WEEG NEWSLETTER June 2021

The newsletter is published monthly by the University of Southampton's Water and Environmental Engineering Group WEEG, and reports things of interest in this field worldwide, as well as ongoing undergraduate student and research work in WEEG itself.

We believe that water and energy are the most important topics worldwide for the next decades. Our work covers river and coastal engineering, water and wastewater and energy related to water.

Editorial: so, here's the second part of our mini-series on water crimes. Today, we are looking from low level stuff such as theft, to – yes - water terrorism.

Hydraulic Engineering International: *Water Crimes, part 2*

The recent legalisation of marijuana in the State of California has led to an increase both legal and illegal production. The limiting factor for production is of course the water supply. For legal production, permits are required whilst for illegal – well, not so. This has led to a growing number of cases where producers illegally acquire water for their farms. Fig. 1 shows a water container seized by the police.

Fig. 1: Police photo of illegal diversion of water in Mendocino County, California

The authorities then focus on the water crime rather than on a potentially illegal plantation, since here the case is much clearer. Plus, penalties can be quite harsh and sympathy from neighbours is usually rock bottom.

Water crime can however be much more sinister. Water supply systems are vulnerable at several different levels. The first aspect that springs to mind is the water infrastructure. In the US, the Department of Homeland Security FEMA had already recognised this danger by 2002 and included dams and reservoirs in the national safety plan.

Compared to infrastructure, chemical or biological attacks on water supply are relatively difficult to carry out as they generally require large amounts of the contaminating agent. If the threat becomes public, however, it may achieve a disproportionate impact by creating public fear and anxiety.

In 1970 an anti-imperialist group known as the Weathermen tried to obtain biological agents to add to the water supply in US cities. 1n 1972 two members of a right-wing group were actually arrested with 30–40 kg of typhoid cultures, allegedly intended for Chicago's water system. Other examples come from outside the US: in 1973 a biologist threatened to contaminate water supplies in Germany with anthrax unless he received a large ransom. While these threats are often implausible or unlikely to be effective, in 1984 a religious cult in Oregon successfully introduced Salmonella into a service reservoir, leading to a local outbreak with more than 750 cases.

Attempts to use chemical agents have a similar history. In 1985, for example, a survivalist group in Arkansas obtained 30 gallons of potassium cyanide with the aim of poisoning the water supply in cities including Washington DC. The scheme was apparently based on a belief that a mass killing would hasten the apocalypse, rather than being an attempt to influence government policy; fortunately the quantity of poison was probably insufficient to achieve its goal. In 1992, however, the Kurdish Worker's Party claimed responsibility when lethal concentrations of potassium cyanide were found in the water storage tanks at a Turkish Air Force compound in Istanbul. Economic grievances have also led to water-related crimes, such as the 2010 contamination of the Po river in Italy in an act of sabotage against an oil company.

Fig. 2: Water crimes are recognised at EU level

Cyber-attacks like the one in Florida earlier this year have a much shorter history, for obvious reasons. Reports are quite rare, although in Australia in 2000 a local man hacked into a district wastewater system in Queensland causing millions of litres of raw sewage to discharge into local parks and waterways. A

former water company employee in Kansas has just been indicted for an attack in 2019, and two more incidents were recently reported in the San Francisco Bay Area and Pennsylvania.

The motives of such lone attackers may be unclear, but the increasing use of digital online control makes this sort of interference easier for many actors. The 2012 Global Water Security report suggested that "*terrorists or extremists almost certainly will target vulnerable water infrastructure to achieve their objectives*.", while the US Intelligence Worldwide Threat Assessment 2015 noted that "*terrorist organizations might… seek to control or degrade water infrastructure to gain revenue or influence populations*".

Fig. 3: NBC News on water cyber attacks

Awareness of the potential for cyber-attacks on water systems is therefore growing, but perhaps not as fast as opportunities for them to occur. And maybe there is a topical parallel here: pandemics were identified some time ago as one of the top potential security issues for the UK, but identification and taking steps towards preparedness are not the same thing...

Which brings us to the question of how to deal with these threats. Many ideas have been suggested, from further limiting access to key sites to increasing surveillance. The development of sensors that can rapidly alert operators to unexpected changes is one promising approach. But given the wide variety of actors, motives and modes of operation this is clearly a case where "more work is needed", bringing together a range of disciplines and agencies to protect the safety of our water.

3rd Year Individual Project (IP): *An Enhanced Quick Assessment Tool for Long-Term Simulation of Nature-Based Coastal Engineering*

The large difference between the timescales of hydrodynamic and morphodynamic change limits the computationally efficient modelling of coastal evolution. This is important in the context of nature-based engineering, where long-term iterative simulations are required. Currently, a morphological acceleration factor morfac is used to accelerate simulations.

In this project, an alternative acceleration algorithm was designed using the numerical model XBeach to more rigorously predict the evolution of beach profiles. Test profiles were used to calibrate the algorithm, based on a non-dimensional parameter representing the profile's erodibility. It was found that the acceleration algorithm predicts beach profile evolution with similar (and often greater) accuracy than morfac, and was approximately twice as fast. Figure 4 compares the outputs of an algorithm accelerated and non-accelerated simulation of one of the test beach profiles

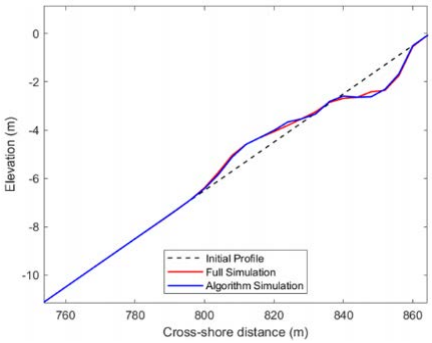

Fig. 4: Comparison of output from non-accelerated (full) and algorithm accelerated simulation of a steep linear beach profile

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Jobs in water engineering:

This section gives you ideas of the type of work you can do when working in industry.

Advert: Here is a Graduate level post with an environmental engineering flavour:

Graduate Engineer - Civils and Environmental

https://www.icerecruit.com/job/201033/graduate-engineer-civils-and-environmental/

Civil and Environmental Engineering at Southampton University:

WEEG: our modules offer the chance to deepen your knowledge in water-related areas, and give better preparation for environmental engineering projects.

Contact: Dr Sonia Heaven, s.heaven@soton.ac.uk, Bldg. 178, Room 5021

Further information:

We have two Facebook pages, which provide a logbook of our laboratory activities:

www.facebook.com/Hydraulicslaboratory/

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