The Environment

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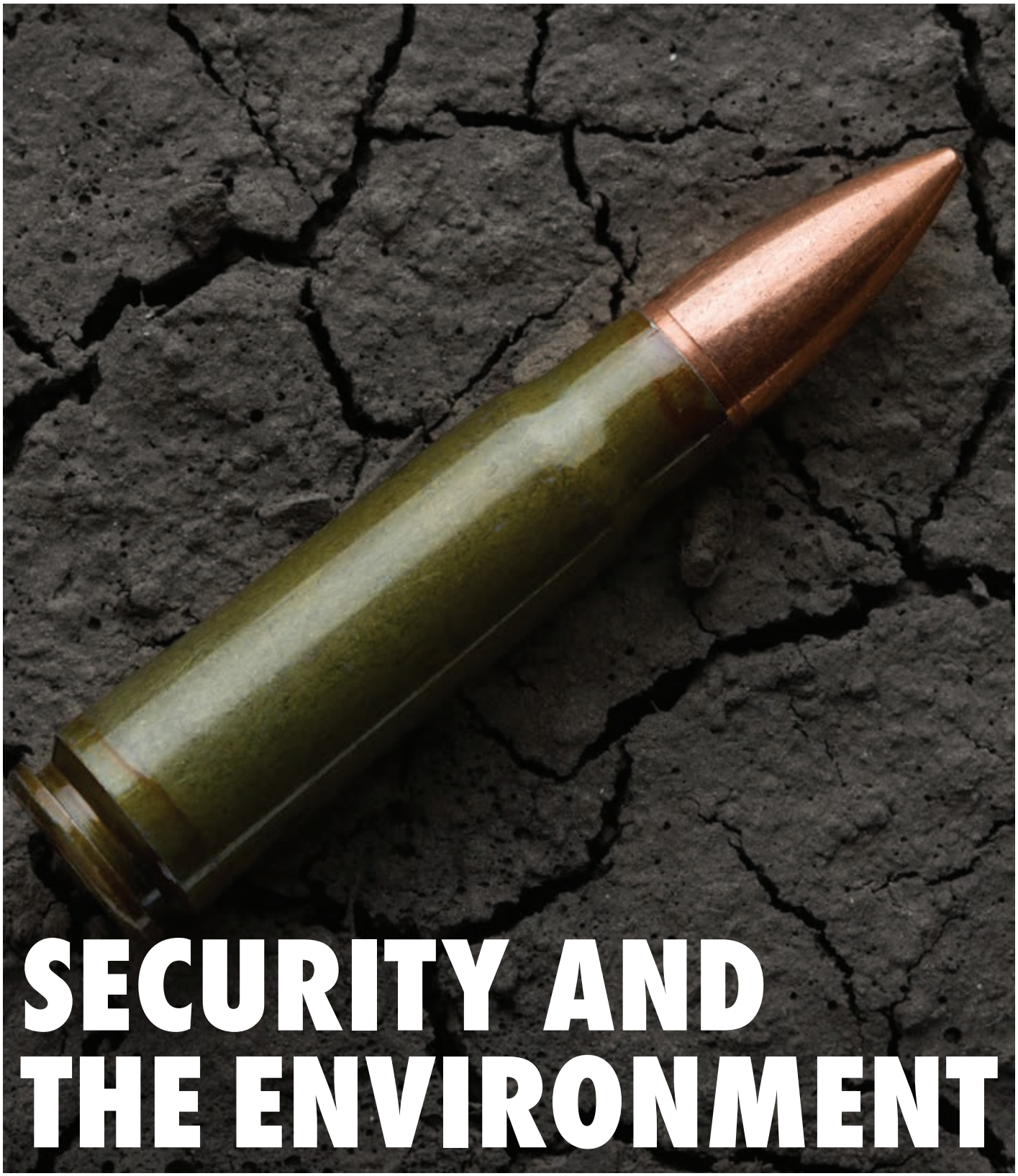
CIWEM



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COVER IMAGE: PENNY DIXIE

Taking the heat

A HEATWAVE HAS GRIPPED northern hemisphere countries this summer. Japan veered within weeks from torrential floods to declaring a natural disaster as the mercury hit 40°C. Europe sweltered, too, with forest fires breaking out from Greece to South Wales. And UK utilities NI Water and United Utilities introduced hosepipe bans.

Experts disagree over how far we can blame climate change for this summer's carnage. But climate change is on policy makers' minds. The United Nations' Intergovernmental Panel on Climate Change (IPCC) report expects global warming to top 1.5°C by 2040, according to a draft leaked to the press this summer. It warns that a 2°C increase would have a devastating impact on coastal communities and on economic growth.

In July, the UK government published its National Adaptation Programme, outlining how to cope with climate change to 2023. It spells out the "high risks" to UK communities, businesses and infrastructure from flooding and coastal erosion and calls for partnerships to tackle flood risk and to make homes, businesses and infrastructure more resilient.

But critics say the NAP does too little to prepare the UK to cope with extreme heat.

Governments face growing pressure to do more to tackle climate change and to meet their carbon targets. Earlier this year, the European Commission took legal action against the UK and five other governments for doing too little to tackle illegal air pollution.

And Friends of the Earth Ireland has filed a climate-change lawsuit, accusing the government in Dublin of doing too little to meet its targets as the country's emissions increase by nearly 10 per cent over 1990-2020. The case comes to court in January.

This emulates a successful Dutch case three years ago, when a court in The Hague ordered the government to cut its emissions by at least 25 per cent within five years.

Climate campaigners are increasingly putting their faith in the courts.

Twenty-one young US campaigners will have their day in court in Oregon next month. The plaintiffs, aged 11-22, are suing the federal government for violating their rights, having known for decades that carbon pollution poisons the environment and doing nothing about it.

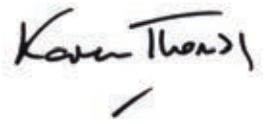
Ireland's former president turned climate-justice campaigner Mary Robinson told a London event: "Governments are afraid to put the facts about climate change on the record. But governments cannot lie in court, so to get this kind of discussion in court is, in itself, very powerful."

Recourse to justice is a recurring theme in this month's op-ed feature.

We asked seven leading thinkers what powers the proposed UK environment regulator needs to hold our government to account, post-Brexit. High standards and the legal recourse to enforce them, came the consensus.

Or as Wildlife and Countryside Link director Elaine King concludes: "With no treasure more valuable than the environment, it's essential to have a pit-bull to defend it."

Karen Thomas
Editor, *The Environment*
@KT_environment



BEAST FROM THE EAST: OFWAT REVIEWS COMPENSATION PAY-OUTS

OFWAT MAY CHANGE the rules on how water firms compensate customers for supply cuts, having reviewed how the industry handled this winter's freeze-thaw due to the snowstorms known as the Beast from the East that hit the British isles in February and March.

More than 200,000 customers lost supply for more than four hours during the storms. Tens of thousands struggled for several days with no water supply.

Although the water companies paid customers £7 million in compensation, Ofwat says the sum fails to reflect how events on this scale affect customers.

Ofwat has opened a consultation to review the guaranteed standards scheme (GSS) through which water firms compensate their customers. The regulator has given four water firms – Severn Trent, South East Water, Southern Water and Thames Water – until September 28 to publish an externally assured action plan, showing how to tackle such problems in future. Ofwat says it has "substantial concerns" over how the four water firms responded to the storm and over the sheer number of customers that lost supply for more than four hours. It has written to all the water companies in the country, outlining the areas they must review by September 28.

Weather forecasters warned that the Beast from the East was about to hit the UK. Although some water companies prepared well, Ofwat says others planned poorly and communicated badly with their customers. Three-quarters of affected customers received no alternative water supply.

Many were left to fend for themselves, or received help only from local groups and volunteers.

Industry body Water UK will co-ordinate better planning for extreme storms. This includes sourcing and distributing bottled water and sharing best practice on possible emergency response. Water UK will publish these findings at the end of the month.

Ofwat said: "Losing water supply can cause huge disruption to people's lives and livelihoods. Water provision is fundamental for everyday life. When that supply is cut off, it is not long before the basics become difficult.

"You cannot flush the toilet, wash, clean clothes or have a drink. If you are sick, elderly or disabled, this can affect your health and cause real distress and worry. Businesses cannot operate and people lose money.

"When that supply goes off for days, those impacts become exponentially worse. The rapid thaw that followed the Beast from the East... caused significant disruption to a large number of water customers."

However, the regulator praised water companies' frontline staff, who worked "tirelessly" to help irate customers.

WHAT WE'VE LEARNED FROM THE STATE OF THE ENVIRONMENT PAPER

9,500 BILLION LITRES OF FRESH WATER ABSTRACTED IN 2016

£1 BILLION+ VALUE OF FRESHWATER ABSTRACTION, 2015

£1 MILLION VALUE OF FISH CAUGHT IN INLAND UK WATERS, 2015

£303 MILLION VALUE OF TIME SPENT AT FRESHWATER HABITATS, 2015

140 LITRES ENGLAND'S AVERAGE DAILY PER CAPITA WATER CONSUMPTION

3 BILLION LITRES OF WATER LOST TO LEAKAGE DAILY

20% OF ENGLAND'S WATER LOST TO LEAKS

90% OF ENGLAND'S WETLANDS LOST SINCE ROMAN TIMES

28% OF GROUNDWATER BODIES HAVE UNSUSTAINABLE ABSTRACTION RATES

18% OF SURFACE WATERS HAVE UNSUSTAINABLE ABSTRACTION RATES

6%-15% OF RIVERS FELL SHORT OF "GOOD" ECOLOGICAL STATUS DUE TO OVER-ABSTRACTION

2,500MM AVERAGE ANNUAL RAINFALL, THE LAKE DISTRICT

200MM AVERAGE ANNUAL RAINFALL, EASTERN ENGLAND

53 MILLION ENGLAND'S POPULATION, 2011

58.5 MILLION ENGLAND'S POPULATION, 2026

2050 "SIGNIFICANT WATER DEFICITS" IN MANY PARTS OF ENGLAND

SOURCE: ENVIRONMENT AGENCY, STATE OF THE ENVIRONMENT: WATER, 2018

Angelsharks: extinct in the North Sea

MICHAEL SEALEY/ZSL

PICTURE THIS...

WANTED: ANGELSHARKS OFF WALES

WALES HAS LAUNCHED a conservation project to save the angelshark, one of the world's most endangered species of shark, now extinct in the North Sea but more widely seen off the Welsh coast.

Zoological Society of London (ZSL) and Natural Resources Wales have launched the Angelshark Project Wales. They want fishermen and women, divers, sailors and schoolchildren to share community memories and report sightings and accidental catches of this critically endangered fish.

Squatina squatina grows to around 2.5m and has fins like wings. Angelsharks live mainly on the seabed, feeding on molluscs and small fish. That habitat makes them particularly vulnerable to trawlers.

The project will gather data from fishing and coastal communities, historical research and citizen science surveys in North Anglesey and the Llyn Peninsula, and between Porthmadog and Aberarth, Fishguard and Milford Haven and Swansea and Porthcawl.

Report your sightings at: http://angelsharknetwork.com/#map

REPORT HIGHLIGHTS 2°C CLIMATE RISKS

GLOBAL WARMING MAY increase by 1.5°C as early as 2040, while a 2°C increase in climate will threaten communities, ecosystems and economic growth, according to a United Nations report leaked this summer.

The draft report from the Intergovernmental Panel on Climate Change (IPCC) warns that global warming to the upper limit agreed in Paris will have "rapid and far-reaching" effects on the world economy.

The IPCC is studying the difference between the 1.5°C and 2°C targets to create a blueprint for combating climate change. It will publish its findings in October.

Staying within the 1.5°C limit would require a 60 per cent increase in renewable energy from 2020-2050, to supply 49 per cent-67 per cent of world energy, and primary energy from coal would need to drop by two-thirds, the report says.

According to the draft, temperatures have already risen around 1°C and are on course to rise by 0.2°C every ten years. Climate change increases risks of storms, heatwaves and floods. The report spells out a 10cm difference in sea levels in warming levels of 2°C, compared with 1.5°C. That 10cm difference exposes 10 million more people to floods, storm surges and damage to crops from salt spray – particularly in coastal communities.

Flooding and droughts linked to higher rates of warming have an economic impact, the report warns: "Economic growth is projected to be lower at 2°C warming than at 1.5°C for many developed and developing countries."

Countries that signed up to the Paris Agreement are working to limit climate change to a 1.5°C increase. But the report says the pledges are too weak to achieve that outcome. And last year, US president Donald Trump withdrew from the Paris Agreement, seeking to promote fossil-fuel production at home.

SONS/FLICKR

‘NORTHERN IRELAND CANNOT BE THE UK’S POOR RELATION, POST-BREXIT’

Northern Ireland Environment Agency chief executive **David Small** is drafting a plan for the environment. But political deadlock could push back its release. **Karen Thomas** reports from Belfast

The collapse last January of Northern Ireland’s power-sharing government has day-to-day consequences for officials such as David Small. Stormont has not sat since January 2016, leaving Northern Ireland’s civil servants in limbo.

Mr Small, one of five deputy secretaries within Northern Ireland’s Department for Agriculture, Environment and Rural Affairs (DAERA), is also chief executive of the Northern Ireland Environment Agency (NIEA).

A judicial review this summer ruled that Northern Ireland’s Department for Infrastructure overstepped the mark in approving without ministerial sign-off a proposed incinerator project north of Belfast. The department took the case to the Court of Appeal in July and was over-ruled. The energy-from-waste project is now on hold.

Speaking to *The Environment* ahead of that ruling, Mr Small hoped the court would clarify what authority civil servants hold, given the power vacuum.

Not much, is what the ruling implies.

This is taxing for civil servants as the clock ticks for the UK to leave the European Union (EU). “With Brexit, there are difficult decisions ahead for Northern Ireland, in terms of our policy direction for the environment and for fisheries,” Mr Small says.

“We face some very big decisions in Northern Ireland and when we reach a decision point I foresee difficulties. We have issues around what our agricultural and fisheries policies should be, and about our future environmental policies.

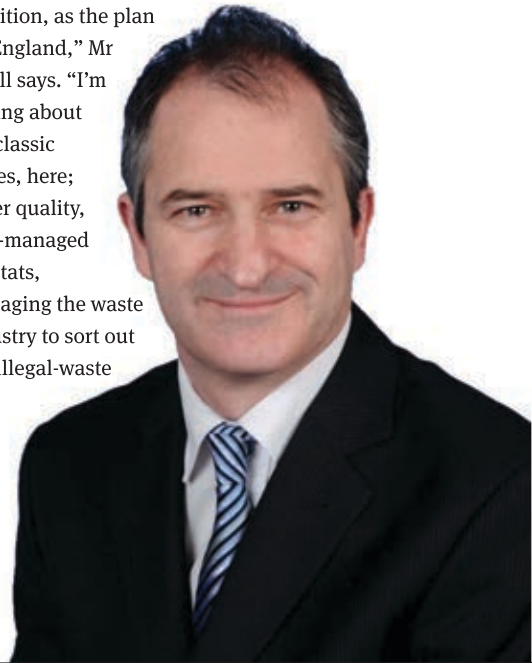
“England now has its 25-year plan for the environment. We are working on a similar plan for Northern Ireland – but we can’t take soundings from ministers. We should be sitting down to talk about what we should and should not do – and that’s a frustration.

“There are other policy issues, too, such as the impact of plastics on our oceans. If we had a minister in place, I would be talking to them about how we respond to this in Northern Ireland.

“We all hope we will have our assembly back soon.”

AMBITION

So what are Northern Ireland’s priorities for the environment? “I would hope our plan is at least as strong, in terms of ambition, as the plan for England,” Mr Small says. “I’m talking about the classic issues, here; water quality, well-managed habitats, managing the waste industry to sort out our illegal-waste



problems, air quality – these are issues in common with our neighbours, that have previously been driven by EU directive.

"No minister would want Northern Ireland to become the poor relation within the UK in stewarding the environment. We need to develop our own thinking. But in all those areas, we want to be as passionate as any of our UK partners."

