



# ***Biosolids recycling to agricultural land***

**The scientific evidence – a UK position**

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## Background

- Biosolids are a valuable source of nutrients:
  - Phosphate
  - Sulphur
  - Organic nitrogen
  - Cation Exchange Capacity
- Biosolids are also a source of stable organic matter. Repeated applications increase:
  - Soil organic matter content
  - Available water capacity and infiltration rates
  - Structural stability and earthworm numbers
- Helps complete natural nutrient and carbon cycles



**Best Practical Environmental Option in most circumstances (UK Government)**

# Background ctd...

- Growing number of scientific papers on emerging issues (e.g. nanoparticles, microplastics, persistent organic pollutants, antimicrobial resistance)
- Increased focus on the safety of recycling of biosolids to agricultural land
- Assessments are not holistic and don't consider existing controls
- Media (and social media) coverage is rarely impartial!



For more than 20 years Protecta-Line has been the most widely used barrier pipe system in the UK

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HOME / NEWS / EFFECTS OF MICROPLASTICS IN SEWAGE SLUDGE ON SOILS 'OVERLOOKED'

Effects of microplastics in sewage sludge on soils 'overlooked'



Science for Environment Policy

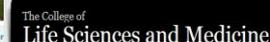
Applying sewage sludge to soil may spread antibiotic resistance

Plastic micro-fibres in Sewage sludge Biosolids

Discussion in 'Agricultural History' started by Yearly, Mar 29, 2016.

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As I drove home late last night I was listening to Radio 4 (nothing else on) and they were washing clothes made with various fibres in a machine and filtering the waste water to measure the plastic fibres that escaped.



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02 March 2016

**Agricultural fertiliser could pose risk to human fertility, sheep study finds**

Eating meat from animals grazed on land treated with commonly-used agricultural fertilisers might have serious implications for pregnant women and the future reproductive health of their unborn children, according to new research.

The study by British and French scientists from the universities of Nottingham, Aberdeen (UK) and Paris-Saclay (France), The James Hutton Institute (Aberdeen) and UMR BDR, INRA, Jouy en Josas (Paris, France) published in the journal *Nature Scientific Reports*, has shown striking effects of exposure of pregnant ewes - and their female lambs in the womb - to a cocktail of chemical contaminants present in pastures fertilised with human sewage sludge-derived fertiliser.

Study looked at effects of exposure of pregnant ewes to a cocktail of chemical contaminants present in some fertilised pastures.

Related Links:

Full paper

**Confidence could be undermined**



## (UKWIR) 'Biosolids to Market' project



Main topic	Sub-topic
Elemental contaminants	Potentially Toxic Elements Radionuclides Other elements of concern
Persistent Organic Pollutants	Organic chemicals Pesticides/herbicides Pharmaceuticals and Personal Care Products
Physical contaminants	Microplastic and fibres Nanoparticles
Pathogens	Bacteria Viruses Protozoans Prions Antimicrobial resistance
Other	Invasive non-native species Asbestos WWT polymers

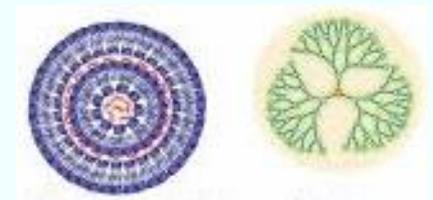
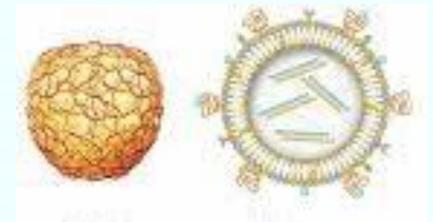
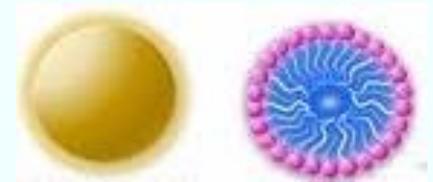
# Microplastics

