

As per- and polyfluoroalkyl substances (PFAS) migrate through the environment, they ultimately accumulate within wastewater and solid waste infrastructure, entering sewage treatment plants (STPs) and impacting residual products such as biosolids. Within these facilities and supporting infrastructure, collected waste undergoes various treatment and stabilisation processes, from anaerobic and aerobic digestion and drying, to thermal destruction, extended aeration, composting and lime stabilisation.[2]

Post-treatment, these processes create end-use products for beneficial reuse within the circular waste economy and resource recovery industries. Treatment processes and facility dynamics may influence PFAS concentrations and distribution in end-use scenarios, underlining the persistence of PFAS in biosolids.[3]

PFAS analysis in biosolids presents significant analytical challenges due to the complex, high organic-matter matrix and elevated moisture content of biosolids samples. These matrix interferences can significantly impact extraction efficiency and instrument performance, thus requiring more stringent processes for quantification and technical accuracy compared to simpler matrices such as water and soil.

Regulatory context for biosolids

The Australian regulatory environment for biosolids management continue to prioritise PFAS and other emerging contaminants, with advances in technical solutions helping to support adaptive environmental and ecological decision-making.

Within the region, wastewater-derived materials, landfill leachates, compost and agriculture reuse streams grow increasingly in focus. The Australian biosolid industry produces 378,000 tonnes of dry solids per year, with agriculture, land rehabilitation, stockpiling and forestry being key end-use settings.[4] Historically, some Australian jurisdictions have included PFAS analysis of biosolids in reuse requirements – such as end-of-waste codes and resource recovery orders.[5] Comparatively, New Zealand approaches biosolid management centrally through the 2003 Biosolids Guidelines, as well as its 2025 and 2017 revisions.[6]

Understanding PFAS sources in biosolids and end-use risks

As a significant proportion of biosolids destined for agricultural reuse are processed into compost or stabilised products, analysis of biosolid feedstocks prior to treatment takes on greater priority. The Heads of EPA Australia and New Zealand's (HEPA) 2025 update to the PFAS National Environmental Management Plan (NEMP 3.1) introduced suggested concentration limits for PFAS in biosolids intended for application to broadacre agriculture and land use. Section 15.4.3 of the NEMP 3.1 outlines risk-based criteria for 'restricted use' and 'unrestricted use' scenarios, based on the most sensitive exposure pathways.[7] **Table 1** presents the proposed biosolids criteria from NEMP 3.1.

Identifying and eliminating PFAS sources that may contribute to re-entry into the food chain, and the broader environment grows increasingly critical to protect ecological receptors and human health.

Table 1. *Criteria for PFOS + PFHxS and PFOA in biosolids and maximum allowable soil contaminant concentrations based on a 1-, 2- and 5-fold margin of safety.*[8]

Criteria type	MOS[a]	Sum of PFOS and PFHxs (µg/kg)	PFOA[b] (µg/kg)
Biosolids threshold restricted use	5	6.2	16
	2	15	40
	1	31	81
Biosolids threshold unrestricted use[c]	5	0.22	0.6
	2	0.55	1.5
	1	1.1	3
MASCC	5	0.22	0.6
	2	0.55	1.5
	1	1.1	3

a At the commencement of PFAS NEMP 3.0 and unchanged in 3.1, the default MOS is 1.
b The PFOA criteria are based on the interim soil ecological indirect exposure guideline value for PFOA.
c The unrestricted use threshold may not be applicable in all jurisdictions. Where it is applicable, it should be applied to the final biosolids product for land application.

Alongside supporting PFAS assessments across treatment processes, emissions or end use products, reliable characterisation of PFAS content in biosolids may also assist with monitoring and detecting potential changes in product quality. These changes include unauthorised trade waste discharges to sewerage and wastewater, and their adverse impact on land application and other reuse scenarios.

The criteria outlined in **Table 1** only covers PFOS, PFHxS and PFOA. The NEMP 3.1 also identifies additional considerations for selection of the most suitable MOS:[9]

- Biosolids may also contain considerable amounts of precursor chemicals of other PFAS compounds, such as di-substituted phosphate esters (diPAPs).
- Risk assessment approaches to choose the preferred MOS may be informed by the total PFAS concentrations present.
- The presence of additional individual PFAS or PFAS classes in biosolids may also need to be managed to mitigate risks to the environment and/or human health and may warrant a larger MOS in some jurisdictions.

Conversely, results showing little to no detectable presence of other PFAS may support an assessment that use of a more stringent margin of safety is unnecessary.

ALS works closely with industry bodies, utilities, consultants and regulators across Australia to provide analytical solutions that support defensible environmental decision-making and emerging compliance requirements.

Sampling and analysis requirements

The standard high-density polyethylene (HDPE) specimen jar for soils is also applicable for sampling biosolids. Samples should be submitted to the laboratory chilled. Please clearly mark the samples as biosolids on the chain of custody (COC) form to ensure safe handling by the laboratory.

The high organic content of biosolids presents unique analytical challenges for PFAS beyond standard soil matrices. Extraction efficiency is typically poor for conventional solvent extraction techniques used for soils, resulting in low PFAS recoveries. In addition, co-extracted organics impart significant analytical interferences.

ALS has developed an in-house extraction procedure to maximise PFAS recovery from biosolids, including a comprehensive extract clean-up to remove interfering co-extracted organics.

