WHAT LIES BENEATH

Essex landfill: Two Tree Island

Forgotten for decades, historic coastal landfill is a sleeping problem that climate change looks set to disturb. What toxic waste lies buried along our coasts and – as sea levels rise and storm surges increase – what can we do to protect ourselves from it? **Karen Thomas** reports

On a blisteringly hot, blustery summer day, Two Tree Island is as lovely as any of the coastal marshlands dotted along the Essex coast, a tangle of buddleia and brambles rising from the cracked earth, boats bobbing on the horizon, seagulls cackling overhead.

But the harsh weather is strangely apt, given what hides beneath the ground. Waste items buried at Two Tree Island are rising out of the bone-dry mud; plastic bags, fragments of carpet, packaging from long-forgotten food brands, often contaminated with chemicals.

It's the same mix of waste dumped in hundreds of coastal sites across the country, before tougher regulations took effect in the 1990s. Nobody knows exactly what's buried at these sites, or how – if exposed to air and water – they could affect wildlife and public health.

From Two Tree Island car park, it's a short walk across the flats to Hadleigh Marsh, a waste-filled flood embankment, and to Leigh Marshes, a recreational area behind a flood defence. Both are built up from historic landfill.

Now, with climate change, rising tides and more frequent storms threaten to expose what lies beneath – with potentially nasty consequences. Climate change increases the risk of contaminants – buried metals, chemicals and plastics – washing into the estuary, where they can poison local wildlife, contaminate neighbouring beaches and enter the food chain.

STORM THREAT

Storms and rising seas have started to reshape the English coastline. Coastal managers would like to utilise more cost effective and sustainable policies such as managed realignment – surrendering the land to the sea – but the presence of coastal landfills makes them more likely to select conservative management policies such as hold the line.

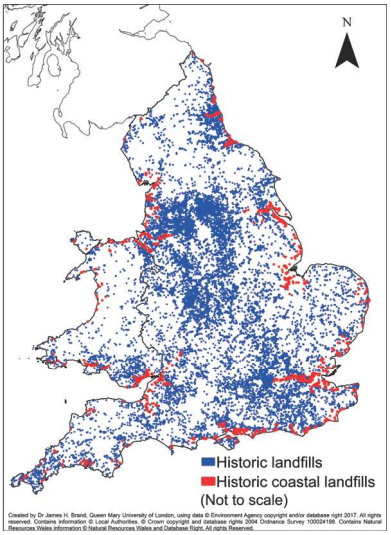
Queen Mary University of London researcher James Brand is an expert on historic coastal landfill. "There are more than 1,200 low-lying historic coastal landfill sites around England and typically there are no detailed records of their contents as they predate 1990s and 2000s legislation that require such records to be kept," Brand says.

"Most are concentrated around our major estuaries – the Humber, the Thames, Portsmouth and Southampton. Although many are protected by flood defences, in some locations the landfills form the flood defence."

Brand has studied the impacts of coastal erosion and ingress of saltwater at these sites. He concludes that Leigh Marshes, dating back to the late Fifties, is far more contaminated than Hadleigh Marsh, created in the Eighties. Erosion of waste materials from either site would probably have adverse effects on flora and fauna in neighbouring Natura 2000 sites, due to their concentrations of heavy metals and hydrocarbons.

But because the older buried waste looks more like soil, the threat from heavy metals, hydrocarbons and industrial ash it contains is not obvious to the untrained eye. Brand's research at Leigh Marsh suggests that salt water could release around 5,000 per cent more of some soluble heavy metals from buried landfill than fresh water.

That said, there is a lot of variability within, as well as between the sites, because what is dumped is so haphazard. What is also not clear – because it needs more research – is how broken-down contaminants and leachates will behave on entering the estuary. Queen Mary University of London researcher Francis O'Shea has surveyed the local saltmarshes, recording numerous



leachate plumes extending from historic coastal landfills.

Brand has developed a methodology to determine which of the 1,215 historic coastal landfills in England present the greatest environmental threat. This will help coastal managers to work out priorities and funding to maintain, improve or relocate these sites.

The likely scale of the costs points to mitigation programmes being rolled out over many years. Brand estimates that it could cost £23 million-£30 million in landfill taxes alone to relocate even a small site such as Hadleigh Marshes. He wants to use existing data sets to develop new ways to assess risk, to work out which historic coastal landfills face the greatest threat of coastal erosion, what waste materials they contain and which sensitive habitats and waterbodies this will threaten.

RETHINK

The threat of contamination persuaded the Environment Agency to rethink its plan for managed realignment at Hadleigh Marsh during the development of the Thames Estuary 2100 Plan and to decide instead to hold the line. But coastal managers will have to make similar decisions the length of the English coast, weighing the costs of defending it against the contaminants not doing so could expose.