Household waste is one priority. The latest figures suggest that Northern Ireland recycles 47.1 per cent of its household waste. As Northern Ireland works to meet EU targets to recycle half its household waste by 2020, it is running out of landfill space.

Water quality is another. Just 37 per cent of Northern Ireland's water bodies have "good" status under the EU Water Framework Directive. Northern Ireland has set itself a target to improve this to 70 per cent by 2021.

"We are thinking about all these issues now," Mr Small says. "But it falls to ministers to decide what balance we strike between our environmental responsibilities and economic growth."

Agriculture generates 1 per cent of UK GDP but 3 per cent of GDP in Northern Ireland. Northern Ireland policymakers have much closer ties with rural society – and its farmers, arguably, have more political clout.

But livestock farming generates a disproportionate amount of greenhouse-gas emissions. And these are a pressing concern.

As the UK shifts from fossil fuels to renewables, Northern Ireland still relies on coal, gas and oil for most of its energy generation.

"We should recognise the progress being made," Mr Small says. "For the 12-month period April 2017 to March 2018, 35.2 per cent of our electricity consumption was generated from renewable sources located in Northern Ireland.

"Notable examples of local investment in solar energy include Dunore water-treatment works, Dale Farm's site at Cookstown and Belfast International Airport, which is reducing the cost of energy and greenhouse-gas emissions."

However, DAERA must do more to promote alternative energy and to tackle greenhouse-gas emissions, Mr Small acknowledges.

REGULATION

Critics say positioning the NIEA within DAERA gives the agency less independence than the Environment Agency, its counterpart in England. Others say its fines are too lenient to prevent repeat offenders, particularly polluters of seas and rivers, something Mr Small has pledged to tackle.

The structure makes sense for administration and for policymaking, Mr Small counters. "I don't see it as a big disadvantage; we manage our respective roles well."

The NIEA has two divisions. The first focuses on the natural environment, looking after parks, designated sites and wildlife. It administers a £2.5 million-a-year fund, allocated over three years, to support non-governmental organisation partnerships to deliver the department's priorities.

"England now has its 25-year plan for the environment. We are working on a similar plan for Northern Ireland – but we can't take soundings from ministers"

The second focuses on water management, pollution prevention, and includes the Drinking Water Inspectorate. There is also a strong focus on resource efficiency, including waste management. It handles regulation and permitting, and its environmental crime unit tackles flytipping and illegal landfill sites.

The agency is working to support Northern Ireland Water's infrastructure-investment plans, upgrading its plants and treatment works. It is also piloting an environmental farm audit scheme, to encourage more sustainable practices. This invites farmers to request audit visits, seeking to improve efficiency, cut costs and protect biodiversity.

DAERA has expanded Northern Ireland's College of Agriculture Food and Rural Enterprise (Cafre) Knowledge Advisory Service to advise farmers on environmental affairs, including nutrient management and rules on when, where and how often farmers apply nitrogen.

And beyond Northern Ireland, the NIEA is working with its counterparts in the Republic and in Scotland under an Interreg Europe scheme to identify and tackle water-quality problems, particularly from diffuse pollution, and to promote biodiversity.

"It could take three or four years to see benefit from these kinds of initiatives," Mr Small concludes.

NIEA, AT A GLANCE

Created in the 2016 restructuring of departments within Stormont, Northern Ireland's Department for Agriculture, Environment and Rural Affairs (DAERA) fuses the former departments of environment and of agriculture and rural development.

As chief executive of the Northern Ireland Environment Agency (NIEA), David Small leads a team of 700, working on the environment and marine and fisheries interests. He joined the agency in 2016.

Within the department, three other units cover animal health and veterinary services, food and farming and central administration. The department has recently established a fifth group, initially leading on rural affairs, forest service and estates transformation.

This will provide the department with greater capacity to handle Brexit, although critics claim this is taking up too much management time and energy.

The NIEA underpins DAERA's mission statement; to support a living, working, active, landscape valued by everyone.

"I sit down a couple of times a year with my counterparts from Scotland, England, Wales and Ireland to share thoughts about the challenges and issues we face," Mr Small says. "When we do meet, we turn out to face very similar challenges, around illegal waste – and we all have challenges regarding intensive agriculture.

"Then, of course, there are issues around climate change – introducing ways to deal with greenhouse-gas emissions. We all have issues about managing the budgets we have, but then there's also Brexit uncertainty. Brexit has created a whole new level of work for us, in terms of how we plan and organise our exit from the European Union.

"The main challenge in Northern Ireland is uncertainty over how we exit the EU – and what that means for a department whose activities have been managed under EU directives for the last 40 years.

"And the real issue is uncertainty over the direction in which we will go, given the political vacuum in Northern Ireland."

KAREN THOMAS

Walls talk: the environment is on Ireland's agenda

NORTHERN IRELAND: BREXIT'S GROUND ZERO

As the UK prepares to leave the European Union, nowhere are the environmental stakes higher than in Northern Ireland, where decisions about borders have a direct impact and where political impasse and fiscal uncertainty are creating widespread unease. **Karen Thomas** reports

In June, CIWEM's Urban Drainage Group drew delegates from the Irish Republic and from across Northern Ireland to Newry for its summer conference.

Delegates and speakers discussed urban drainage, based on case studies from projects from Dublin to Belfast that showed how a sustainable approach can benefit the environment in our towns and cities, and reduce the risk of flood.

Newry was a pertinent choice of venue, a border town equidistant to Dublin and to Belfast that will also become a frontier town, post-Brexit. When the UK leaves the European Union, Northern Ireland becomes the border country. And nowhere has debate been more heated about what form the EU/UK border should take.

NGOs want to consider the island of Ireland "a single biogeographic unit" and to find ways to resolve and manage cross-border environmental issues and prevent unfair competition, post-Brexit

Northern Ireland voted 56 per cent to 44 per cent to stay in the EU. Analysts variously attribute this to EU membership having eased and opened up north-south relations, to a disconnect from Westminster and its decision-making priorities and to dependence on Brussels for structural funding and subsidies.

The Environment visited Northern Ireland at a time of widening political fissures, in Westminster with the UK government struggling to finalise its divorce from Brussels, and at home, where political impasse and summer heat stoked traditional marching-season tensions this July.

Northern Ireland has endured a year-and-a-half power vacuum, following the collapse of the government at Stormont.

Stormont stopped sitting after a row over failed green initiative the renewable

heat incentive (RHI) scheme, now infamous as the so-called cash-for-ash scandal. The failed scheme is reported to have cost the taxpayer £500 million.

The RHI scheme paid applicants to use renewable energy – but at a rate higher than the fuel price, as Stormont failed to introduce cost controls. A scheme to switch Northern Ireland to greener energy ended up paying people to heat their properties.

Democratic Unionist Party (DUP) leader Arlene Foster led the RHI scheme as minister for enterprise, trade and investment. By the time the scandal broke in November 2016, she was first minister. In January 2017, the late Sinn Fein leader Martin McGuinness resigned as deputy first minister in protest.

Under the power-sharing agreement, his resignation removed Ms Foster from office and brought down Northern Ireland's executive office.

DEADLOCK

With their political bosses effectively on leave on full salary, civil servants cannot make planning decisions. In July, the Court of Appeal ruled that Northern Ireland Department for Infrastructure officials overstepped the mark in approving without ministerial sign-off a planned incinerator at Mallusk, north of Belfast.

At the time of writing, attempts to restore a power-sharing government had failed. Dublin and Westminster were planning to reconvene the British-Irish InterGovernmental Conference (BIIGC) – the consultative body that the Good Friday Agreement created – in late summer, seeking a deal to break the deadlock.

Protracted Brexit negotiations have only prolonged the agony. Northern Ireland now has no voice of its own at these talks, yet its porous 300-mile land border forms Brexit's front line.

The so-called backstop border option would maintain borderless trade between Northern Ireland and the republic, post-Brexit.

However, Theresa May's government wanted to maintain regulatory unity between Northern Ireland and England, Scotland and Wales. That would require either a new Customs partnership with Dublin or border checks using cameras or sensors – something critics say is costly and time-consuming. During his tenure as UK foreign secretary, Tory MP Boris Johnson even dusted off a proposal to build a land-bridge between Larne in Northern Ireland and Portpatrick, Scotland, connecting into the HS2 rail link.

Spanning less than 30 miles, the bridge would cost some £15 billion. Money aside, the project would have to tackle deep seas stuffed with dumped Second World War munitions.

Ireland's environmental groups, north and south, are united in their concerns about borders.

Local NGOs say Brexit opens up a raft of new problems, cross-border, from river pollution to fly-tipping. "And in Northern Ireland we'll lose access to the European Court of Justice to tackle any of it… The polluter-pays principle is going to be a big issue for us," says an RSPB spokesman.

This is doubly true, as Northern Ireland has no independent equivalent to the Environment Agency. The NGOs say that being part of the executive puts the Northern Ireland Environment Agency (NIEA) under far too much political pressure from industry lobby groups.

There are questions in particular about fines – and whether these are high enough to deter repeat offenders, in particular farmers who pollute rivers.

Northern Ireland's so-called cash-for-ash renewable-energy scandal is reported to have cost the taxpayer £500 million

PRIORITIES

But borders aren't the only problem. This summer, Westminster launched an enquiry into how withdrawing from the European Union's Common Fisheries Policy will affect Northern Ireland sea fisheries, which employ nearly 1,000 people. This will shape everything from export tariffs to sustainability, and the way Northern Ireland manages its fisheries and fish stocks.

If Northern Ireland's environmental groups are deeply unsettled by Brexit, the picture is more nuanced than Brussels, good; Westminster, bad.

Nature Matters NI, the coalition of environmental NGOs, told a Commons enquiry at Westminster this spring that the Common Agricultural Policy and UK policies have encouraged overproduction at the expense of habitat and wildlife. It describes direct EU subsidies to farmers as "inefficient and ineffective and inequitable".

The NGOs have called for public funding for farming to be maintained for ten years after Brexit, but to channel more money into schemes to promote biodiversity.

Nature Matters NI has called for:

- A sustainable policy for agriculture and land use that is fair to farmers, good for nature and benefits Northern Ireland society
- A nature-friendly marine and fisheries policy to protect the seas and marine biodiversity
- Protection for nature and the environment
- Funding for conservation to replace lost EU funding
- To consider the island of Ireland "a single biogeographic unit, with effective mechanisms to resolve and manage cross-border environmental issues and to prevent unfair competition, post-Brexit".

It wants Westminster to deliver a 25-year plan for the environment for Northern Ireland, similar to that for England. It says this would offer a long-term blueprint, covering everything from flood defences to protected wildlife habitats, and from air pollution to paying farmers to promote biodiversity.

Privately, however, some NI Matters members question whether England offers the best available model – or whether the Scottish government presents more ambitious objectives.

Either way, Northern Ireland needs its own environmental plan, as Nature Matters NI and RSPB spokeswoman Emily Hunter says: "Northern Ireland has a unique and beautiful environment, home to more than 20,000 different species, including threatened pine marten, red squirrels and the cryptic wood white butterfly… [but] we've seen a greater loss of biodiversity than any other region of the UK.

"We don't want to lag behind the rest of the UK when it comes to protecting the environment and it's vital that we continue to work together as we leave the EU, given that nature doesn't respect borders."

FOUR WAYS TO AVOID A DIRTY BREXIT

Laurence Tubiana: leading the transition to a greener economy

French diplomat and environment campaigner **Laurence Tubiana** visited London this summer to discuss climate change, clean energy and what the UK needs to do to remain a good neighbour, post-Brexit. **Karen Thomas** reports

When Laurence Tubiana speaks, the world listens. As France's climate-change ambassador and special representative at COP21, Dr Tubiana was a leading architect of the Paris Agreement. Famously, she abolished the summit dress code, introducing a relaxed tone to the event. That more relaxed approach helped delegates to agree more ambitious targets than many onlookers had expected.

Now France's high-level champion for climate action, the chief executive of the European Climate Foundation is leading the debate on climate change, energy and the environment, in Europe and worldwide. This summer, she travelled to the UK to meet campaign groups to discuss Brexit and the challenges ahead.

"More than half the UK's climate goals derive from Brussels. Whatever your view on the European Union, it has had legal oversight of that ambition – and that's important to keep government honest"

Brexit threatens to undermine the UK's leadership role in Europe, she told Green Alliance members in London – not least in leading the fight against climate change. "More than half the UK's climate goals derive from Brussels," she said. "Whatever your view on the European Union, it has had legal oversight of that ambition – and that's important to keep government honest."

Remembering the COP21 negotiations in Paris, Dr Tubiana praised the role of green campaigners and civil society, first in making the agreement possible – "you were on the frontline when we needed you" – and second for holding governments to account, keeping up the pressure to make good their promises to meet their climate-change goals.

She praised the UK as the first country to put climate change on the United Nations agenda, under prime minister Margaret Thatcher, and the first G7 nation to phase out coal-based power production. She also praised the UK's cross-party consensus when it comes to protecting the environment.

"In an increasingly polarised world, this consensus needs to be nourished," she said. "This common ground must allow you to make a stronger society."

Last year, she noted, the UK generated more than half its energy from renewable sources. "This is leadership; this is why the UK is so important... You are part of an energy revolution that is being driven by UK scientists."

BREXIT TALKS

But these, of course, are uncertain times, as the Brexit negotiations have dragged on throughout this year. The UK must retain its leadership, in working towards the Paris Agreement's 1.5˚C climate targets, Dr Tubiana said.

"Britain is a leader in Europe, but that leadership stems from its shared values with Europe. We will miss the UK's voice in Brussels when you leave. The UK drives the rest of Europe to higher ambitions on climate... The UK's alliance with Europe helped Europe to punch above its weight in Paris at COP21."

"We have seen UK investment in clean energy fall by more than 50 per cent in the last 12 months and clean-energy businesses have been cutting jobs. That's a concern"

Europe is committed to sustainable growth, to promoting renewable energy sources and to leading the transition to electric vehicles. EU member states recognise that pollution is not a problem simply for one country. But Brexit weakens Europe's moral leadership in the debate, she says.

"In Europe, we share the price of pollution and the prize of delivering cleaner, greener cities for our children to live in. For the UK to leave Europe is a loss for Europe on the climate-change scene."

Post-Brexit, there are also worries about the UK's energy security, she notes. "We have seen UK investment in clean energy fall by more than 50 per cent in the last 12 months and clean-energy businesses have been cutting jobs. That's a concern."

ACCOUNTABILITY

Dr Tubiana urged the UK to create a new regulator that can hold governments and businesses to account. "We need to have a body that has the teeth to make future governments stick to their commitments," she said.

"Many of you are worried that the government will not deliver this – that it will compromise on a Green Brexit. Even now, in the US, the Environmental Protection Agency still has the power to take government to court, to ensure it does not renege on its commitments. Do you really want to have weaker environmental governance than the US?

"... For or against Brexit, I do not believe that anyone in Britain voted for their country to become more polluted. If the UK maintains its direction, this will be good for everyone in Europe."

SNAPSHOT CV

Laurence Tubiana was born in Oran, Algeria and her family moved to France, after the War of Independence.

An academic, she rose through the ranks to become a professor and scientific director at Sciences Po in Paris and professor of international affairs at Columbia University. In the 1980s, she founded the NGO Solagral, which engages with food security and the global environment.

Dr Tubiana was senior adviser on the environment to the government of Lionel Jospin from 1997-2002, going on to found the Institute of Sustainable Development and International Relations (IDDRI), which she led until 2014.

Dr Tubiana also set up the Directorate for Global Public Goods at France's foreign ministry.

She said. “The final test will be what the UK does at home. The biggest barrier the UK faces is tackling pollution. We know from The Lancet that 50,000 people die every year in the UK from air pollution. Petrol and diesel cars are putting at risk both children’s health and the country’s ability to meet its climate-change targets. It needs a solid plan to phase out the combustion engine by 2030. That could be a common European goal.

