Management Considerations for Contaminated Land

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What is Contaminated Land?

Land is legally (UK definition) defined as ‘contaminated land’ where substances are causing or could cause:

- significant harm to people, property or protected species
- significant pollution of surface waters (for example lakes and rivers) or groundwater
- harm to people as a result of radioactivity or other substance

Land contamination can result from a variety of intended (and/or illegal), accidental, or naturally occurring activities and events such as hurricanes and floods.

Contaminated Land

Millions of hectares across the globe – no exact count. Land may previously have been used by:

- Manufacturing
- Mineral extraction (including historic abandonment of mines)
- Waste disposal such as land fill
- Refineries

However significant amount of contamination from release of hazardous substances and pollutants caused by Defense, conflicts and war which could include:

- discarded munitions
- munitions constituents
- unexploded ordnance
- building demolition debris

Contaminants

- Heavy metals, such as arsenic, cadmium and lead
- Oils and tars
- Chemical substances and preparations, like solvents
- Gases
- Asbestos
- Radioactive substances

Wider effects of Contamination

- Leach toxic chemicals into nearby ground or surface waters
- In dry areas, contamination in soil can be further distributed through wind-borne dust
- Human and livestock exposure

Remediation

Land remediation aims to restore land to:

- Its original state or
- An acceptable condition or
- A base standard to protect the environment, human health or buildings

by resolving or treating problems caused by contamination in soil, air and water.

Why remediate

- Environmental – sustainability, protection etc
- Social – access, proximity, ownership, culture etc
- Economic – resources, funding and tax relief etc

Remediation options

- Removal of site pollutants or contaminants such as soils, surface water, and groundwater
- Stabilisation of in-situ soils
- Containment of contaminated soils by the use of cover systems
- Many countries have regulatory standards
- Consider ongoing risks around land management

Very dependent on local budget, knowledge and resource

Issues particular to Agriculture and Horticulture uses

- Residual contaminants can be toxic to humans, animals and plants
- Some low levels of contaminants can affect fertility and other aspects of health
- Combinations can act additively or synergistically to perturb multiple physiological systems at all ages but particularly in the developing foetus
- Effects of exposure on the thyroid gland, immune, cardiovascular and obesogenic systems suggests that these systems can also be perturbed
- Increase crop uptake or soil ingestion by grazing livestock can ultimately lead to the transfer of zootoxic elements to the human diet

However, some of these are also necessary for living organism to survive – which is why livestock often suffer from ailments such as copper deficiency

pH levels

- Extractable concentrations of heavy metals are pH dependent
- In areas of mine spoil, zinc is usually found in conjunction with lead – though the presence of limestone (usually pH >7) reduces the phytotoxicity of zinc
- Can vary at different levels within the profile
- Therefore correct levels of pH will reduce risk of certain contaminants
- Not all cultures have access to the information or ability to address the issue

Recent issues in the UK

In 2008, a group of 50 dairy cows on a Shropshire farm was affected by lead poisoning caused by grazing near a lead mine – 14 cows showed signs of lead poisoning and 6 died.

In 2014, a group of 6 sheep died from copper toxicity due to escape onto nearby brownfield site.

In 2017, free range chickens bred for meat were rejected from the food chain after high levels of heavy metals were found in the offal.

Levels of Risk

- Some elements may affect plant growth – zinc, copper
- Generally, only a small portion of contaminants are taken up by the plant, thus forage is not the main source of toxicity in livestock
- Cattle ingest up to 18% of their dry matter as soil
- Sheep ingest up to 30% of their dry matter as soil
- Up to 80% of the lead, and 90% of the arsenic ingested by cattle on contaminated land is from soil ingestion
- Reworked/restored land does not always reduce the risk of toxicity and in some cases can increase the risk of toxicity (i.e. lead, copper)

Consider a hierarchy

Assuming the remediation is fit for purpose:

- Plants for non food use – fuel, building
- Plants for food use – livestock
- Plants for food use - human

Managing Risks

- Where the regenerated sward is close-knit, there is usually little to no risk of toxicity to grazing animals from soil ingestion
- Sparsely covered land is the biggest risk to grazing animals – increased chance of soil ingestion / higher amounts of soil ingested
- Soil contamination of food crops – encourage washing, peeling
- Potential for human toxicity from plants containing toxic elements

Minimising risk when restoring land

- Grassland is less demanding on soil than arable crops
- 90% of grassland roots in top 40cm of soil
- It is often more suitable for wetter and cooler sites where the growing season is shorter
- Grazing land needs to make use of suitable livestock (e.g., sheep, youngstock), and at a suitable stocking density
- A contingency plan to move livestock if signs of damage become apparent
- Secure fencing
- A water supply (not natural sources)
- Stock free periods

Ongoing Management Examples

- Maintain a dense sward that is not too short
- Manage grazing to prevent over-grazing
- Do not allow grazing on waterlogged land
- Keep animals away from bare areas of soil, e.g., fence them off
- Molehills (other soil burrowers are available!) cannot be controlled, but where they appear, try to flatten

Ongoing Management Examples

- Provide salt licks and mineral blocks – review supplements
- Do not allow livestock to access water that may be contaminated, such as natural pools of run-off water. Ensure clean water is provided in drinking troughs
- Calibrate mower height to minimise soil uptake when cutting for silage and hay or harvesting
- Applications of organic or chemical fertilisers should be considered carefully, only done so in accordance with the limits set out in agricultural guidance documents – soil testing is required pre-applications
- Ensure trace element applications are on need

Summary

- Risk from soil contamination depends almost entirely on the amount of soil ingested and the PTE levels in that soil
- Other factors which may alter the risk include:
  - Difference in element availability to stock
  - Type, species, age, and health of stock
  - Length of exposure to the contaminants
  - Provision of supplementary feedstuffs


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