Brand's proposed risk assessment considers the likely rate of erosion of the given site, how protected it is, what lies under its surface, how quickly that is likely to emerge, and the proximity of receptors in order to rank sites by relative risk. He's tested the approach using eight pilot sites in Essex and identified gaps in knowledge to address to allow the methodology to be refined.

Earlier this year, Natural Environment Research Council (NERC) put out a call for proposals for eroding coastal landfill research, making available up to £4 million. Queen Mary University of London, Southampton University and others have formed a consortium, hoping to secure up to half of that funding to address these gaps in knowledge and create new risk-assessment standards.

Another issue is that funding for coastal flooding defences puts homes and businesses first. There are limited funds to defend contaminated sites. The evidence suggests that – without intervention – 10 per cent of England's 1,200 historic coastal landfill sites will have started to erode, come 2055.

Half of England's historic coastal landfills are in or near areas affecting bathing water quality but, to Brand's knowledge, no one has investigated the public-health impacts of exposing historic waste materials on that kind of scale. "We need a better understanding of the environmental impacts if historic landfills erode and how best to manage them," he concludes. "The sheer number of these sites means it will be impossible to defend them all indefinitely and it is likely we will need to make the difficult decision to allow some to erode into the sea.

"The faster sea levels rise, the more frequently these sites will flood, increasing the risk of erosion or catastrophic failure of capping materials, which would result in uncontrolled release of waste materials into estuarine and coastal environments."

James Brand is a research fellow at Queen Mary University of London and a chartered member of CIWEM since 2011. For more information, visit www.jameshbrand.com

BELOW THE SURFACE

THE WASTE EXTRACTED from Hadleigh Marsh landfill for analysis had the appearance of present-day waste before separation for recycling, consisting of plastics, ceramics, textiles – shoes, carpets, clothes, paper, wood, batteries, soil, predominantly clay, and putrescible materials.

The waste extracted from Leigh Marshes landfill for analysis was composed predominantly of a brown and black, fine-grained particulate matrix interspersed with broken bricks, glass, ceramics, and small quantities of paper, rubber, bones, plant materials and wood

There are no specific standards or guidelines for assessing the pollution risk from eroded landfill waste. So, on the assumption that any eroded solid waste materials will ultimately break down and become incorporated into sediments, Brand compared contaminant concentrations in the waste samples to Canadian Sediment Quality Guidelines, which are commonly used in the absence of UK sediment-quality guidelines. Contaminant concentrations in the materials analysed from both sites generally exceed these sediment-quality guidelines, indicating that if waste erodes there may be a significant threat to nearby designated habitats.


Landfill waste embedded in a cliff and exposed due to coastal erosion

HISTORIC COASTAL LANDFILL
TIME TO CLEAN UP OUR ACT

How does the UK tackle historic coastal landfill, to ensure that rising seas and storm surges don't expose buried waste that could contain contaminants that threaten future generations? **Mark Stratton** sets out his thoughts

Landfill has been the foundation of UK waste management for more than a century. Since the 1920s, controlled tipping at the coast reflects how we have devalued the natural environment. Historically, using the coastal zone was seen as a way to dump our waste and to reclaim land for other uses.

The UK has some 1,200 historic coastal landfill sites at risk of coastal erosion and flooding, as James Brand outlines overleaf. Vast amounts of waste and associated pollutants could be released into the marine environment from these sites, particularly where existing coastal defences are ageing or were never built.

It may be difficult to predict levels of flooding and erosion of these sites over the next century, but climate change and sea-level rise significantly raise the risks.

What, as a nation, are we doing about this legacy issue? Four points are critical.

- Is it safe to assume that monitoring and management of old landfill sites, including in coastal areas, is simply a matter – under the 1990 Environmental Protection Act – for local authorities?
- Part 2A of the act allows local authorities to carry out remediation where there is an unacceptable risk to human health or controlled waters, and to recover the costs from those considered liable. More often than not, though, the original polluters are long gone – or the authorities themselves laid down this waste in previous decades. Do Part 2A powers go far enough to solve the problem?
- Can we be certain, given the scale of the problem and given the Environment Agency's regulatory role and pollution-control powers, that we can minimise, remedy or mitigate potential pollution from these sites?
- Given that the government's 25-year environment plan pledges to leave our environment in a better state than we found it – and given growing public interest in preventing waste entering the marine environment – can we assume that government has set aside a funding pot to deal with this problem?

It is difficult to answer any one of these points confidently or with conviction. However, we have seen excellent work around the country to try to address them and some outstanding academic and practitioner research to determine the scale of the problem and how to tackle it over the coming decade.