“There must be new money available to support city leaders – the mayors of London, Birmingham and Manchester – to work towards new clean-air laws, to tackle energy poverty. We can’t leave old people to die in their homes in winter, when a warmer house is better, both for health and to meet our climate targets. We should be out in the streets, protesting about energy poverty.” Dr Tubiana ended her address to the Green Alliance with a direct appeal to her audience of NGO bosses and activists.

“To prevent a dirty Brexit, we need so much more from all of you to ensure that the UK does not compromise on its agreements,” she said.

“The UK needs a stronger climate movement – we need to take people with us. That is why I launched the European Climate Foundation. We need to reach and engage with those who are not yet climate campaigners – which, to be frank, is the majority of the population.

“We need young people to engage with campaigns for cleaner, safer homes. We need the farmers and the churches and the trade unions. We mobilised them for the Paris Agreement, but where are they now?

“...Your country needs you. The transition to a greener economy is within our grasp. It must be fair. We must care about where the costs fall, about who wins and who loses. In this age of fake news, of media manipulation, we must ensure that our voices are heard.

“Above all, we must speak truth to power – we cannot shy away from that responsibility, using science as our foundation.”

"Your country needs you. The transition to a greener economy is within our grasp. It must be fair. We must care about where the costs fall, about who wins and who loses"

DR TUBIANA HAS SET THE UK FOUR WAYS TO COMMIT THE GOVERNMENT TO A CLEAN BREXIT:

- Brexit or no Brexit, there must be continue to be close co-operation between the UK and Europe when it comes to clean energy and to fighting climate change. The UK must embed the principles of the Paris Agreement in its final exit deal with the EU and in future trade deals
- Leaving Europe cannot be an excuse for the UK to weaken its existing environmental laws. The UK must replace the European Commission’s powers with a watchdog with equal enforcement powers. New, strengthened institutions will be vital to protect people in the UK and in Europe from pollution that knows no borders
- A global Britain is a green Britain. The UK must create an environmental legacy – at home and overseas – of which it can be proud. “We must never set out to achieve only what we think we can achieve – had we thought that way, we could never have achieved the Paris Agreement”
- Together, Europe must position itself “as a strong counterpoint to China. We do not want to move from a US-dominated to a Chinese-dominated world economy”. The UK must continue to align its interests and strategy with those of Europe, "as the government of Theresa May did in siding with Brussels this summer over the Iran nuclear deal".

ENVIRONMENTAL REGULATION: ‘IT’LL BE A PROBLEM OF ENFORCEMENT’

The Environment sat down with Laurence Tubiana at London’s Chatham House and asked her what powers the UK’s proposed environmental regulator needs to have.

“The European Court of Justice is a strong entity when it comes to breaches of environmental regulations,” Dr Toubiana said. “EU regulation really has been the last resort. For France, this has been a powerful driver to respect its own environmental laws.

“In the UK, the regulations are stronger than in France – you have the Climate-Change Committee, although this has fewer teeth than the European Court of Justice.

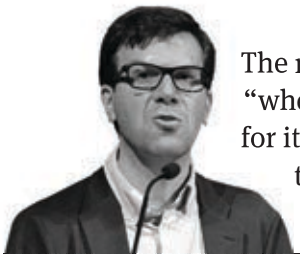
“In an ideal world, you have the committee, with this strong advisory role, but you also need teeth, on the justice side. For France, it would be a catastrophe for our environment regulation if we didn’t have the European Court.

“So you will have to fill that gap with an equivalent. It’s about lobbies, about tackling delays. It’s a similar thing with the US. I recently met the former Environmental Protection Agency administrator Gina McCarthy, who of course is very critical of her successor. But she pointed out that, even now, the EPA can sue the US government if it feels it is not doing its job properly.

“The UK needs that judiciary dimension. I’m absolutely convinced that, without Europe, France would be so much less active in complying. There is no government that does not need this balance. It’s crucial.

“When it comes to standards, I’m sure people will want to maintain the best standards they can. It won’t be a problem of wanting to degrade the current standards – it’ll be a problem of enforcement.”

CARMAKERS PONDER UNCERTAIN TIMES



The main question for UK automotive is "whether Brexit will be bad or really bad" for it, GIS Gerpisa director **Tommaso Pardi** told a conference in Lille, France this summer. Karen Thomas reports

Everything rests on whether or not Britain remains within the Customs Union, Tommaso Pardi told the Forum on European Automotive Industry (FEAL) conference. Exiting the Customs Union spells trouble for UK manufacturing and assembly, opening an opportunity for rival European automotive firms, he said.

"No one in the automotive industry in Britain sees Brexit as an opportunity. The critical thing is for the UK government to limit the damage from Brexit."

The UK dilemma is also tricky for the EU, Mr Pardi said. Other member states face growing Euroscepticism. EU member states must work out whether Brexit was an accident that damage-limitation measures can fix, or whether it foreshadows the EU's demise.

High-wage countries usually move up market, or focus on innovation, to compete against lower-cost rivals. But although UK has world-leading technology, from electric vehicle systems to devising storage for renewables, Mr Pardi sees little respite from either for UK automotive.

Other speakers argued for and against electricity or hydrogen fuel replacing petrol and diesel.

"We have to ensure that the switch to electric vehicles is not detrimental to carmaking jobs," Hauts de France president Xavier Bertrand told the conference.

"It takes seven times fewer employees to produce a fully electric engine – and that has consequences."

He added: "The way forward is our initiative to increase the part that hydrogen plays in our energy mix, to ensure that this region is not left behind. The automotive industry will find a favourable ecosystem for hydrogen here, in Hauts de France."

Backers for electric vehicles included Toyota France boss Luciano Biondo, whose company makes petrol, diesel and hybrid Yaris cars at Valenciennes. "Since 1997, 11.8 million hybrid vehicles have sold worldwide – and this has saved our planet 90,000 tonnes of CO_2," Mr Biondo said.

Ronan Noizet of IHS Markit predicted that European Union production of electric vehicles will increase from 600,000 this year to 2.5 million by 2025, when one in every ten produced will be battery-electric.

Meanwhile, Mr Pardi described the protracted negotiations between the government of Theresa May and officials in Brussels as "broad, complex and messy", leaving deep uncertainty "about what Brexit will mean, both for ordinary people and for strategic industries such as the automotive industry".

Brexit without a deal would mean higher taxes and duties, adding 10 per cent to the cost of every vehicle imported and exported between the UK and Europe.

Data shows that the UK exports 80 per cent of the cars it produces. By value UK drivers import 60 per cent of their cars from Europe.

And if Britain deviates, "even a little" from European Union regulatory and environmental standards, it will become "extremely cumbersome" to export cars and parts to the continent, he said.

Even a new trade deal would be unlikely to allow free movement of all goods and services and could introduce complex new requirements for local content.

The final challenge, Mr Pardi said, is that the UK automotive industry is transnational, with labour spread across borders and depending heavily on imported skills.

"It will become more difficult to move engineers and other manpower back and forth."

Investment in UK automotive has already slowed since the Brexit vote, because backers are uncertain and nervous about what lies ahead.

A hard Brexit could see UK-based automotive firms, from Ford to Nissan and from BMW to Toyota, shift production to lower-cost markets, including Slovakia, Brazil and China.

"I have been quite pessimistic about the future of the British automotive industry and I hope I am wrong," Mr Pardi concluded.

"But there are dangers ahead that must be addressed."

WHAT POWERS DOES THE NEW REGULATOR NEED TO PROTECT OUR ENVIRONMENT POST-BREXIT?

The government has pledged to create 'a world-leading body' to protect the environment, post-Brexit. What powers will it need to hold government and the authorities to account? ***The Environment*** asked the experts

Consultation continues on government plans to create "a world-leading body" to protect the environment post-Brexit. Campaign groups want the proposed watchdog to hold government to account, replacing the checks and balances enshrined in European Union law.

In mid-June, the House of Commons passed an amendment to the EU Withdrawal Bill, requiring environment secretary Michael Gove to maintain EU environmental principles within domestic law, post-Brexit. Parliament will vote this autumn on a draft bill on environmental principles and governance.

Ahead of that vote, The Environment asked leading experts what powers the UK's new watchdog will need.

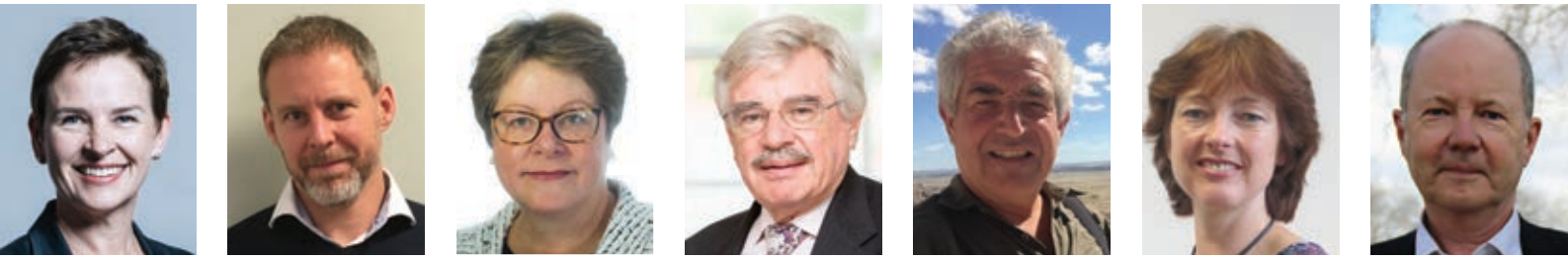
MARY CREAGH MP

IF WE WANT world-leading environmental protections, we need a world-leading environmental watchdog.

As recently as May, the European Commission referred the UK and five other European Union member states to Europe's highest court (CJEU) for failing to tackle illegal levels of air pollution. The CJEU has the power to impose large fines. Yet the government's proposed watchdog does not backfill these functions and has no teeth. It was so weak that parliament had to intervene and allow it the ability to start legal proceedings against the government – yet the government remains silent on how this would be applied. The Environmental Audit Committee's (EAC) report, The Government's 25-year plan for the environment, proposes a new independent oversight body – the Environmental Enforcement and Audit Office (EEAO) – to retain the governance, enforcement, oversight and policy functions carried out by the European Commission and European Environment Agency when we leave the European Union.

Previous governments have form on abolishing environmental watchdogs whose criticisms are a little too uncomfortable and tart. We do not want this body to be established, only for a future government to shut it down. To guarantee its independence: it must be overseen by parliament.

The EEAO should oversee all public authorities, including local councils and arm's-length bodies, not just central government. Its remit should include



Left to right: Mary Creagh, Alastair Chisholm, Baroness Brown of Cambridge, Lord Larry Whitty, Tony Juniper, Elaine King and James Thornton

strategic oversight as the European Commission offers and, taking the Climate Change Act as a model, it should provide scrutiny of the government's 25-year plan five yearly and annual progress reports against legally binding targets.

It should have the power to initiate its own investigations and an enforcement function to investigate compliance with environmental law, including complaints from the public that the courts can adjudicate. Only then does it have a chance at replacing the protections that the commission has overseen.

Environment Audit Committee chair Mary Creagh

ALASTAIR CHISHOLM

PRIME MINISTER Theresa May said: "We will use the opportunity Brexit provides to strengthen and enhance our environmental protections, not to weaken them." Secretary of state Michael Gove promised a "world-leading" scrutiny and governance body.

Taking this at face value, government must establish a body stronger than the European Commission, whose complaints mechanism provides scrutiny and gives citizens affordable access to justice, and stronger than the European Court of Justice, which can enforce sanctions on governments for non-compliance with environmental obligations.

These are big dogs with sharp teeth.

Government must also ensure that environmental principles underpin all appropriate policies created in the UK. These go a long way to informing the obligations against which government would need to comply.

This amounts to an entity independent of governments, answerable to parliament, that cannot be shut down for being too challenging. It should have resources to scrutinise governments' policies and operations, ensuring they comply with their obligations.

It should be able to issue advisory and binding notices to require action and undertakings to agree actions.

The future of our imperilled environment is too important to leave to chance in this febrile Brexit climate.

In May the House of Lords passed a powerful amendment to the EU Withdrawal Bill, putting the fundamental requirements for the regulator in the bill wording. In June the government, responding to parliamentary and stakeholder pressure, made its own amendment in lieu of the Lords.

This banks a number of important powers and provisions in the EU Withdrawal Bill. Our dog is growing teeth. In the forthcoming Environmental Principles and Governance Bill it will need to grow a few more.

CIWEM head of policy Alastair Chisholm

JULIA KING, BARONESS BROWN OF CAMBRIDGE

The environmental regulator must have sharp teeth. This is so important to us. We need to reproduce the powers now held by the European Commission and by the European Court of Justice.

The consultation document contained some very good things – but it's not as robust as it needs to be in giving the regulator teeth. That's why members of the Climate Change Committee filed an amendment on maintenance of environmental principles and governance in the third reading of the European Union (EU) Withdrawal Bill.

The timescale is uncertain, regarding the environmental body. We're talking about a bill to be published this autumn, with legislation in the first half of next year. But the consultation document presents several options, some less robust than others.

We cannot be certain that we will leave the EU with the same levels of environmental protection that we enjoy at the moment.

Chair of the adaptation subcommittee, Committee on Climate Change Julia King, Baroness Brown of Cambridge

LORD LARRY WHITTY

The stated intention of the government's European Union (Withdrawal) Bill was that by translating all existing EU directives and regulations into UK law our legal position would remain the same after Brexit.

In the field of environmental protection and enhancement that was just not true. Transposing the texts of individual pieces of legislation did not always transpose key principles of environmental legislation; the polluter-pays principal, for example. And, crucially, the EU's enforcement mechanisms in the environmental field were in no way transposed.

The EU Commission and executive agencies have a range of powers, from requiring action from member states to refraction proceedings; fining the governments. Recently, there was a substantial fine on the UK and five other member states for failure to reach air quality standards.

The Commission can also require member states to apply payment agencies to reductions of Common Agricultural Policy (CAP) payments to farmers for failure to meet environmental standards through cross compliance. Other powers rest with other EU bodies and agencies. And in disputes, there is reference to the European Court of Justice.

Post-Brexit, we will not be subject to the Commission and will not be full parties to EU agencies. There has been no reproduction of EU enforcement mechanisms within UK law.

In the Lords, many of us have pressed for equivalent powers in post-Brexit UK. Promises were made that a separate bill would be produced, delivering just that.

Regrettably the consultation we now

have on the proposed Environmental Principles and Governance Bill betrays the paucity of intention.

For all the talk of a powerful new statutory environmental watchdog, the powers the government would bestow on the new body would be confined to monitoring and advice plus an enhanced form of improvement notice.

What we need is a watchdog that can sanction for failure to deliver environmental outcomes; sanction government departments and local authorities, and existing agencies like the Environment Agency and Natural England – both Defra agencies and bodies with environmental responsibilities under other departments.

It was presumably this ability to sanction other government departments and agencies that led to opposition around Whitehall and the emergence of a watered-down body... But if we are genuinely to be in the same situation for environmental matters, we need a watchdog with teeth.

We will probably also need to reproduce at UK, or England, level some powers of the EU agencies. And we may well need to constitute an Environmental Justice Court in case of disputes. The present proposal falls well short of what we need.

Chair of the EU internal market subcommittee and president of Environmental Protection UK (EPUK) Lord Larry Whitty

TONY JUNIPER

We face an unprecedented collapse in wildlife populations and need a much more determined approach from government to protect the natural world.

The June amendment is better than nothing, but offers the tamest poodle of an environmental watchdog. It does not maintain our current protections or achieve the government's own level of ambition to leave the environment in a better state than it inherited.

Post-Brexit, we need a body to hold governments and public bodies to account in respect of their performance implementing environmental law. It will need the powers and capacity to scrutinise and investigate, to hear citizens' complaints and to take offending institutions to judicial processes.

The new body must work in the context of new, legally binding targets for the recovery of nature, comparable to those enshrined in the 2008 Climate Change Act. Otherwise it might simply end up presiding over the same long-term decline in our environment that has been evident for many decades.