- In biosolids microplastics are thought to be derived from personal care products, tyres, cosmetics, and shedding of synthetic fibres during washing
- Lack of standardised approaches to monitoring and measurement leads to considerable levels of uncertainty
- Limited data suggest the majority (>90%) of MPs are found in the solid fraction and will be present in biosolids
- Most research has been in the aquatic environment
- Little information on the proportion of (marine or terrestrial) MPs from land-applied biosolids (or from alternative sources)
- Little research on fate and behaviour in terrestrial ecosystems
- Need for research to establish what level of MPs are in biosolids and whether MPs and fibres potentially in biosolids applied to agricultural land pose a risk to human health or the environment



# Nanoparticles

- Widely used in range of consumer products (e.g. bandages, paint, clothing, sunscreen, pharmaceuticals, building facades)
- Little information on types/concentrations in biosolids and soil (and from alternative sources) – measuring techniques expensive and time consuming
- Various source to soils – no evidence that biosolids are the largest contributor (likely to be important)
- Some evidence that AgNPs in biosolids are toxic to plants and invertebrates – generally not ‘real world’ studies
- Safe levels of NPs not established; environmental and biological exposure pathways largely unknown
- Potential risk to human health not fully quantified
- There's a need for field studies using biosolids ‘naturally contaminated’ with NPs to assess potential impact on soil quality and fertility



## Pathogens

- No evidence to suggest the risk assessments underpinning the Safe Sludge Matrix should be re-evaluated
- But... operational process performance must be maintained to retain confidence
- The multiple barrier approach provides generic protection (unless new pathogens emerge with 'cell from hell' characteristics)



## Antimicrobial resistance (AMR)

- Biosolids contain antibiotics, antibiotic-resistant bacteria and antibiotic resistance genes, but the relative importance of biosolids compared to other sources is unknown
- For antimicrobial resistance, it is reasonable to consider the risk from biosolids to agricultural land route within the context of the entirety of environmental microbiological exposures
- Research on this topic area should be regarded as a high priority



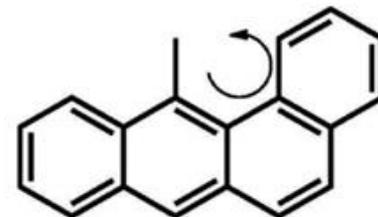
# Pharmaceuticals and personal care products (PPCPs)

- A group of thousands of chemical substances used for healthcare and/or cosmetic purposes
- Currently no regulation of PPCPs in biosolids
- Veterinary products are a major contribution to soils
- Domestic sources account for 70% of PPCP loading at wastewater treatment plants
- Levels in biosolids unlikely to pose a direct risk to humans or grazing livestock
- Techniques to model inter-relationships between sludge treatment processes, derivative compounds and synergistic/antagonistic hazards are required
- More evidence required to quantify risks to soil biology for specific compounds

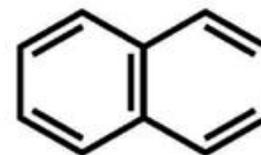


# Persistent Organic Pollutants

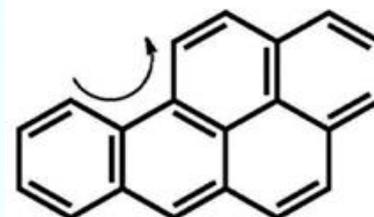
- Proposed EU regulations for PAHs, PCBs, PCDD/Fs and DEHP (already regulated in some countries) – many ALARA
- Good evidence to suggest levels in UK biosolids are below proposed regulatory limits or do not pose a risk (adequately controlled by the existing constraints)
- Other sources of OCCs include atmospheric deposition, manures, compost, agrochemicals, digestate, etc. The relative importance of biosolids (compared to these other sources) is not always well understood
- Emerging compounds include PFCs, PCAs/CPs, PCNs, HFRs and PBDD/Fs. Most absorb to sewage sludge solids during treatment – more research needed to understand any potential risks
- More evidence required to understand risks from mixtures of chemicals