How do we approach the next decade, let alone the next year, when no option is currently affordable or sustainable, given the number of landfill sites

INITIATIVES

Recent examples include a 2016 Eastern Solent Coastal Partnership (ESCP) study for four south coast local authorities. This flagged up the need to fund protection of former coastal landfill sites, particularly where shoreline management plans (SMP) recommend holding the line – but where, despite the risks, no flood and coastal erosion risk management (FCERM) funding mechanism exists. ESCP then raised this with the Southern Coastal Group and the National Coastal Group Chairs Network.

Another example is Queen Mary University PhD candidate James Brand's 2017 PhD thesis, Assessing the risk of pollution from historic coastal landfills, which provided sound evidence for the pollution risk that this national issue presents.

Last year, the Standing Conference on Problems Associated with the Coastline (SCOPAC) commissioned ESCP to analyse the scale of the problem on the south coast, with additional funding from the Southern and Wessex Regional Flood and Coastal Committees (RFCC) and the Local Government Association Coastal Special Interest Group.

The findings reveal 144 coastal landfill sites along the 750 km shore between Lyme Regis and Shoreham-by-Sea. Of these, 75 per cent had hold-the-line SMP policies but no obviously accessible funding mechanism to protect them. The cost of protection was estimated at £200 million, or £1 billion to move the sites, as "new" landfill is taxed at £100 per sq m. Apply that to 1,200 sites in England and Wales and the funding implications are eye watering.

Last year, Southampton University led the Natural Environmental Research Council (NERC)-funded research project, Coastal landfill and shoreline management: Implications for coastal adaptation infrastructure. This sought to understand the management-response options available to tackle our national issues, and reflected and built on CIRIA report C718, Guidance on the management of landfill sites and land contamination on eroding or low-lying coastlines.

This year, the Southern RFCC chair flagged the matter to the national chairs to raise the issue's political profile. In response, the Environment Agency set out the national picture to the RFCCs. This led to correspondence about how central government ministers, Defra and senior Environment Agency are addressing the issue.

ACTION

So what needs to happen next? The scale of national political interest is welcome, academic research is clarifying the options for management response and the practitioner-led investigations are highlighting the likely scale of the costs.

Yet the status quo remains; no funding, no resolution and – in some extreme cases – coastal landfill sites already releasing waste into the natural environment.

That leaves coastal managers with difficult decisions to make to reduce the risks of pollution. Doing nothing is not morally sound; maintaining or replacing ageing sea defences is impossible without central funding and austerity has eroded local authority budgets. The scale of costs reduce to a pipedream the prospect of treating and removing the waste before it gets eroded.

The threat from erosion of contaminated coastal landfill is a collective responsibility that we need to address now

How do we approach the next decade, let alone the next year, when no option is currently affordable or sustainable, given the number of landfill sites. Complexities regarding who owns the risk and who should pay for it and long timescales for policy and funding reviews are not helpful. Nor is blaming previous decision makers.

I wonder what future generations will make of our decision making on this matter?

There may be no obvious funding solution, but that does not eliminate the benefit in protecting the sites from erosion and flooding. Rather, our funding system is not yet configured to account for the economic benefits from avoiding damage from former coastal landfill. However, protecting the Water Framework Directive status of water bodies, preventing pollutants entering coastal habitats and reducing risks to human health are equally important drivers for FCERM and for wider society.

Over the past few years it has become more widely accepted that we should look to FCERM schemes to deliver benefits beyond flood and erosion risk mitigation, to act as catalysts for broader outcomes – improving the public realm, regenerating our coasts, enhancing the environment, recreation and tourism and our mental health and wellbeing.

Reframing how we see our coastal projects and how we fund them will be key to solving the risks from coastal landfill. Protecting them and repurposing them as safe public spaces presents a win-win for society and for the natural environment.

But it is encouraging that this legacy issue has now moved into the spotlight and, despite the limited opportunity without a clear funding mechanism to remediate the immediate risks, the UK is finally taking the issue seriously.

Academic and practitioner institutions are applying for new NERC funding to better understand the risk and impacts of doing nothing. The Environment Agency is developing a funding proposal for the 2019 spending review to study the extent of the issue, working with local authorities to support pressing issues. The RFCCs are providing local levy funding to progress small-scale practical solutions to protect key at-risk sites. Defra's FCERM Policy Statement is due in 2019/2020 and a review of FCERM funding policy in 2021. All that gives us cause for hope.

Because it really doesn't matter which act allows which organisation to respond, or what funding mechanism we can use, or who administers it. The threat from erosion of contaminated coastal landfill is a collective responsibility that we need to address now.

To clean up our act over the next decade and avoid risking the health of future generations and the natural environment, organisations must act together creatively, to erode the political and regulatory barriers, to tackle this legacy issue of managing our waste at the coast.

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