The new body must be part of a wider package that takes forward ambition fit for the 21st century. The UK is one of the most nature-depleted countries in the world. Millions of people breathe polluted air. Many of our soils are rapidly degrading and only a minority of our rivers have attained the good ecological status required by EU law. We require an ambitious, forward-looking new Environment Act, laying foundations to improve nature in a generation.

We need such a law because even with the foundation of progressive European environmental legislation, and the enforcement capability of the European Commission and European Court of Justice, our environment is far from healthy and our impacts and demands upon it far from sustainable.

Current proposals for the new institution take us backwards and, while commitments for nature's recovery rely on policy rather than law, we can expect that the environment on which we all depend to be at even greater risk. We still urgently need a Westminster Environment Act to restore our nature, without which we may never see a green Brexit.

WWF executive director advocacy and campaigns Tony Juniper

ELAINE KING

Any watchdog must have a fearsome bark and the teeth to back it up. The greater the treasure it protects, the more important sharp teeth are to attack those who put it at risk – and with no treasure more valuable than the environment, it is essential to have a pitbull to defend it.

It should not have been a shock that there was a furore over the government's plans to give a new environmental watchdog no powers to initiate action in the courts to tackle polluting businesses and hold the government to account.

A watchdog unable to take legal action is just that – a watcher, not an enforcer. This is hardly the world-leading independent environmental watchdog we were promised in the 25-year plan.

With our environment in spiralling decline – with one in six UK species verging on extinction – we need a watchdog that has:

- a keen eye on the detail through careful monitoring, assessment and transparent reporting
- keen ears to hear and aid complaints from citizens and civil society organisations
- a commanding bark to raise the alarm whenever government and businesses fail in their responsibilities
- and a powerful bite, delivering remedies, sanctions and legal action in response to breaches

The proposed shape of the new watchdog weakens the environmental governance that we have in the EU. This is something the government promised would not happen and, given the strength of feeling about protecting our environment, goes against the tide of public opinion.

Wildlife and Countryside Link director Elaine King

JAMES THORNTON

If the government wants to make good on its "world-leading" promises and improve compliance with environmental law, the new green watchdog should have the legal powers to truly make a difference. A green watchdog must have the power to take to court all public bodies that fail to protect people and the planet.

It must also have the power to issue formal notices that require particular actions by government or public bodies to meet their environmental duties. And courts should be empowered to back up the words of the body, giving legal teeth to its expert advice.

Without these powers, there is a real risk that environmental laws will be ignored.

The plans outlined by the government's consultation fail to guarantee that the new watchdog can receive complaints directly from the public. This risks disconnecting the watchdog from the people and communities that could aid and benefit from its work.

We don't need another faceless bureaucracy. So the watchdog must reach out and work with communities affected by environmental problems, involving them in identifying issues and in developing solutions to them, too.

ClientEarth founder and chief executive James Thornton

WHY PUTTING THE ENVIRONMENT FIRST MAKES ALL OUR LIVES MORE SECURE

By **Erik Solheim**

International security is central to international politics. During the Cold War, US-Soviet relations shaped world security and insecurity. Under the shadow of the bomb, few regions escaped devastating proxy wars.

Since then, achieving global peace and security – central to the United Nations' work – has become far more complex. It's no longer a simple playing field of two teams. Traditional post-World War II mediation mechanisms are no longer fit for purpose. This forces us to rethink security from the ground up.

Our understanding of what drives conflict has also changed, as we grapple with new crises. One change concerns the environment. We have now grasped that, far from being a niche issue, the environment is central to global security – as a threat multiplier and a tool for peace.

That relationship can be clear. Our work to restore southern Iraq's Mesopotamian marshes – home to one of the Middle East's biggest environmental catastrophes – is a force for wider regional post-war recovery.

In parts of the recently liberated north, Iraq officials are trying to reverse Daesh scorched-earth policies that left the skies black with burning oil and poisoned cities and rivers.

But we need to go further to integrate environmental questions into the international security framework, to reshape the security narrative and its mechanisms.

Countries need practical tools and new, solid and well-grounded policies to implement their environmental commitments despite mounting external threats.

There are parallels between today's political situation and the experiences of science in the early 20th century, when discoveries in nuclear physics contradicted classical theory. Those discoveries demanded new, extraordinary ideas to solve those contradictions. One of those physicists, Niels Bohr, said that a theory must be crazy enough to be true.

Focusing on the environment to solve global and regional security issues might just be that crazy theory. Helping Somalia to adapt to more frequent, intense droughts that create a cycle of environmental degradation may well be key to lasting peace.

> "We need science, the policymaking community and civil society to work together, to turn understanding of the role of the environment in modern security into political will – and eventually into a powerful tool"

NEW MIND-SET

The environment is not an obvious solution to global and regional security. Concepts and ideas need time to develop and prove their worth. Half a century ago, parts of the world accepted discrimination based on skin colour. A century ago, everyone accepted the right to acquire territory by force in military conflict.

The intersection between environment and security is under-researched, despite examples showing how heightened tensions coincide with periods of extreme climate events, natural disasters, even changing weather patterns.

Research by UN Environment, conducted last year for the Munich Security Conference, overlaid areas of drought with incidences of low-intensity civil conflict. The findings showed a clear correlation. We are working to expand this work through our Science-Policy Platform on Environment and Security.

However, several common themes are beginning to emerge. First, the environmental consequences of military conflicts are huge. Damage to chemical, oil refining and metallurgical enterprises in a conflict zone can cause region-wide ecological catastrophe. The risks are higher still for nuclear power plants and infrastructure.

Second, most countries' military budgets are significantly higher than the costs of stabilising the environmental situation. Redirecting even a relatively insignificant part of the military budget to address the consequences of environmental change would support peace-building, generating trust and capacity to restart peace negotiations.

Finally, the legal regulation of environment and security – which is still underdeveloped – is also critical. Environmental organisations can play a key role in this process, led by UN Environment.

Environmental lawyers describe our role as "normative entrepreneurship", galvanising political will and contributing to the progressive development of international law.

We need science, the policymaking community and civil society to work together, to turn understanding of the role of the environment in modern security into political will – and eventually into a powerful tool.

After all, we can have no peace without a healthy planet. o

Erik Solheim is programme executive director of United Nations Environment

THE ENVIRONMENT AND SECURITY

ENDING THE VICIOUS CIRCLE

Climate change, environmental degradation and loss of biodiversity threaten world peace and security. Here, the UN Environment Science-Policy Platform on Environment and Security sets out ways to tackle these problems

Threats from chronic changes in the environment are difficult to predict. Difficulty mitigating these threats then creates uncertainty and instability across global society. Governments focus on more acute threats such as terrorism and cyber-attacks. This creates a blind spot around global security challenges that include environmental degradation to food security, agriculture, water accessibility and housing.

Military, social, economic and environmental threats are growing. Security implies an effective response to the risks, dangers and challenges of the modern age.

These risks are increasingly complex, due to technological, financial and political interconnectedness in modern society that creates unpredictable risk and threat combinations for all of us.

They are also creating a vicious circle, due to the uncertain cause-effect relationships in many old – often frozen – conflicts and to inefficient management.

In broad terms, security exists in the absence of threat. With drought, environmental uncertainty has security implications because it threatens people's ability to secure their livelihoods.

Environmental uncertainty makes people more vulnerable, decreasing their ability to cope with new threats of environmental uncertainty. Vulnerable people, unable to cope with new or changing environmental situations, seek ways to support themselves and their families – becoming desperate in dire situations.

With environmentally driven food insecurity, for instance, that desperation can create civil unrest and erode civil security.

REGIONAL EXAMPLES

In Central Asia, glaciers supply fresh water during hot periods, and provide water during drought years. But these glaciers have shrunk by 20-30 per cent.

Central Asia, with its arid climate and historic lack of environmental management, is already among the most vulnerable regions to climate change. Rising temperatures, melting glaciers, and more frequent extreme weather will aggravate its existing problems with water, energy and food security, exacerbating regional tensions – and beyond.

Environment and security incorporates vast issues, particularly if we consider security in its broad definition as human, economic, and social security.

One issue that narrows the scope of the relationship is the link between environment and armed conflict. However, there is considerable scope to apply this narrower concept.

Environmental change can exacerbate inter-state tensions and disputes or terrorism. However, most studies focus on acute transboundary conflicts, with a high probability of violence.

CAUSE AND EFFECT

Climatic and environmental changes are unlikely to directly cause conflict. However, environmental changes exacerbate existing poverty, overpopulation, demographic inequality, unmanaged migration, ethnic fractionalisation, political marginalisation, poor governance, historical conflicts and neighbouring conflicts.

It goes beyond academic discussion to distinguish between a general causal effect, in which climate change and water scarcity lead to conflict, and an indirect and conditional effect, in which climate change and water scarcity lead to conflict where exist low economic growth or ineffective political institutions.

Instead, it points to the factors to address to avoid or end conflict. Rather than discuss the risk of climate wars and water wars, scholars and policymakers must investigate the conditions in which climatic changes and water scarcity exacerbate the threat to societal stability and peace, and the mechanisms – the intervening variables – that can have a destabilising effect.

For more than half a century, Sudan has endured armed conflict and civil unrest. In Darfur, drought, demographic pressure, and political marginalisation helped to push the region into lawlessness and violence. Since 2003, 300,000 people have died and more than two million have been displaced.

Although the causes of conflict in Darfur are complex, a 2009 UN Environment report named regional climate variability, water scarcity and the steady loss of fertile land as important underlying factors.

Long-term drought and desertification do not inevitably lead to conflict. Yet, by causing poverty, by marginalising population subgroups, and driving migration, drought and desertification create conditions that lead to violence.

And so marginalised pastoralist groups in Sudan have joined militia proxy wars, to raid cattle to supplement their own herds. Nomads, whose camel-herding livelihoods have been hard-hit by drought

and desertification, have also been easy prey for armed groups in the region.

Because climate change may compound water and land stresses, Darfur and the entire Sahel region – recently dubbed "ground zero" for climate change – must foreground adaptation in their development and conflict-prevention plans.

Europe is not immune to compromised security due to environmental degradation, either. The European heatwave of 2003 killed some 70,000 people.

Ukraine, which has experienced a steady rise in temperatures and droughts, now faces a protracted conflict. A giant of heavy industry, one fifth of Ukraine's production is concentrated in Donetsk region, with more than 1,000 mining, metallurgical, chemical, energy and heavy machinery enterprises. Around 78 per cent of industry in Donbas is environmentally hazardous.

Since 2014, the fighting in southeast Ukraine has created significant, partially irreversible negative environmental consequences, with a destructive impact on ecosystems, industrial and social infrastructure. These have significantly worsened people's security in a region that was among Ukraine's most disadvantaged before the conflict.

Shelling of metallurgical and chemical plants has polluted the main river, the Seversky Donets, threatening the population of the Russian Federation living along this tributary of Russia's Don River. Security has deteriorated in the entire region.

DISASTER-RISK REDUCTION

Traditional political and diplomatic methods for mitigation are insufficient and ineffective to tackle the threats facing our world today. Decentralising the international security system fragments global security into relatively independent regional regimes.

Given the increasing risks from climate change such as drought, a functioning natural environment can ensure food security, protect household assets and livelihoods, and increase community resilience.

Conducting well-planned disaster-risk reduction (DRR) within a framework of sustainable development can also protect social and economic development gains. Where vulnerable populations depend on functioning ecosystems, environmental problems foster social uncertainty and – where security is understood to include existential threats to individuals' or communities' wellbeing – can lead to environmentally induced security issues.

Addressing environmental problems and social vulnerability simultaneously, using ecosystem-based DRR, can help governments to more coherently and systematically address the nexus of environmental uncertainty-vulnerability-security.

"Water is unevenly distributed, nine countries sharing 60 per cent of world resources, 28 facing regular shortages and 80 facing occasional shortages"

Another factor in that nexus is competition versus co-operation over fresh water. Linkages between water, international peace and security are increasingly central to international policy and security.

Water is unevenly distributed, nine countries sharing 60 per cent of world resources, 28 facing regular shortages and 80 facing occasional shortages. Water scarcity, accelerated by climate change, affects availability and increases the risk of competition.

Although transboundary water agreements boost peace and stability, there are too few such agreements. Of 263 shared river basins, 84 have joint water-management bodies. Yet, co-ordinated management of shared water resources can increase co-operation between states.

It is not rare for watercourse states to apply international watercourse treaties despite periods of armed conflicts. Scarcity of water may encourage the parties to co-operate despite creating riparian tensions.

CONCLUSION

To reduce climate change and water-related security risks, we need an increased scientific understanding – but also better knowledge-exchange and knowledge-building processes, involving the scientific, political and socio-economic communities at national and international levels.

We must consider co-operation over natural resources such as water as a tool to start negotiations, build trust and peace between states. And at the national level, governments must ensure that populations have access to water, to safeguard peace and security at national and global levels.

UN organisations, national agencies, and scientific institutions can develop a stronger research and policy agenda.

National governments' approaches to environmental problems must be holistic and acknowledge that environmental problems – and their influence on security – stem from interdependence between natural and social dynamics that cut across traditional policy fields, administrative responsibilities and epistemological communities. To address this, we must recognise these dynamics and how they interact.

Cross-departmental integration and coherent international co-operation can contribute to practical, lasting solutions. Disaster-risk reduction can protect development gains, and mediate the relationship between environmental uncertainty, environmental vulnerability, and environmental security issues.

UN ENVIRONMENT SCIENCE-POLICY PLATFORM ON ENVIRONMENT AND SECURITY

THE AUTHORS ARE:

- Mahir Aliyev, regional co-ordinator for Europe of the United Nations Environment Programme (UNEP) Europe office in Geneva, for environment and security, international waters, and regional and country co-ordination.
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MAPPING THE DEEP BLUE

Two ambitious projects are applying a natural-capital approach to two English marine areas to develop a national blueprint

As rising seas increase the risk of flooding and erosion, and with marine species threatened by everything from plastics to coastal erosion, the UK's coastal and marine environment is at best under pressure and at worst in decline.

To tackle this, the Department of Food, Rural Affairs and the Environment (DEFRA) has included two marine sites among its England-wide Pioneer projects.

The North Devon and Suffolk Marine Pioneer projects bring natural-capital methodologies to coastal and marine areas. They will evaluate coastal and marine flora and fauna and sea-life, devising fundraising models and setting priorities, to create a natural-capital template for local and regional coastal projects.

Marine Pioneer's springboard is the 25-year plan for the environment. It aims to identify areas of concern, weighing up risks linked to climate change and setting out priorities to prevent future damage and to deliver net gains. Brexit makes this ever more urgent, amid worries about future regulation and funding.

Marine Management Organisation (MMO) is leading the Marine Pioneer projects, drawing together the stakeholders. Marine Pioneer hopes to deliver "a consensus about what has the most value for the agreed environmental priorities", project lead Aisling Lannin told The Environment.

> "Unless people really feel they can make a difference, this will not work. We need to win their trust"

Researchers will look at the environment, not as something that needs protection but as a thing of value, that delivers measurable benefits. That means evaluating everything from sea mammals to plankton and from shellfish to seabirds, to see what is at risk and how that affects marine ecosystems.

It also means raising locally the funds to deliver that. DEFRA has funded a marine officer for each project for two years – beyond that, there is no money from central government.

PLANNING

Both projects agreed their goals and aspirations last spring and set up steering groups. Both established project teams in June 2017. Having agreed initial demonstration projects, the teams are working with NGOs and government experts to deliver them.

The Pioneers' experiences will underpin a Marine Natural Capital Plan, shaping governance and methodologies for future projects.

It's a tough ask. "It's about recognising that you probably won't be able to do everything you want to do because of the funding that's available to environmental management," Dr Lannin says. "It's also about using the information we gather on how much money is spent.

"It's a busy space, with dozens of NGOs and different people spending on different things. A natural-capital approach allows us to understand where all that spending is happening. We can then collectivise,

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ENGLAND EXPANDS ITS BLUE BELT

CONSULTATION CLOSED in July on the government's plan to create a third tranche of marine-conservation zones around English coast to protect wildlife from damaging activities, including coastal and offshore development and dredging.

