The cultural ecosystem services of waste repositories

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Introduction

• NERC-funded INSPIRE: In situ processes in resource extraction (2014-2017)
• Can resource (specifically elements of value, E-tech elements and energy) be recovered by leaching and other treatments whilst the material lies in situ, thus avoiding the need to actively mine the material and thereby minimise environmental and social impacts?
• Cardiff (lead), UWE and Warwick
What are waste repositories?

- **Landfills:**
  - ≈ 2,600 licensed sites in England and Wales (28,000 ha)
  - ≈ 2,100 closed but 25,000 historic unlicensed sites

- **Mine wastes:**
  - ≈ 100,000 mines in England and Wales
  - 3619 closed metalliferous mine wastes sites in England and Wales

- **Ash wastes:**
  - 5.6 Mt PFA, 1 Mt FBA, 0.75 Mt IBA; ≈ 50% to landfill (Sanna et al., 2012)

- **Metallurgical waste:**
  - 1.25 Mt of steel waste (Teeside, South Wales, Kent)

<table>
<thead>
<tr>
<th>Area</th>
<th>Estimated mine waste area</th>
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</thead>
<tbody>
<tr>
<td>Northern and Southern Pennines</td>
<td>200-1000 ha</td>
</tr>
<tr>
<td>Lake District, Anglesey and Snowdonia</td>
<td>20-40 ha</td>
</tr>
<tr>
<td>Cumbria, South Wales and Forest of Dean</td>
<td>490 ha</td>
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<tr>
<td>Staffordshire and South Yorkshire</td>
<td>300 ha</td>
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</tbody>
</table>
Abandoned metalliferous mines and quarries in England and Wales

Polumbo-Roe and Colman, 2010
Land use on waste repositories

- Waste storage and...
- Development
  - Housing
  - Commercial/industrial
- Recreation and amenity uses
  - Community woodlands and greenspaces
  - Sports and leisure activities
- Tourism
  - Historic environments
  - Nature and geological conservation
Restored waste repositories

- Natural regeneration:
  - Species represent local environment
  - Site conditions allow unusual species to develop
  - Lack of disturbance
  - Lack of management
  - Takes many decades (or centuries) to develop

- Managed restoration:
  - UK Biodiversity Action Plan
  - Faster restoration than natural regeneration
  - In conjunction with the creation amenity value or detoxification
  - May lose some natural pioneer species
  - May result in homogenous habitats
Biodiversity on waste repositories

- Landfills:
  - Bird species richness greater than reference sites (Rahman et al., 2011)
  - Plant communities (Remon et al., 2005; Tarrant et al., 2012)
- Sand and gravel quarries:
  - Ground nesting birds (e.g. Thames Basin SPA)
- Mine sites:
  - Invertebrates, birds and mammals (e.g. lesser horseshoe bats)
  - Metal-tolerant plants and lichens, mosaic habitats of grasslands, wildflowers, orchids (Barnatt and Penny, 2004)
- Pulverised Fly Ash (PFA)
  - Plant assemblages
- Recognition and protection:
  - Calaminarian grasslands (Priority Habitats and SACs)
  - Open Mosaic Habitats on Previously Developed Land (Priority Habitat)
  - Two SSSIs: metallophytes, lichens
What are cultural ecosystem services?

- Amenity use
- Visual landscape
- Education
- Connection with historic environment

Figure 5: Relative importance of Broad Habitats in delivering ecosystem services and overall direction of change in service flow since 1990. This figure is based on information synthesized from the habitat and ecosystem service chapters of the UK NEA Technical Report (Chapters 5–10), as well as expert opinion. This figure represents a UK-wide overview and will vary nationally, regionally and locally. It will therefore also inevitably include a level of uncertainty; full details can be found in the Technical Report. Arrows in circles represent where there is high evidence for or confidence in the direction of service flow amongst experts; arrows in squares represent where there is less evidence for or confidence in the direction of service flow. Blank cells represent services that are not applicable to a particular Broad Habitat.

Source: UK National Ecosystem Assessment (2011a)
Factors that affect the ecological value and/or cultural ecosystem services

- Current land use
- Type of waste
- Age of waste
- Topography and aspect
- Restoration strategy (if any)
- Reworking
- Type of ongoing management
- Proximity to settlements
- Surrounding habitats (e.g. SSSIs, hedgerows)
Typology of waste repositories

• Will be developed from:
  • Further analysis of literature
    • Link factors with types of waste repositories
  • Spatial distribution
    • Waste repositories
    • Priority habitats, protected habitats
    • Settlements
• Mapped typology of waste repositories
• Test with stakeholder groups
• Refine
How we will use the typology

• Contribute to identifying which waste repositories to focus resource recovery on
• Identify the potential environmental and social impacts of resource recovery
• Inform the debate on the ecological value of waste repositories in the UK
• Inform the debate on the management of restored waste repositories
Acknowledgements and references

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