Supporting PFAS capability for biosolids across the region

With greater scrutiny on PFAS in land application programs and waste-derived products, lower detection capabilities across the broad range of potential PFAS classes that may be present are becoming increasingly important for risk assessment and environmental management programs, supporting more confident biosolids management and beneficial reuse decisions.

ALS is NATA accredited for an extended range of PFAS compounds with lower limits of reporting (**Appendix 1**). Our capabilities include traditional regulated PFAS compounds, alongside a growing number of emerging PFAS analytes requested by regulators and project stakeholders. The range includes broad classes of compounds currently understood to be present in Australian biosolids described above, as well as recent replacement PFAS compounds that may emerge in the future.

ALS methodologies have been developed to achieve limits of reporting significantly below many current Australian regulatory thresholds for biosolids and environmental solids. These lower LORs provide improved confidence when assessing low-level PFAS presence and support future-proofing against tightening guideline values.

Get in touch with us

Contact your local ALS laboratory to discuss PFAS testing for biosolids and sampling requirements for your project.

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Appendix 1

Extended range of PFAS compounds and specific LORs offered by ALS for analysis of PFAS in biosolids.

Perfluoroalkane sulfonic acids

Test parameter	CAS number	LOR (µg/kg)
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.5
Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.5
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.1
Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.5
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.1
Perfluorononane sulfonic acid (PFNS)	68259-12-1	0.5
Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.5

Perfluoroalkane carboxylic acids

Test parameter	CAS number	LOR (µg/kg)
Perfluorobutanoic acid (PFBA)	375-22-4	0.5
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.5
Perfluorohexanoic acid (PFHxA)	307-24-4	0.5
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.5
Perfluorooctanoic acid (PFOA)	335-67-1	0.1
Perfluorononanoic acid (PFNA)	375-95-1	0.5
Perfluorodecanoic acid (PFDA)	335-76-2	0.5
Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.5
Perfluorododecanoic acid (PFDoDA)	307-55-1	0.5
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.5
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.5
Perfluorohexadecanoic acid (PFHxDA)	67905-19-5	0.5

Perfluoroalkyl sulfonamides

Test parameter	CAS number	LOR (µg/kg)
Perfluorooctane sulfonamide (FOSA)	754-91-6	0.5
N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.5
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.5
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.5
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.5
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.5
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.5

Appendix 1
Continuation.

(n:2) Fluorotelomer sulfonic acids

Test parameter	CAS number	LOR (µg/kg)
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.5
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.5
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.5
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.5

Perfluoroalkane sulfonic acids

Test parameter	CAS number	LOR (µg/kg)
Perfluorododecane sulfonic acid (PFDoDS)	79780-39-5	0.5
Perfluoro-4-ethylcyclohexanesulfonic acid (PFECHS)	335-24-0	0.5

Ether sulfonic acids

Test parameter	CAS number	LOR (µg/kg)
Perfluoro(2-ethoxyethane) sulfonic acid (PFEESA)	117205-07-9	0.5
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9ClPF-3ONS)	73606-19-6	0.5
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	83329-89-9	0.5

Ether carboxylic acids

Test parameter	CAS number	LOR (µg/kg)
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA / GenX)	13252-13-6	0.5
Perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	0.5
Perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	0.5
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	151772-58-6	0.5
Dodecafluoro-3H-4,8-dioxanonanoic acid (ADONA)	2250081-67-3	0.5

Fluorotelomer carboxylic acids

Test parameter	CAS number	LOR (µg/kg)
3:3 Fluorotelomer carboxylic acid (3:3 FTCA)	356-02-5	0.5
5:3 Fluorotelomer carboxylic acid (5:3 FTCA)	914637-49-3	0.5
7:3 Fluorotelomer carboxylic acid (7:3 FTCA)	812-70-4	0.5
6:2 Fluorotelomer carboxylic acid (6:2 FTCA / FHEA)	53826-12-3	0.5
8:2 Fluorotelomer carboxylic acid (8:2 FTCA / FOEA)	27854-31-5	0.5
10:2 Fluorotelomer carboxylic acid (10:2 FTCA / FDEA)	53826-13-4	5

Appendix 1
Continuation.

Unsaturated fluorotelomer acids

Test parameter	CAS number	LOR (µg/kg)
6:2 Fluorotelomer unsaturated carboxylic acid (6:2 FTUCA / FHUEA)	70887-88-6	0.5
8:2 Fluorotelomer unsaturated carboxylic acid (8:2 FTUCA / FOUEA)	70887-84-2	0.5
10:2 Fluorotelomer unsaturated carboxylic acid (10:2 FTUCA / FDUEA)	70887-94-4	0.5

Fluorotelomer sulfonamides

Test parameter	CAS number	LOR (µg/kg)
6:2 Fluorotelomer sulfonamide alkylbetaine (6:2FTAB)	34455-29-3	0.5

Polyfluoralkyl phosphate esters

Test parameter	CAS number	LOR (µg/kg)
6:2 Polyfluoroalkyl phosphoric acid diester (6:2 diPAP)	57677-95-9	0.5
8:2 Polyfluoroalkyl phosphoric acid diester (8:2 diPAP)	678-41-1	0.5
6:2 / 8:2 Polyfluoroalkyl phosphoric acid diester (6:2 / 8:2 diPAP)	943913-15-3	5

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