12-methylbenz[*a*]-anthracene



Naphthalene



Benzo[*a*]pyrene

# Potentially Toxic Elements

- Substantial evidence base to underpin Regulations and Code of Practice PTE limits:
  - Zn, Cu, Hg, Pb, Ni, Cd, Cr, As, Mo, F, Se
  - Concentrations in regulated PTEs in UK biosolids have declined considerably in recent years
  - Regular reviews of the evidence do not indicate a need to change the current limit values
- Some studies (non-UK) suggest that tin, silver and antimony levels may be a cause for concern – more research needed
- Some PTEs (and other chemicals potentially present in biosolids) may influence the transfer of antimicrobial resistance in soil – requires further investigation



# Other issues investigated

## Radionuclides:

- Discharges are regulated
- Negligible risk from biosolids



## Wastewater treatment polymers:

- Majority breakdown in soil
- Negligible risk



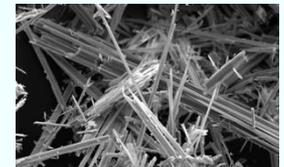
## Invasive non-native species

- No information on the risks from biosolids

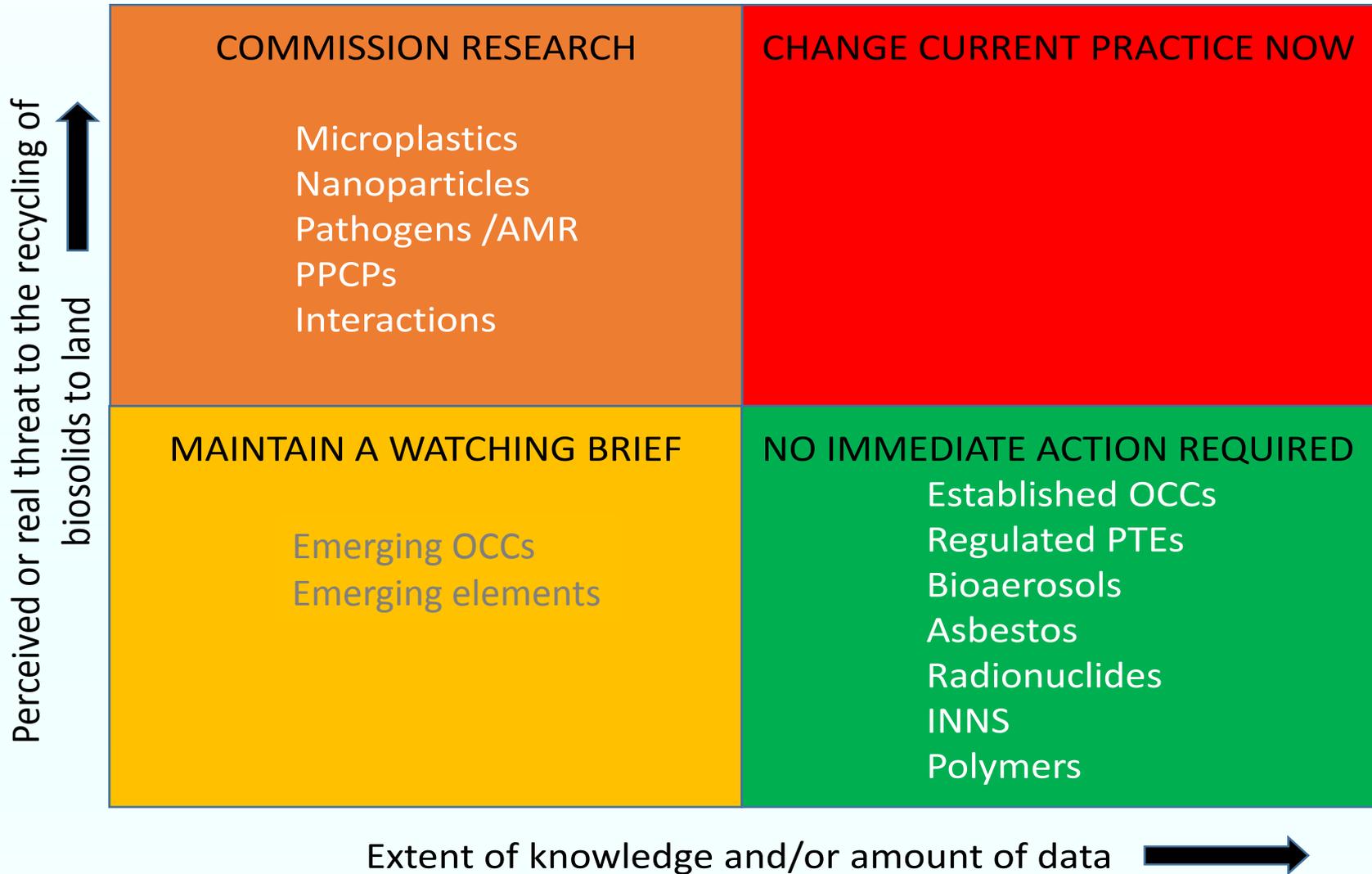


## Asbestos

- No information – levels in biosolids likely to be low
- Anecdotal evidence confirms this



# Action quadrant for future research



## Summary

- Biosolids recycling to land provides numerous benefits to crops and the soil
- It is low risk because of existing controls on:
  - Sources entering wastewater/sludge treatment
  - Application rate/return periods
  - The separation between humans (and animals) and biosolids
- Biosolids are not the only (and not always the most important) source of contaminants
- But... more information on some substances/issues required to ensure there is a comprehensive and robust evidence base derived from sound UK specific scientific studies.



**No immediate changes to current practice required.... however, not enough evidence to adequately assess risks from some emerging contaminants (environmental effect)**



# Communicating to stakeholders & the public



## **Assured Biosolids Limited (ABL) Biosolids Assurance Scheme (BAS) Position Statement on the potential impact of microplastics on biosolids recycling to agricultural land**

### **Introduction**

The increasing amounts of plastics produced globally each year, combined with their potential