Secretary of state for the environment Michael Gove announced on World Oceans Day that the government will protect more than 40 additional marine habitats, expanding the UK's so-called Blue Belt by nearly 12,000 sq km, an area eight times bigger than Greater London.

The 41 proposed protected areas are spread from Berwick to mud habitats off Northern Ireland's coast. England has 50 marine-conservation zones, having launched the Blue Belt programme in 2013.

"We need to restore the seabed that has been ravaged over the past century, and allow fragile marine life to recover – this can only be done with good management," says Wildlife Trusts director of living seas Joan Edwards.

to agree a list of priorities. We may not have the money to invest in everything, but if we come together – as industries, agencies, NGOs and landowners – we can invest in the priorities we identify to deliver what the 25-year plan for the environment describes as net gain."

Both projects will study pollutants and pathogens, climate-change and flood resilience, productive seas, and regional and common issues. But both are very different in scale and scope.

Rural North Devon relies on leisure, tourism and fishing. Its marine pollution comes from agricultural run-off. Project teams are looking at managed realignment, at bioremediation such as shellfish laying and at restoration projects such as saltmarshes to absorb nutrients before they reach the sea.

Plymouth Marine Laboratory-led South West Environmental and Economic Partnership (SWEEP) has led the drive to win funding for North Devon. Here, the Marine Pioneer benefits from its proximity to the landscape pioneer, and to the UNESCO Biosphere reserve.

These elements have raised the Pioneer's profile, pushing natural capital up the southwest socio-economic agenda.

Marine Pioneer helps the community to focus on what the marine environment provides, and how best to manage it, says SWEEP Marine Pioneer investigator Melanie Austen, Plymouth Marine Laboratory head of science, and society and lead/principal investigator of the Blue Communities programme.

SWEEP is developing a tool to support natural-capital decisionmaking. It features a geo-database configured to illustrate value and to register risk.

SWEEP has £5 million worth of funding from the National Economic Research Council (NERC) and a similar amount from partners including WWF, which tapped global broadcaster Sky, and Blue Marine, which won business funding against its interests in fisheries.

MARINE PIONEER AIMS TO:

- apply a natural capital approach to the marine environment
- identify environmental priorities for coast and sea in Suffolk and North Devon
- improve inter and intra-government and non-government working together
- increase care for, and understanding of, the marine environment
- gather information about the marine system, social, economic and ecological
- apply social and economic science and practice to marine management
- plan and prioritise investment to restore natural capital
- develop and implement innovative finance models
- share lessons and best practice
- contribute to implementing and updating the 25-year environment plan.

FLOOD RISK

Meanwhile, Suffolk needs to build resilience against coastal flooding, beyond projects with funding from the Environment Agency and local authorities. Its project officer is based at Suffolk Coast and Heaths Area of Outstanding Natural Beauty.

However, austerity budgets and Brexit are creating what one onlooker describes as "a post-grants world".

This spring, NERC turned down the project's bid for funding to set up a natural-capital forum. "Here, we don't have substantial funding yet," Dr Lannin says. "Funding really is difficult. The

challenge, sometimes, is where the innovation and creativity comes in.

"DEFRA pointed out that the local authorities and the Environment Agency are putting a lot of money into flood-prevention in Suffolk, a particular issue in this area. However, that money is running out, due to the austerity agenda.

"This has pushed some Suffolk communities to crowd-fund coastal projects. That is a real sea-change; for numerous, very complicated reasons this is the way things are moving."

Future projects will rely on blended finance, combining grants and loans, says Coastal Partnership East strategic funding manager Paul Mackie. Communities will raise funds from local authorities and from local businesses and landowners. All want to see a solid business case that delivers quantifiable commercial benefits.

"Marine Pioneer is like a wrapper for existing coastal projects," Dr Mackie says. "Rather than create new marine and coastal projects for Suffolk, the project creates a catalyst for support.

"Innovative projects can move slowly; some hit roadblocks. Marine Pioneer helps us to understand the blockers and the enablers, and to feed back to DEFRA the support we require from central government for projects that demonstrate the aims of the 25-year plan."

FOCUS

The Marine Pioneers will pool their findings at the end of three years. North Devon will then produce a Marine Natural Capital Plan.

"This will be the first plan of its kind," Dr Lannin says. "[This] will enable others to write plans explicitly for their own areas. The important thing is to explore governance; how that plan is then administered.

"Governance is about joining up at local, regional and national level – and understanding how that might work, for example in administering an investor prospectus. The organisations in that area will have the money in one pot and should work towards the same environmental objectives.

THE MARINE PIONEERS' TO-DO LIST

- **ENGAGE** with 25-year environment plan policy and evidence leads
- **PREPARE** a paper linking the objectives to the demonstration projects, setting out how to answer the Pioneer requirements and decide the outputs
- **AGREE AND IMPLEMENT** a monitoring and evaluation programme
- **DELIVER** the demonstration projects and agree new ones, working with Historic England, the Environment Agency, National Trust and others
- **RAISE** awareness, source input and engage in dialogue about Marine Pioneers
- **ENGAGE** with government departments, local authorities, government agencies and partnerships to integrate policy, planning and delivery
- **EXPLORE** options for sustainable funding via an inter-pioneer funding group, talking to financial experts to agree strategically what should be funded
- **RAISE** money for officers and project work
- **COLLATE** and develop the evidence base for a natural-capital approach

"You might think that happens now. It doesn't; government agencies for example are often competing for money."

A PhD student is evaluating the governance process.

If all goes well, the two Pioneers will change how we think about and value our coasts and seas.

"Another challenge is to deliver projects that support natural capital that also bring socio-economic benefits to poor coastal communities"

ENGLAND'S FIVE PIONEERS

DEFRA has chosen five Pioneer areas in England, selecting areas that had active partnerships, working to gather knowledge and to agree their environment priorities.

The two projects in North Devon will also explore the interface between land and sea

"What we have to do is advocate," Dr Lannin concludes. "We must be champions, to embed a change in institutions' and personal understanding of our responsibilities and of stewardship, in particular, of the natural environment in the time that we have.

"And that, in three years, is really, really challenging. It's next to impossible. So we're trying to keep a realistic view of exactly what we can do – and to press, at ministerial level, for more support throughout the policy and delivery system."

However, Professor Austen, who has recently joined the government's Natural Capital Committee, warns that uncertainty – about future funding and political support – is creating "a sense of stakeholder fatigue".

The other challenge, says Dr Mackie, is to deliver projects that support natural capital that also bring socio-economic benefits to poor coastal communities. "We cannot separate these two things," he concludes. "If we do, we miss the opportunity to deliver much wider benefits."

Engagement is critical, Prof Austen agrees. "It's early days, but as a concept this is a good thing to do – to think about how we adopt a natural capital approach," she says. "I just wish we had more resources and more time to think about how to do things efficiently and to bring people on board, so that they feel this is worthwhile – they feel empowered.

"Unless people really feel they can make a difference, this will not work. We need to win their trust." ●

CIWEM is organising a conference on natural-capital net gain in December. See ciwem.org/events for more information

THE WATER FRAMEWORK DIRECTIVE IN A RESILIENT INDUSTRY

With the installation of event-duration monitors (EDMs) throughout UK sewerage systems, having robust performance data available for combined sewer overflows (CSO) is becoming the norm.

The implications of what to do with all this additional data have, in many ways, been addressed by the 21st century document, Decision framework for addressing high-frequency discharges from storm overflows under the Urban Waste Water Treatment Regulations (SOAF) with the need for operational reviews, extreme-event analysis, outfall assessments and, where required, water-quality impact assessments.

The expected analysis outlined within this document, and within other water-quality assessments, is to focus on typical-year events and the impact from these which, water quality experts will agree, is the general area where concerns regarding Water Framework Directive (WFD) failures will occur.

The interesting point is when you link this with the need to have resilient urban-drainage systems.

The term resilience in urban drainage can be applied to many facets of the industry. The Ofwat paper, Towards resilience: how we will embed resilience in our work (2015) explains resilience as "the ability to cope with, and recover from, disruption, and anticipate trends and variability to maintain services for people and protect the natural environment, now and in the future".

These changes to maintain services typically talk about stresses such as extreme events, population growth, development and climate change with the impact more commonly linked with catchment flooding.

But the question I always move towards is linking the want to be resilient in the way the catchment reacts with the ability to review CSO current spill frequency analysis, and in particular, CSO operation during extreme events.


CHRISHARBY/FLICKR

These are the events that will be sidelined by the SOAF assessment but will be critical in understanding how excess flow is managed within a sewer network. A network can use a mixture of extreme event release points that could be low-lying manholes or CSOs, with low-lying manholes potentially allowing sacrificial land management to be utilised.

But what if your CSO is the main release point for your network?

Even if a CSO does comply with the low-frequency spill expectations during small storms, this CSO could, in theory, discharge an excessive amount of flow during a high-return period event. And even if the expectation is that low-lying manholes route excess flow to sacrificial land, is there still a watercourse risk in the long term?

In these extreme events, can we really say that, just because we haven't flooded any houses, the system is truly resilient and able to return to its original steady state?

By keeping watercourses at good WFD status and making our systems even more resilient to higher-return period rainfall events, are we moving towards the need to understand even more about the impact from sewer systems in a dynamic, real-time environment?

This is leading to a drive to real-time assessment. Not just reading monitor data, but making informed decisions. This process of assessing data and making informed decisions is being attempted throughout the UK by water companies, to be more resilient and to manage the disruption from extreme storms.

To be able to review the rainfall forecast, set the sewer, surface water and river systems to a ready status ahead of the rainfall and then manage the excess flows in a resilient manner not just for flood protection, maintaining service to customers, but also protecting the environment.

This is a challenge that water companies are trialling in test catchments. But in many ways, there are still many steps to take account fully of the balance between flooding and WFD compliance, in a resilient manner across an entire water-company region.

RPS

UNDER PRESSURE: TOKYO'S WATER-USE CHALLENGE

Greater Tokyo is one of the most densely populated regions in the world – and that presents a particular challenge for urban water management. **Aaron Burton** reports

With a population of more than 38 million people in the Greater Tokyo area and 13 million in the city itself, Tokyo is among the largest cities in the world. And that means, as a megacity, that Tokyo experiences a range of sustainability pressures.

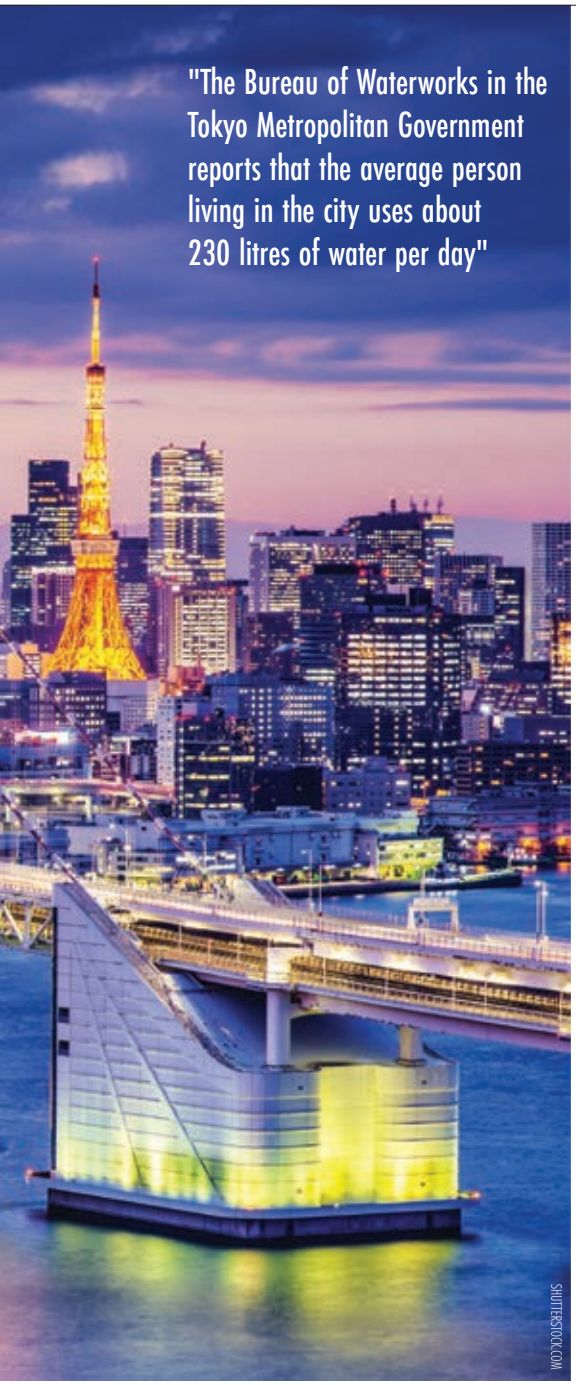
One of those pressures is water management. Ahead of the International Water Association (IWA) World Water Congress, which takes place in Tokyo in September, I wanted to explore some of these pressures on a visit to the city to develop the programme for the event.

Part of the programme focusing on resilience will focus on water use and water efficiency. To prepare for this, I visited the Tokyo Sewerage Museum Rainbow in Obaiba district, to learn more about water management in the city. This is what I've learned:

WHERE IS WATER USED WITHIN HOUSEHOLDS IN TOKYO?

Water demand in Tokyo has fluctuated, reflecting the city's economic growth and population increase. It is expected to peak between 2018 and 2027 at a maximum of 6 million m^3 per day.

According to a survey by the Bureau of Waterworks in the Tokyo Metropolitan Government, the average person living in the city uses about 230 litres of water per day. The highest use is flushing toilets, at 64 litres, followed by taking a bath or shower at 55 litres and cooking and washing dishes at 53 litres.



The museum features an interactive household showing what happens when we use water, showing visitors how it drains away in the system. This shows how much water is used when you flush a toilet for example.

HOW DOES THIS COMPARE INTERNATIONALLY?

The IWA collects statistics on a range of issues, including household water use. The latest averages from 2014 are shown below. These indicate that Tokyo is within the top third of consumption.

Average water consumption in England, UK, is around 140 litres per person per day. The EST At Home with Water report outlines water use for the UK based on a water and energy calculator. This results from this report showed showering to be the largest water user at 25 per cent, followed by toilet flushing and then other – cold tap – use.

London is the one of two cities in Europe in the top 50 worldwide by population. Current consumption in London is on average 146 litres per person per day.

Thames Water is forecasting a deficit in supply compared with demand of 864 million litres per day by 2100. From the draft Water Resources Management Plan for Thames Water, we can also compare where water is used in the home. For metered homes, which are the most easily compared, the largest water use is personal washing, followed by toilet flushing.

HOW WATER EFFICIENT IS TOKYO?

Comparing water efficiency based only on per capita consumption is too simplistic, as there are many different approaches to calculation and this approach does not account for wider factors that explain water use within cities.

The IWA's Efficient Urban Water Management Specialist Group has been undertaking research to compare water efficiency in cities over the past few years. When using a wider range of metrics, as in the Sustainable Cities Water Index 2016, Tokyo is actually rated in sixth place; London is rated 34th. This can be attributed to greater metering and water recycling in Tokyo, even though the city has a higher per capita consumption. There is potential to reduce consumption linked to toilet flushing and showering and bathing in Tokyo, however. This could come from improved efficiency of new devices, retrofit programmes and behaviour change.

The Bureau of Waterworks in Japan carries out a range of campaigns, to show households what actions they can take to reduce consumption. The bureau has also required manufacturers to develop and promote water-efficient devices.

The UK is developing per capita consumption targets, both for individual water companies and at a national level in England.

According to the Sustainable Cities Water Index 2016, Tokyo ranks in sixth place; London is 34th

The National Infrastructure Commission (NIC) has suggested that we need to reach a target of 118 litres per person within 50 years. However, CIWEM has suggested that, over the next 50 years, the UK should aim for an average per capita consumption of 75 litres per head per day, or less.

As we develop innovative new ways to engage with customers in the UK, including the community and individual incentive schemes that Thames Water and Southern Water have started to test, we must ensure that we also share this knowledge with our colleagues internationally through CIWEM and the IWA.

Aaron Burton is director of policy and innovation at Waterwise, a trustee of CIWEM and secretary of the International Water Association (IWA) efficient urban water management specialist group

UK UTILITIES ARE GOING GLOBAL TO DELIVER PR19 GOALS

Brexit presents a challenge and an opportunity for UK utilities. **Paul O'Callaghan** reports back from this summer's BlueTech Forum in Vancouver about the changing shape of innovation

When large water utilities get together, as they did at the BlueTech Forum in Vancouver, Canada in June, it creates a massive opportunity for cross-pollination of ideas. And when corporate end-users join in too, everyone finds more in common than expected.

This year's BlueTech drew its biggest ever gathering of utilities and corporate end-users. Severn Trent Water and Scottish Water attended from the UK, alongside Metro Vancouver, Denver Water, DC Water, City of Chicago and large operators such as Suez. Large corporate water end-users included Walmart, Google, P&G, Nestle, Pepsi Cola and Intel.

Tech giant Google, which operates buildings across the world and recognises the need to factor in the capacity of the utilities that supply them, provided a good example of the modern corporate's need for water know-how.

In the forum's end-user panel – a twist on the Dragon's Den model, in which corporations pitched their needs – Google sustainability programme manager Eddie Corwin said the company is seeking ways to optimise water use within existing municipal structures for water supply and wastewater collection across its real-estate portfolio.

"Figuring out opportunities to go beyond efficiency within our operations and further reduce our potable water use is one of our biggest challenges," he said.

A discussion then unwound about decentralised strategic water treatment and reuse, and about stormwater management. Water utilities were pitching too. Severn Trent Water (STW) external funding lead Paul Knuckle said the utility had five principle areas of need, including tackling leakage, abstraction reduction, minimising supply interruptions and extracting more value from wastewater.

"Brexit is creating uncertainty about the way in which UK water companies will work with Horizon 2020 in the future. It stands to reason that, if European funding is not forthcoming, they will look more widely"

"The fifth is around how we introduce technology," Mr Knuckle said, "especially artificial intelligence and the internet of things and how we make sense of big data and increase the efficiency of our operations."

PARTNERING UP

As a water-technology market intelligence company, BlueTech Research focuses on identifying industry trends, especially relating to innovation. And we are seeing a trend for UK water utilities to connect with overseas institutions.

STW has been possibly the most successful UK water utility in international collaboration, particularly in Europe, with Horizon 2020 to bring in funding. The value for STW is in leveraging millions of pounds of research funding on large multi-stakeholder projects.

One example is a full-scale demonstration test-bed site at Spernal sewage treatment works in Redditch, which secured a grant for £453,000 of funding from Horizon 2020 as part of STW's NexGen Wastewater Treatment programme.

The process under investigation is a circular-economy initiative. It uses an innovative water-treatment technology to produce biogas for use as renewable fuel.

Brexit is creating uncertainty about the way in which UK water companies will work with Horizon 2020 in the future. It stands to reason that, if European funding is not forthcoming, they will look more widely.

BlueTech anticipates that UK water firms will look at cross-collaboration opportunities further afield, with organisations such as Water Research Foundation and Water Treatment Water Energy Resilience Research Institute at Lawrence Berkley National Laboratory.

This could play a big part of the next periodic investment review (PR19) for water companies in England and Wales. The big win is that they can access a world of technological innovation and minimise the investment in research and development by not reinventing the wheel.

FASTER TO MARKET

Suppliers can collaborate and co-develop across geographies and institutions, bringing in other international partners and to get the technology faster to market.

Melbourne's utility, South East Water (SEW) is a strong example. Having established the internet of things in its own network, SEW set up a spinout, Iota, to disseminate these solutions more widely.

UK water utilities have the opportunity to watch a technology pioneered in Australia and to follow it in the UK.

In all aspects of our lives, we use and consume products developed through international collaboration across the supply chain – our iPhones, cars and computers. Water is no exception.

Industry regulator Ofwat has indicated that PR19 is about competitiveness, customer service, innovation and reliability: collaborating internationally will help utilities to meet those objectives.

United Utilities (UU) has an impressive programme at its innovation labs in Warrington. It invited seven technology companies to spend 12 weeks on site and worked with them to identify ways to add value for UU. One participant that took up the opportunity was Canadian start-up Emagin, which also won an innovation award for best market strategy at BlueTech Forum.

Emagin has developed an operational intelligence platform, enabling utility operators to manage infrastructure in real time. In the demonstration project with UU, the platform leveraged machine-learning to generate real-time pump schedules, minimising the cost of operations while guaranteeing compliance and maintenance requirements.

This delivered exceptional cost efficiencies, including energy savings of 17-22 per cent. The two companies are now exploring ways to scale their network solution and to deploy the technology in other applications.

ASK ALEXA

Northumbrian Water (NW) is another UK utility leading in this area. Its Run2Innovation programme has identified six themes, four of which map directly to PR19; customer service, resilience, affordability and customer service. The fifth is regional economic growth, and the sixth is environmental protection.

Severn Trent is pursuing partnerships overseas

NW is one of the leaders in trialling Alexa-type voice-recognition software to enhance customer support and categorise different types of request. Northumbrian is also one of several companies trialling satellite-based leak detection with Israeli technology company Utilis.

UU has combined Utilis with sniffer dogs – bringing together satellite technology and canine technology. This really is an example of looking outwardly – into space, in fact – to find solutions to meet the PR19 goals of reducing water loss and improving resilience.

> "The UK represents a unique market of 60 million people with only 12 major utility customers. In global terms, this is exceptional. Everywhere else is much more fragmented"

UK Water Partnership (UKWP) is leading an initiative to look at major societal leads in water to identify where the UK's strengths lie. Lights On aims to scope how can UK establish itself as a national water hub to meet needs at home, and position itself to export and provide those services internationally in a post-Brexit world.

The UK's tremendous brain trust in water is only now coming to the surface thanks to a survey carried out by Lights On. The universities of Leeds, Sheffield, Newcastle, Cranfield are leading research centres. There is the work on graphene at Manchester University, anaerobic technology at Imperial College London, and on sensors and metagenomics.

For all this incredible research to find its way to market, utilities will need to partner with them.

The UK represents a unique market of 60 million people with only 12 major utility customers. In global terms, this is exceptional. Everywhere else is much more fragmented.

The fact that PR19 is driving the 10 utilities in England and Wales in a similar direction is unique. There are other drivers too; climate change, population growth, ageing infrastructure and emerging contaminants. The UK shares these pressures with water utilities globally.

Couple this with the incredible opportunities coming through in biotechnology, biological treatment and advanced sensors, to name just a few, and you have an interesting mix. The water companies are increasingly driven to find ways to improve value, reduce costs, innovate and be resilient to climate change.

For international companies that is good news: it means they are open to business. For UK companies that is good news because it allows them to increase value and harness the expertise of the world.

Paul O'Callaghan is chief executive of BlueTech Research

SUSTAINABLE-DEVELOPMENT GOALS – AN OPPORTUNITY FOR PARTNERSHIP

Arup is mobilising its political, socio-economic and environmental clout to support the United Nations' 2030 Agenda. By **Justin Abbott**

In 2015 the United Nations sustainable development goals (SDGs) set out a bold new agenda for alleviating global poverty, based on 17 priorities.

Eighteen years ago, the UN launched the millennium development goals (MDGs) to reduce inequality and extreme poverty. The MDGs lifted millions out of poverty, but the world appears to have become increasingly precarious for many:

- Inequity has increased significantly, the richest 1 per cent owning half the world's wealth
- Global population has increased by 1.5 billion, with more people living in cities, which increases greenhouse gases and pollutants
- Patterns of consumption adopted by a growing middle-class population, fuelled by urbanisation and unsustainable production, mean we now use resources equivalent to 1.7 planets per year
- Most people now perceive climate change as a reality

Our ecosystems continue to deteriorate: over the last century the world has lost 70 per cent of its natural wetlands.

Transforming our World; the 2030 Agenda for Sustainable Development was adopted at the UN General Assembly in September 2015. This plan of action for people, the planet and prosperity aims to end poverty in all its forms, so that "no one is left behind".

The SDGs define a bold path for our collective future, to reverse patterns of consumption and production, repair the ecosystems on which we all depend, and enable peaceful coexistence.

Agenda 2030 applies to all countries at all levels of development, considering their different capacities and circumstances. The plan refers to shared responsibility, mutual accountability and engagement by all.

The SDGs see business as part of the solution, not the cause of the problem. "Business is a vital partner in achieving the Sustainable Development Goals. Companies can contribute through their core activities, and we ask companies everywhere to assess their impact, set ambitious goals and communicate transparently about the results," says former UN secretary-general Ban Ki-moon.

The WaterUp team is working with rural communities in India

SDG6: THE CHALLENGES

SDG6 aims to ensure availability and sustainable management of water and sanitation for all. It recognises the influence of water in securing economic development, food security, health promotion, poverty reduction and in sustaining economic growth in agriculture, industry and energy generation. It also recognises the role of water maintaining healthy ecosystems.

Its eight global targets are universally applicable and aspirational. Each government must decide how to incorporate them into national planning processes based on national context and priorities.

The targets cover the entire water cycle including:

- Provision of drinking water
- Sanitation and hygiene services
- Treatment and reuse of wastewater and ambient water quality
- Water use efficiency and scarcity
- Integrated Water Resources Management (IWRM) including transboundary co-operation
- Protecting and restoring water-related ecosystems
- International co-operation
- Participation in water management.

The synthesis report published this year reviews the SDG, including baseline status and the trends and gaps at regional and local levels. It identifies several key messages:

- The time to act is now. The world is not on track to achieve global SDG6 targets by 2030
- Effective water resources management needs more, better data. Less than half of member states have comparable data on progress towards SDG6 targets
- Access to drinking water remains a huge challenge. Over 800 million people lack access to basic water services; another 2.1 billion lack safely managed drinking water services

- Billions of people lack basic toilet and handwashing facilities. Over 2.3 billion people lack basic sanitation services and 4.5 billion people lack safely managed sanitation services.

The report concludes that the world needs to tackle weak funding, planning and capacity building as a priority. We need new partnerships involving stakeholders out with the water sector to balance competing needs and to embrace smart technologies to make interventions as efficient as possible.

In addition to the global synthesis report there is also an increasing resource of national and voluntary reporting on progress and challenges.

SDGS: THE OPPORTUNITIES

The UN SDGs provide us with a lens to think differently about how we manage the water cycle. They require us to think more broadly, adopting a Design with Water approach that recognises the wider interactions of water with the economy, ecosystems and society.

Arup addresses critical water issues by placing a re-integrated water cycle at the heart of sustainable planning, design and delivery. By aligning with, and supporting other socio-economic and environmental drivers, actions to protect and enhance the water cycle can deliver wider benefits.

The SDGS are integrated, indivisible and interlinked, and water in particular should be seen as a key integrator. An integrated and holistic approach with water at the heart of policy, planning, action and investment will be a key factor in building sustainable equitable and resilient societies.

Broader linkages between water and the other SDGs have been explored in numerous publications. There are some strong and obvious linkages:

- Hunger and nutrition (SDG2)
- Health and wellbeing (SDG3)
- Cities (SDG11)
- Sustainable consumption and production (SDG12)
- Climate action (SDG13)
- Life below water (SDG14)
- Life on land (SDG15).

We could make the case that water significantly influences all 17 SDGs. These linkages inevitably lead to trade-offs, but one of the benefits of the SDGs is to make these explicit with a view to making better decisions in policy and on projects.

Taking catchment nutrient management programmes as an example; how do we best reconcile end-of-pipe treatment to improve water quality with the immediate and urgent need to deliver affordable low carbon infrastructure?

What is the evidence base for water quality linkages with ecosystem function and performance? What data are we basing our decisions on and do we understand the impact of nature-based solutions in managing water quality?

The SDGs provide a coherent framework that encourages us to think creatively and, where necessary, to challenge the status quo. They provide a consistent frame of reference, global to local, with which to engage stakeholders and partners in shaping a better world.

At Arup we believe that these global commitments by all nations will progressively define government policy and public and private investment. The SDGs invite us to seek meaningful sustainable development outcomes across all dimensions – political, social economic and environmental.

We have, therefore, made a commitment to align our business with the UN SDGs; our collective aim is to shape a better world and the SDGs help us describe what better looks like.

And so, over the past four years we have been tracking our social impact on our projects through our Global Water Social Benefit Account. We are running a pilot to enhance our approach by mapping our projects to SDGs and reporting how we contribute to transforming our world.

We also making a social impact through our partnerships. Arup recently signed a two-year agreement with The Flow Partnership to help rural communities to manage their water to alleviate droughts and floods, and increase the availability of clean water for sanitation and other uses.

The WaterUp project team will work with rural communities in India to understand how their traditional water-management methods can be adapted, improved and replicated by communities worldwide. This will create a set of language-neutral, educational tools available for free on the Water School website, helping communities to implement simple, affordable solutions to improve their water resilience.

Visual tools will use schematics, symbols, icons and animations to share information across cultures and language barriers. The website will also crowd source ideas to help us to achieve the SDGs.

Justin Abbott is director and global water-skills leader at Arup. Contact him at: Justin.abbott@arup.com

ARUP

POLICY

WE'RE ALL WATER

Clean water and sanitation are high on the United Nations list of 17 sustainable-development goals to 2030. CIWEM head of policy **Alastair Chisholm** examines the UK's track record

"SOCIAL DEVELOPMENT and economic prosperity depend on the sustainable management of freshwater resources and ecosystems" – that's what UN Water says about sustainable-development goal six (SDG6), relating to clean water and sanitation.

Many in the UK take cheap, clean, plentiful water for granted and consider the SDGs more of a challenge for industrialising countries. However, we have our own fundamental problems: we need to manage our water resources and the water environment better in the face of increasing pressures.

Water touches everything. Like the air we breathe, it is the essence of life. Humans are roughly 60 per cent water. Take it away, we die. Pollute it and it makes us sick or degrades our environment, compromising ecosystem functions that are vital to a healthy, well-nourished and prosperous society.

Water is a cultural reference point, central to many religions and defining our identities and sense of place through our proximity to rivers, lakes and the sea and the bounty they provide. And so unless we conserve and protect our water, we jeopardise our economic and cultural prosperity.

The UK was at the vanguard of developing modern-day water-treatment and sanitation technology and infrastructure. Rapid development of towns and cities at the start of the Industrial Revolution generated barely managed sewage and wastewater that caused widespread disease. The problem soon reached Parliament as the Great Stink. MPs demanded action, launching the UK's progression to a largely centralised system of water and sanitation provision that is among the best in the world.

TARGETS

Undoubtedly, progress against the headline targets under SDG6 is strong. The proportion of the UK population using safely managed drinking water services is very high. The drinking-water standards compliance rate of roughly 99.9 per cent across the UK is reassuring to most, except the Drinking Water Inspectorate, which is apparently – equally reassuringly – frustrated at the 0.1 per cent slippage.

> Significant numbers of combined sewer overflows discharge during storms every year. Our sewer-replacement rates are behind those of our European neighbours

Statistics for those with access to adequate and equitable sanitation are very similar, at 99 per cent.

But when you contrast that with other areas of water management across the UK, you see the nub of the challenge. In 2016, just 14 per cent of river-water bodies were classified as good or better status under the EU Water Framework Directive.

Of course, the figures aren't directly comparable; issues relating to water and sanitation have a direct and immediate bearing on human health rightly command the most concerted attention. But the gulf in performance should concern us. Over recent decades, we have seen a slow decline in the quality of our water bodies. Once, heavy industry spewed toxic effluent into the British industrial heartlands' almost-dead urban rivers – but rural streams, rivers and lakes teemed with wildlife.

Today, low-level, diffuse pollution from a wide range of sources, but mostly agricultural and urban runoff, has pushed aquatic wildlife into a decline or weakened position, apart from pockets of protected sites and the most remote landscapes.