impact on the environment has resulted in a large amount of public and media interest. Much of the interest in the fate of plastics, including microplastics, has focused on the marine environment. However, there has been recent interest in the terrestrial environment that has included their concentration in biosolids (i.e. treated sewage sludge) and their potential impact when treated and recycled to agricultural land. Despite this interest, there are still large gaps in the scientific understanding of microplastics; for example there is no internationally recognised definition of what a microplastic is. Although the most commonly used definition in scientific literature is of synthetic polymers of less than 5 mm in diameter. In terms of the scale of the issue, it is estimated that between 75,000 and 300,000 tonnes of microplastics from all sources are released into the environment each year in the European Union (EU).

Microplastics are typically split between primary and secondary. Primary microplastics are plastics that were manufactured to be small in size. Secondary microplastics are plastics that have degraded from larger pieces to become smaller in size. Some microplastics ultimately find their way into wastewater; based on the limited studies undertaken on biosolids, it is thought that the main sources in biosolids are from tyres, fibres (from polyester, nylon and acrylic clothing – i.e. microfibrils), cosmetics and exfoliants (i.e. microbeads), certain industrial processes and fragmentation or degradation of larger plastics.

### **Microplastics in biosolids and other sources**

As with all aspects of microplastics, most of the data on occurrence is focused on the marine environment. Some studies have investigated the wastewater process, but these are limited and are not representative of the variations in wastewater and sludge treatment processes used in the UK. There is no doubt microplastics are present in wastewaters, but the available evidence suggests

Available from: <https://assuredbiosolids.co.uk>



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Nicholson, F., Gale, P., Hough, R., Jiang, Y., Kabir, M., Longhurst, P., Rollett, A., Taylor, M., Tompkins, D., Tyrrel, S., Sakranbani, R. and Williams, J.