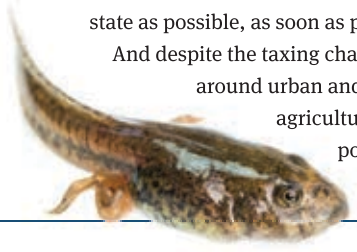
Encouragingly, governments increasingly recognise this. Wildlife bodies' committed monitoring and campaigning is highlighting the picture and the trends. And, along with environmental concerns such as climate change and plastic pollution, the state of our wildlife resonates strongly with younger voters in particular.

The message is clear: future generations won't tolerate inheriting a chronically weakened, denuded environment, exposed to increasing stresses from a growing population and extremes of weather from a changing climate.

PLEDGES

Government has pledged to tackle this fragile status. Under its 25-year environment plan, 75 per cent of all water bodies should be as close to their natural state as possible, as soon as practicable.

And despite the taxing challenges around urban and agricultural diffuse pollution, the



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water companies that provide us with such consistently high access to safe drinking water and sanitation do not come out unscathed.

There is still a great legacy of ageing sewerage and drainage infrastructure, polluting our rivers far too often. Significant numbers of combined sewer overflows (CSOs) discharge during storms every year. Our sewer-replacement rates are behind those of our European neighbours.

And although pollution incidents have generally fallen in recent years, 2016 saw an increase in water companies' most serious incidents.

At the other end of the spectrum, demand for water is growing as population increases and as demographic trends change. Government targets for more than 275,000 new homes a year to tackle a housing crisis, allied to projections of increasing levels of water stress due to climate change, mean we need concerted action on many fronts.

Our rural streams, rivers and lakes once teemed with wildlife.

More widespread use of sustainable drainage systems and natural flood management techniques will, if well designed, enhance water quality, biodiversity and amenity value

We need to be smarter capturing water when it's plentiful or oversupplied during floods to recharge our resources, storing water for when supplies are tight. This requires more widespread use of sustainable drainage systems and natural flood management techniques that, if well designed, will also enhance water quality, biodiversity and amenity value.

We probably need to develop more resources. But we also need to do a lot more to waste less. Both the Secretary of State for the Environment and the chair of the water regulator Ofwat have rightly been outspoken about why water companies must go further to promote efficiency and reduce leakage from their water-distribution networks.

How can these companies ask customers to be more careful using water when they themselves are perceived to be wasteful? As a society we can all do more to change our behaviour and become more efficient, but we need the right signals to help us. These include improved labelling of water-using products and fittings and smart water meters that show us how much water we're using and when, and help the water companies to identify and fix leaks along the UK's 420,000km of mains and supply pipes.

Consumers need ready advice on how to make the most effective savings. We must also make sure we leave enough water to enable our environment to cope with dry weather.

Abstraction-licensing reforms are introducing greater co-operation among water users at a catchment scale. This is welcome, but we must wait to see how effective the present non-statutory approach is in achieving the results we need.

UK progress against SDG6 is strong in the very obvious areas. But scratch the surface and you find quite a different picture. Our complex and intertwined pressures will only grow between now and 2030. We must focus on our water stewardship.

In the UK we have largely addressed those pressures of immediate concern to human wellbeing. But the remaining pressures require more than engineering might and scientific ingenuity to resolve.

They also need vision, compassion, persuasion and co-operation. Above all, they need political will, and for UK government to be ambitious in delivering the SDGs. o

EVENTS

CIWEM – GET TOGETHER, GET INVOLVED

www.ciwem.org/events

27 SEPT — CIWEM presidential induction
LOCATION: West Midlands

28 SEPT — CIWEM North West and North Wales Branch annual dinner
LOCATION: Holmes Chapel

17 OCT — Surface Water Management 2018
LOCATION: London

6-8 NOV — Urban Drainage Autumn Conference and Exhibition 2018
LOCATION: Blackpool

14 NOV — Mentor Training
LOCATION: London

5 DEC — Water Resources: are we fit for 2050?
LOCATION: London

CIWEM organises events across the UK and internationally

For full information visit www.ciwem.org/events

Contact the events team on +44 (0)20 7831 3110 or email events@ciwem.org

To sponsor an event call +44 (0)20 7269 5810 or email sponsorship@ciwem.org

UKCP18

UKCP18: TOMORROW'S CLIMATE PROJECTIONS

UKCP18 – the next generation set of climate-change projections – will use cutting-edge science to provide updated observations and climate-change projections to 2100, in the UK and globally, write **Megan Gawith** and **Caroline Webster**

THE UKCP18 PROJECT harnesses the latest science and supercomputing capabilities from the Met Office Hadley Centre, combined with the expertise of the Environment Agency and the Department for the Environment, Food and Rural Affairs (DEFRA).

It builds on UKCP09 to provide the most up-to-date assessment of how the UK climate may change over the 21st century. The project will update UKCP09 projections for UK land areas and for sea-level rise, giving greater regional detail, analysing the risks we face, nationally and globally, and providing more information on potential extremes and impacts of climate change.

So why do we need updated projections? UKCP18 will equip the UK with information to adapt to the challenges and opportunities of climate change. UKCP18 will provide essential information for future climate change risk assessments and help equip the UK to adapt to the challenges and opportunities of climate change in line with the National Adaptation Programme.

THERE ARE THREE COMPONENTS TO THE UKCP18 PROJECT:

1. OBSERVATIONS OF HISTORIC CLIMATE

The annual State of the UK Climate report for 2017 will be included as part of the UKCP18 package, bringing the observed data right up to date. This annual update covers trends, the multi-decade climate record and significant weather events such as the hot spell of early July 2015 and the exceptionally mild and wet December that year.

Quality-controlled UK observational datasets from the Met Office observations network, provided at spatial resolutions to match the land projections and for pre-defined administrative regions and river basins, will be available under an Open Government Licence.

For variables such as temperature and precipitation these data sets will span the late 19th century to the present day and will be provided for daily, monthly, seasonal, annual and long-term averages.

2. MARINE PROJECTIONS

Sea level rise projections will extend to 2100 and will include contributions from glaciers, ice sheets, freshwater reservoirs, groundwater and thermal expansion. Outputs will include an estimate of the year-to-year changes in sea level rise.

A new feature of UKCP18 will be exploratory sea level rise projections to 2300. The projections will use the latest information from the CMIP5 models and apply methods used in the Intergovernmental Panel on Climate Change's (IPCC) fifth assessment report.

Storm-surge projections will be updated to provide new estimates of the change in high-water levels over the 21st century. These estimates will be based on a combination of projected mean sea-level change and projections of change in the extremes due to changes in atmospheric storminess. These storminess projections will use the same surge model as in operational weather forecasting, using the wind and pressure from the CMIP5 ensemble to drive the surge.

New understanding of the modification of large-scale sea-level change signals as they pass from the open ocean onto the shelf sea around the UK will be incorporated into the UKCP18 marine projections.

UKCP18 will also include storm surge historical case studies derived from applying plausible future sea level change to historical extreme events.

3. PROJECTIONS OVER LAND

UKCP18 will update probabilistic projections of climate change over land and produce a set of high-resolution spatially coherent future climate projections for the globe at 60km scale and for the UK at 12km scale. The 12km climate model will be scaled down further, to a level previously used only for short-term weather forecasts allowing realistic simulation of high impact events such as localised heavy rainfall in summer.

Global projections at 60km scale will enable more realistic simulations of climate for the UK and capture the drivers of extreme weather, a significant advance on the 300km-resolution global simulations that informed UKCP09.

Probabilistic projections at 25km will be updated using an up-to-date collection of Met Office climate-model simulations and the latest IPCC-assessed simulations. These will be based on the method that UKCP09 used for estimating uncertainty for use in risk-based analysis.

Projections will be on a 25km grid for the UK at monthly intervals for several emission scenarios, including the SRES

A1B scenarios used in UKCP09. The new, probabilistic projections will indicate the range of uncertainty in our knowledge of the climate system and natural variability through the 21st century, using probability density functions to provide information on how climate varies from month to month.

This contrasts with UKCP09, which provided only 30-year means.

Downscaled high-resolution projections will provide information at a scale relevant to adaptation at two different resolutions.

The 12km model provides a downscaled product similar to UKCP09's 25km simulations but driven by an improved global model and at a higher resolution. This may be especially useful for those interested in water availability and some aspects of agriculture. A key reason for providing this data is that users will be able to compare it directly with EURO-CORDEX.

The global projections will also be downscaled to 2.2km using nesting models at finer resolution that maintain the integrity of the representation of evolving atmospheric processes.

Key benefits of simulations at this resolution will be the information provided on high-impact events such as localised heavy rainfall in summer and potential improvements in the diurnal cycle.

The output will be available at a time resolution of three-hourly, possibly higher for some output, for a high-emission scenario.

Spatial coherence will be maintained and specific time slices, such as 2061-2080, will be available.

USING CLIMATE-CHANGE PROJECTIONS

The existing UKCP09 climate change projections have been widely used to assess future risks, as case studies on the UKCP09 website show.

Organisations and individuals will be able to use UKCP18 to inform future risk assessments and adaptation plans, ensuring they are resilient to extreme weather and climate change. Examples may include:

- To understand how changes in coastal-erosion risk and river flood risk could impact on flood defences and infrastructure
- To better understand future drought severity, frequency and extent and so how we manage our water resources
- To provide information on future habitat suitability for our flora and fauna
- To understand how we should design or adapt our buildings to ensure they are energy-efficient and comfortable to live and work in.

Demonstration projects have been conducted during the development of UKCP18 to show how the new information could be used for such studies. The projects describe how existing methods or risk-assessment approaches can still be used and where new methods could be developed to exploit the opportunities that UKCP18 data brings.

Short leaflets showing the potential application of UKCP18 in the management of water resources, flood risk, coastal-erosion risk, forestry and building design can be downloaded from https://www.metoffice.gov.uk/research/collaboration/ukcp/ukcp18-demonstration-projects.

HOW AND WHEN CAN I GET THE UKCP18 INFORMATION?

The UKCP18 climate projections will launch in late 2018, with the exception of 2.2km. The website will provide key messages about the future, guidance on how to use the projections data, peer-reviewed science reports, case studies, and a user interface for selecting and downloading data and customising visualisations.

Web-application developers will also have access to an application programming interface (API). The 2.2km high-resolution data and science report will be released next year.

For the latest information visit www.metoffice.gov.uk/research/collaboration/ukcp

Megan Gawith is principal scientist at the Environment Agency. Caroline Webster is senior communications executive at the Met Office. They contributed this report on behalf of the UKCP18 project

UKCP18

UKCP18: WHAT WILL SUCCESS LOOK LIKE?

UKCP18 will update the UKCP09 climate-change observations and projections, with a range of new products for application in climate-change risk and opportunity assessments and related decision-making across the UK, write **Adam Hosking** and **Peter von Lany**

ONGOING, LONG-TERM CHANGE of our climate, and thus of the environment, is a simple fact. The challenge for UKCP18 is to translate that message into relevant, workable information that drives better management of future change. We will measure its success in the uptake and application of UKCP18 outputs. UKCP09 recognised the complexity and uncertainties inherent in future climate-change projections. UKCP18 builds on this, providing greater detail in its projections.

UKCP18 considers a new set of emissions scenarios, which reflect climate-change mitigation strategies. However, uncertainties regarding future emissions limit our ability to predict exactly what the future climate will be. That uncertainty can be used as an excuse or a reason for inaction.

The UKCP18 projections provide confidence in the direction that climate change is likely to take and indicates the range of this change.

In working with the UKCP18 projections, we must highlight the certainty of change in our future climate, not the uncertainty in specific values, to drive action on adaptation.

CIWEM's policy position statement on climate-change adaptation calls for climate-change data that is "usable and relevant" to the needs of industry, business and the public, to better encourage adaptation.

CIWEM's Climate-change Network believes that companies will invest in adaptation planning and actions based on a clear narrative and understanding of the trajectory of change, without needing additional complex climate modelling.

The UKCP18 project team has worked with potential users to understand what information and products will help them most. With these products in place, the challenge then is to maintain supporting discourse that articulates why action is imperative.

SUPPORTING PRIORITY ADAPTATION NEEDS

The second National Adaptation Programme (NAP) was due to be published this summer, ahead of UKCP18. The timing offers an opportunity to extract key aspects of the new projections to support the priorities set in the NAP.

To have the NAP define the need and UKCP18 provide the information on ways to meet those needs provides a strong platform, helping the UK to move forward with managing risks and opportunities to climate-change and improving long-term resilience.

CIWEM's Climate-change network steering group has identified several priority areas that need urgent, strong action to reduce risks associated with climate change:

- Risks to soils from increased seasonal aridity and wetness
- Risks of land-management practices exacerbating flood risk
- Risks to infrastructure from river, surface/groundwater flooding, and coastal flooding and erosion
- Risks to water abstraction and public water supplies from drought and low river flows
- Risk to people, communities, buildings and business sites from flooding.

Demanding improved management of these risks relates, in part, to improved co-ordination of responsibilities and action. The NAP must address these, but we must also have access to "usable and relevant" climate-change data.

UKCP18 will improve scientific understanding of the implications of climate change in the context of these risks.

Those concerned with climate change in public and private sectors, the research community and government, must use the UKCP18 data and products effectively to understand climate-change impacts.

Having invested significantly to improve scientific understanding of how our climate could change, we must now invest to support those who assess climate-change impacts and deliver adaptation responses to priority risks.

NEW PRIORITIES

In addition to more detailed data on the projections presented in previous UKCP outputs, UKCP18 will include new products not previously quantified in a systematic way. These will provide important new insights into future climate-induced environmental change

These new outputs present some challenging additional questions around our priority risks.

Sea-level rise projections to 2300 present ongoing sea-level rise, regardless of future emission scenarios. The IPCC has described this very long-term sea level rise, but it has never been part of the projections. Our decision making at coastal sites tends to focus on adaptation to changes to the end of the century. Clear presentation of sea level rise long beyond 2100 will reinforce the need to re-evaluate the sustainability of our near-term decisions. The Thames Estuary 2100 Plan considered the long-term implications on flood risk of sea-level rise of more than 4m above baseline, assessing the adaptive potential of near- and longer-term actions by developing adaptation pathways. The projections to 2300 should enable us to apply similar approaches elsewhere.

Similarly, high-resolution projections that better represent high-intensity convective rainfall are likely to define future intensities that are higher than previous projections have suggested. When UK Water Industry Research considered the implications of changing rainfall intensity for sewer design, it applied early outputs from the joint Met Office/NERC CONVEX project. This demonstrated that the high-resolution climate model produces significantly greater increases in peak rainfall intensity than previous down-scaled approaches. These projected increases have significant implications for pluvial flooding and performance of combined sewer systems. Having this high-resolution intensity data for the whole UK supports a critical evaluation of sewer capacity that will identify actions to manage higher rainfall intensities.

For the practitioner community to better understand the implications of the new UKCP18 climate data products, we must consider these issues, identify the potential impacts and vulnerabilities, and provide useable and relevant data to decision-makers.

So, what will success look like?

We will measure the success of UKCP18 in the extent to which industry, business and the public embrace it to update assessments of climate-change risks and opportunities, and the support it offers to climate-change adaptation actions.

We all have a part to play in that uptake. Government must identify adaptation priorities and pursue programmes to better manage risks. Research groups must understand and apply the data to assess the implications of climate change. In turn, this will give industry and the public more confidence in understanding the implications of climate change. It will help them to act to manage the opportunities and vulnerabilities that our future climate presents.

We have every confidence that the UKCP18 products, based on the latest science and supercomputing capabilities of the UK Met Office Hadley Centre, will build on the success of UKCP09.

They will provide a world-class, scientific basis for managing future climate change. When they are published we, the practitioner community, must engage with these products to deliver world-leading adaptation responses to climate-change risks and opportunities.

Adam Hosking is global water resources director at Jacobs, and chair of the CIWEM Climate-change Network steering group. Peter von Lany is strategic water management technical lead at Jacobs

UKCP18

AGRICULTURE AND CLIMATE CHANGE

Is UKCP18 a new opportunity for improving climate change adaptation in UK agriculture? **David Haro**, **Geoff Darch** and **Jerry Knox** report

THE UK AGRICULTURE sector, which accounts for circa 72 per cent of UK land area, features cropping, arable and horticulture, and livestock farming of beef, dairy, pigs and poultry. It is strategically important for food supply, providing just under half the food the UK consumes.

Although most crops are rainfed, supplemental irrigation has the potential to become more important and more widespread – if adequate and reliable water supplies are available.

Irrigation is important for high-value, field-scale vegetable and potato crops, but is also becoming more widespread on cereals, notably wheat, where extreme temperatures and drought stress can affect crop development and yield.

Of course, the economic viability of irrigation depends on the benefits that accrue, which are a function of yield, any price premia for quality assurance and for staple crops, world market supplies and price.

A changing climate will increase production risks and impose greater uncertainty in water supplies and demand for agriculture, for irrigation and for livestock production. More than half of all irrigated production is located in catchments defined as over-abstracted and/or over-licensed. This creates concerns regarding the impact of increases in water demand on resources' availability and the environment.

Moreover, climate change is expected to exacerbate the situation, with greater rainfall uncertainty impacting on stream flows and making direct summer abstraction less reliable. There may be higher rainfall in winter, but we would need significant additional storage to provide resources at the right time.

The UK Climate Change Risk Assessment (CCRA) 2017 Evidence Report set out how climate change combined with population growth might exert greater pressure on water availability for agriculture and for public water supply, and how extreme weather might impact on international food production, trade flows and supply chains.

By the 2050s, many catchments across the UK are expected to face reduced water availability and rising competing demands for water between public supply, industry, power generation, agriculture and the environment.

Longer-term incremental changes in climate will also affect land suitability for agricultural production in regions critical to national food production, including eastern England. Recent initiatives such Water Resources East (WRE) promote multi-sector collaboration to identify resource options that might increase resilience in water supplies including shared investments in new water infrastructure.

The CCRA report recognised that although a policy framework exists for managing these long-term risks, an agile approach will be required as the policy landscape develops. It recommended continued, flexible action to take account of the uncertainty surrounding future projections of seasonal rainfall, including increased frequency and intensity of water shortages and drought, and to manage the impacts of these risks on UK food prices, considering the links and feedbacks between agricultural production, food demand, markets and land-use trends, to identify a range of policy alternatives.

CLIMATE PROJECTIONS

Agriculture is probably one of the sectors that has benefited most from climate data products since climate models were developed.

UKCP09, the last version of UK climate projections, was extensively used in UK agriculture studies investigating impacts and adaptation responses linked to agricultural yield, flooding, pest and disease risks and livestock health impacts.

But despite the valuable advances and knowledge this generated, users raised some concerns. For example, the UKCP09 weather generator could not

CASE STUDY: WATER RESOURCES EAST

The Water Resources East project is an example of integrated water resources planning for agricultural, environmental, energy and public water demands. Using a robust decision-making approach, it considered a large number of climate and socio-economic scenarios and droughts and made extensive use of UKCP09. It tested a wide range of options for balancing future supply and demand with stakeholder trade-offs at the heart of the decision-making process. In addition, catchment-level studies have been used to consider local demands and supply of water including new catchment partnerships.

David Haro, Jerry Knox and Geoff Darch

A changing climate will impose greater uncertainty in water supplies and demand for agriculture, for irrigation and for livestock production

represent certain extreme events, due to uncertainties in the underlying science, such as blocking patterns associated with drought conditions.

The reduced availability of spatially coherent projections also constrained options to conduct in-depth analyses and to compare sub-regional impacts on agriculture. Both are relevant, as key elements in decision-making for farmers and water-resource managers.

First, dry years pose a significant risk to agricultural production, particularly the irrigated sector, with reduced stream flows and heightened risks of abstraction restriction. Second, the spatial distribution of weather is critical, determining river flows and aquifer recharge and defining water availability in catchments.

"More than half of all irrigated production LIES in catchments defined as over-abstracted and/or over-licensed"

Finally, although UKCP09 provided probabilistic assessments of future climate for individual variables – rainfall, temperature, radiation – it was conceptually difficult to select the combination/s of probabilities. Lacking robust guidance, many studies simply chose the 50th percentile for each variable.

UKCP18 will update findings on climate change and uncertainties and provide new, better-quality information. Its downscaled high-resolution projections will provide greater spatial granularity, better representing extremes and information on sub-daily timescales.

Its high-resolution projections will be spatially coherent, for direct use across large catchments and regions. It will allow comparison with European climate products.

MULTI-SECTOR ADAPTATION PLANNING

Previous agricultural assessments assumed a single climate impact with no links to other climate parameters or feedbacks to other aspects of agriculture. Integrated frameworks must consider the impacts and feedbacks from climate and from socio-economic changes to support more objective assessment of the risks, consequences and sensitivity of agriculture to climate change.

Recent research has also highlighted the policy risks in conducting single-sector climate-impact assessments. These studies risk misrepresenting the spatial shape, direction and magnitude of many impacts and neglect critical interactions between anthropogenic and environmental systems.

Developing policies to make UK agriculture more climate-resilient demands much greater attention to the links between agricultural production and competing water uses, particularly in catchment hotspots, where irrigated agriculture is concentrated and where future supply-demand imbalances might occur.

Multi-sector initiatives provide new insights and valuable understanding to inform national policies and regional planning, identifying targets, resources and incentives for adaptation, and fostering research to achieve more resilient agricultural practices.

National climate-change policies should also identify options to encourage innovation in agriculture and investment in new food crops in regions with favourable soils and agroclimatic conditions and where new markets might emerge.

The UKCP18 weather dataset provides a new opportunity to approach climate-change adaptation with improved and extended data. These initiatives will continue the work started in previous years, where impacts of climate change and adaptation measures are best explored from a multi-sector perspective.

David Haro works for Estacion Experimental de Aula Dei – Consejo Superior de Investigaciones Científicas. Geoff Darch works for Anglian Water. Jerry Knox is based at Cranfield University

EXPERIENCE FROM SPAIN

As in the UK, other countries in Europe have initiated or renewed their strategies for adaptation to climate change in recent times.

In Spain, where the agriculture sector constitutes an important pressure on water resources and is a major supplier of UK markets, authorities have put the development of improved future climate projections as a high priority on the research priorities list, paying special attention to the spatial-temporal distribution of rainfall and temperature. The objective is to provide improved and more reliable measures of evapotranspiration, soil moisture and plant interception.

Also, to improve reliability of aquifer recharge estimation and the development of detailed streamflow and water management models. All this will lead to a better evaluation of the response of crop and livestock to future changes in climate that will allow forecasts of the effect on productivity, biotope adaptability and seasonal dynamics of plant processes.

BREXIT COUNTDOWN: DEAL OR NO DEAL?

AS AUTUMN APPROACHES, nothing will dominate debate about environmental policy more than Brexit, *writes CIWEM head of policy Alastair Chisholm*.

The final deal must be agreed in October. At this point we will have a clear picture of the extent of regulatory alignment – ie, which agencies and frameworks we will participate in.

Or not.

The government had set out its position at the time of writing in the white paper, The future relationship between the United Kingdom and the European Union. This makes a commitment to "non-regression of environmental standards".

This can only be positive – but could all change in the not-unrealistic event of no deal. Either way, the waiting should be over soon.

We expect environmental principles and governance, agriculture, and fisheries bills to be laid before Parliament this side of Christmas. These set in train the serious job of putting together new bodies and new regimes to manage crucial environmental issues. Consultation has been concluded, or continues – in Wales on agriculture, for example – on environmental governance and on the future of agriculture. These give government the basis to develop more concrete proposals, to be scrutinised further.

Elsewhere, it is hard to escape the influence of Brexit even if policy development is not directly informed by the need to establish new instruments.

A waste and resources strategy is expected, which should spur considerable discussion after years in the policy wilderness for waste management.

And the concept of delivering environmental net gain, building on the more established biodiversity net gain and central to the government's 25-year environment plan, should be subject to consultation.

Both will need to consider how we achieve the best outcomes outside of the European Union.

OBITUARY: JACK GARNETT RODGERS

By CIWEM chief executive **Terry Fuller**

I AM SAD TO ANNOUNCE the death on June 19 of past president of CIPHE, Jack Garnett Rodgers, FCIWEM, C.WEM, Hon FCIPHE, MCIPHE RP. He was 95.

Jack's work at Building Design Partnership and his involvement with CIWEM and CIPHE were major factors in his life, not only because of the contribution he felt able to make to both society and the industry, but also because of the friends and colleagues he made along the way.

He will be sorely missed by family and friends alike.

CHRIS BROOME WINS JACK LEWIN PRIZE

CIWEM RIVERS AND COAST GROUP has awarded this year's Jack Lewin Prize for an outstanding contribution to flood and coast risk management to Chris Broome, MCIWEM, C.WEM.

Chris Broome retired last year, having spent 30 years in the water industry, specialising in flood risk. But he remains busy, working with his local rivers trust, on water-related projects in Belarus and Ukraine and with a charity that offers rest and recuperation to the children of Chernobyl.

Accepting the prize at the RCG Group AGM in Leeds in June, he said: "I'm just as busy in retirement as I was during my working life. I'm just back from working in Ukraine and Belarus on a ground-water project. The results of the project are already showing a big drop in levels of nitrates after just three weeks."

Aecom regional director water Fay Bull (right) took over as chair of CIWEM's Rivers and Coast Group from David Thomas (left) at the AGM in Leeds.

The lives of the children of Chernobyl are still blighted, more than 30 years after the nuclear reactor incident, because their water, food and the wider environment are contaminated. "We have to carry on helping these kids – and that's what I plan to keep doing over the next few years," Mr Broome said.

CIWEM – MEET THE TEAM

Lucy Norris has joined the CIWEM membership team

TELL US WHAT YOU'RE DOING AT CIWEM

As CIWEM's new membership administrator, I provide administrative support to the membership team and guide individuals through their student, graduate and non-chartered membership applications.

TELL US A BIT ABOUT YOUR BACKGROUND

I recently graduated with a BSc degree in Geography from Royal Holloway, University of London. I have a keen interest in environmental affairs, particularly how human activities impact on all aspects of nature. I also run a monthly river clean-up along the River Wandle for the Wandle Trust and South East Rivers Trust.

WHO INSPIRES YOU?

Dian Fossey, Jane Goodall, Elon Musk and, of course, Sir David Attenborough, who have all dedicated their careers to conservation, raising awareness of the importance of protecting the environment and working to improve the way humans live by reducing our impact on nature.

None have been afraid to break the mould to make a positive change and, because of this, they all leave a legacy.

WHY DO YOU ENJOY WORKING FOR CIWEM?

Working for industry leaders in the water and environmental industry alongside other people who are truly dedicated to create a safer, more sustainable world has made my time so far enjoyable and meaningful. And being able to interact with and support people starting out in the sector, helping them to progress and influence the way the environment and waterways are managed, is very rewarding.

IN MY SPARE TIME, YOU'LL FIND ME...

Being active. I enjoy trying new sports – I have been skydiving, white-water rafting, canyoning, coastal scrambling and I regularly run, cycle and hike outdoors. I also love cooking and, more importantly, eating.

Connect with Lucy online at: www.linkedin.com/in/lucynorris31

CIWEM LEADS DEBATE AT FLOOD EXPO

CIWEM CHIEF EXECUTIVE Terry Fuller, Rivers and Coast Group chair Fay Bull, Environment Agency director Claire Dinnis and The Environment contributor Mary Dhonau join forces this month to lead a panel discussion at Flood Expo in Birmingham.

Visions of a Flood-resilient UK, 2050 is one of the highlights at Flood Expo 2018, taking place on September 12-13 at the NEC in Birmingham. Flood Expo bills itself as the world's largest flood resilience, mitigation and rescue exhibition and conference.

Organisers expect to attract more than 4,000 flood professionals. Flood Expo will showcase innovative products and infrastructure to tackle the threat of rising seas, coastal erosion and urban flooding. It features 150 exhibitors and 100 expert-led seminars. Exhibition visitors can meet the team from CIWEM on stand 4D23.

The panel takes place at 2pm on Wednesday September 12.

NORTHEY GRANTED FELLOWSHIP OF CITY AND GUILDS OF LONDON INSTITUTE

CIWEM MEMBER Christopher Northey, has been granted a Fellowship of The City and Guilds of London Institute for his "outstanding contribution to the engineering sector and his promotion of vocational education". He became a member of CIWEM in 2001.

Mr Northey started his career at 17 as a plumbing apprentice within the family business and completed City & Guilds craft and advanced craft certificates in plumbing, going on to work in public-health engineering. He studied building services engineering design and management at the University of Reading, before becoming a chartered engineer.

He has worked to promote plumbing apprenticeships as a pathway to becoming a chartered engineer and to pass his knowledge and experience on to the next generation of engineers and designers.

Christopher Northey (left) receives his fellowship diploma from City and Guilds chairman Sir John Armitt

CIWEM: RELEVANT, ACCESSIBLE – AND MORE DIVERSE

2018 will be remembered as the year that established a transformation of CIWEM, writes **Terry Fuller**

At our annual general meeting this year we set out some significant foundations for the growth of our institution and support of our members. Our plans are bold while being true to CIWEM's core values and the heritage that underpins our strengths.

Our strategy has two key principles: that we are relevant and that we are accessible. These bring some very important emphases, including our continuing desire to strengthen relationships with our members especially through our branches, technical networks, groups, boards and committees.

The foundations include changes to our Royal Charter and bylaws. These bring our governing documents in line with contemporary practices and improve the effectiveness of our institution. Following consultation with our full membership the changes were approved at our AGM and these will now go to the Privy Council for ratification in September.

One of the changes allows any of our members to stand as CIWEM president, making this prestigious role accessible to all.

Our growth is fuelled by the talent and dedication of our members who voluntarily engage in our activities. Our executive team provides central support and leadership.

We have invested in new roles in the team to strengthen our services to members and the public. Our regional branches and groups are central to this and we have employed Barbara Woods to develop plans tailored to our local ambitions that complement our corporate aims.

We are a learned society and so our work to accredit the training offered by universities and colleges and employers is central to our drive to increase professionalism. We also offer our own courses on technical subjects, mentoring, management and the soft skills required by today's practitioner. These activities are expanding under the leadership of Joseph Wilson and Rachael Bliss. We promote the interests of the public through influencing decisionmakers, raising awareness and inspiring people to apply themselves to solving global environmental challenges. Our policy team has been strengthened by Heather Jones and Sarah Anderton joining us under Alastair Chisholm's leadership.

Allied to this are our publications and journals and we are delighted to have Karen Thomas as our full-time editor of *The Environment* and for Vicky West to be dedicated to leading our full suite of publications and awards.

As I look towards the achievement of our ambitions I see one factor that is crucially important to our success and the achievement of our aim to be accessible and relevant. Much is said and is written about diversity and inclusion (D&I) and all sustainable organisations have activities and policies dedicated to improving this.

CIWEM is no exception. A diverse organisation creates diverse thinking and different perspectives. In this way, and only in this way, will we find the solutions to our global challenges.

I see the usual measures of diversity as indicators of how diverse our thinking is and how fairly we represent the public. The metrics are not the goal. We have some way to go in CIWEM which is why I, and our Trustee Board, are looking at ways of improvement.

If anybody has an experience or perception of CIWEM that they feel inhibits their participation in our institution, I would like to know about it. Equally, good examples are also welcome.

CIWEM is an exciting organisation to be a part of, facing a world full of immense challenges and opportunities.

Never has our Institution been more relevant.

Our desire and ability to be accessible to all has never been greater.

Terry Fuller is chief executive of CIWEM

3 IMPORTANT EVENTS OVER 2 DAYS, IN 1 GREAT SHOW

27th - 28th February 2019
Peterborough Arena

FLOODEX run in partnership with the Association of Drainage Authorities, attracts more senior people from IDBs than any other event.

Only dedicated event, run in association with the UK Irrigation Association, which will see the UKIA hold its annual conference at **IRRIGEX.**

The **Association of SuDS Authorities** (ASA) will be holding its launch event and conference, for sustainable drainage planning and implementation, for flood professionals within Local Authorities.

Take advantage of these important events to generate business and open valuable, new contacts.

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