THE FOUNDATION FOR SCIENCE AND TECHNOLOGY

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THE LORD LLOYD OF KILGERRAN AWARD LECTURE

LESSONS FROM THE FLOODING OF NEW ORLEANS: COULD IT HAPPEN IN LONDON?

Held at The Royal Society on 11th December, 2007

We are grateful to
City & Guilds of London Institute and Risk Management Solutions for supporting this event

Chair: **The Earl of Selborne KBE FRS**
Chairman, The Foundation for Science and Technology

Speakers: **Dr Scott Steedman FREng FICE FRSA**
Director of Group Strategy, High-Point Rendel and
Vice President, The Royal Academy of Engineering

DR.STEEDMAN outlined the circumstances of the flooding in New Orleans in 2005. He described how the path of the hurricane - a storm covering an area of the size of the UK - drove winds and created a sea surge which raised sea levels and funnelled water into the New Orleans area. This led eventually not only to overtopping sea defences but to severe damage of 169 out of the 264 miles of federal levees and 34 out of the 71 pumping stations. Severe flooding occurred in the lower areas of the city, which were 20 ft. below sea level, but much less damage in areas close to the river, which were 20 ft above sea level. The path of the storm had a path predicted by the Corps of Engineers in 1964. Although there had been continuous work on the levees, there were still runs which were below grade. A central question, vital for insurance liabilities, in the investigation after the flood was to establish where the water had come from which caused the damage - was it from breaches in the levees, overtopping, rain backing up through drains, or from flood gates and pumping stations. An important finding in the investigation had been that in many cases the walls built on the levees had fallen before they had been overtopped. They had collapsed because the pressure of water in the peat and sand subsoil had led to movement and shifting of the walls, with particular problems at structural interfaces. This was not an unknown aspect of sea defence construction and he was surprised that US codes, unlike the UK and EU codes, had not recognized it. Moreover the levees themselves had not been constructed in some cases to the correct datum.

There were significant lessons from the New Orleans floods for London and indeed, other flood prone areas in the UK and in the Netherlands. The most important was, perhaps, to recognize the nature of levees and sea and river banks. They were not static artefacts, but partook of the nature of natural features, subject to changes due to many circumstances, pressures in the subsoil, increased water pressures and currents, weather patterns and man-made developments. Particularly in the Thames estuary there were many signs that the river banks, with peat and sand sub-soils, were subject to movement and damage from erosion, scouring and rising pressures. Building walls on top of them would be likely to make matters worse, as they would fail if pressure grew on the levee. Any sea defence must not have regard only to known problems such as this, but must take account of climate changes (drought was effecting peat based defences in the Netherlands). New Orleans showed the danger of buildings being too close to the defences, thus inhibiting engineering access. Also in the Thames, defences against sea flooding had to take account of the back flow from the Barrier, if it were shut and analyze the damage if, although this was unlikely, the barrier failed, as the existing walls may not be high enough. The most likely cause of substantial damage from flooding was from breaches in the defences, not overtopping.

In the subsequent discussion, emphasis was placed on the importance of ensuring that populations who might be at risk understood the dangers they faced and accepted that measures

to reduce them were necessary. It was clear, for example, that there had been no systematic attempt to alert New Orleans citizens of the likely damage from storms and to gain acceptance of, for example, the need to restrict development in certain areas, and to maintain access to the levees. This was contrasted to the Dutch polder strategy, which involved steady communication between citizens in the polders and the engineering and other authorities. It would be wrong to assume that the New Orleans disaster happened because the levees had been neglected and we had no problems because our defences had been kept up to date. The New Orleans defences had been undermined because of a failure fully to appreciate the nature of levees and the importance of continuous and detailed monitoring of them. Because there were so many individual factors involved in failure of defences; they could not be dealt with by a broad brush approach; ideally, they should be examined every few hundred yards. Of significant interest was why many of the levees or walls did not fail. There were particular problems in the UK because the sea defences had been built over many years - centuries in some cases - without an engineering input and known structure.

Questions were also asked about alternatives to relying on more and more sea defences. There was the alternative of allowing some land to revert to saltings or sandbanks, particularly where the cost of maintaining sea defences was out of all proportion to the number of people likely to be affected (Venice, at the end of the Mississippi delta, was such an example). As the primary source of protection was levees or sea walls, and the most likely cause of widespread flooding was a breach in them, serious consideration might be given to ensuring that a breach occurred in a place where it would do least damage, thus relieving pressure on other elements of the defences. An interesting idea, as one questioner put it; he would dearly like to be the lawyer engaged in advising on where the insurance liability lay when a building was destroyed because the coastal authority had deliberately blown up a section of the sea wall. Much more stringent regulation of building, not only to ensure adequate access, but also, in effect, to require self defence, by raising all services and living areas above certain levels and providing escape routes, was required. A background to this was the cost of insurance. As in so many cases we needed to recognize that individuals will have to bear more elements of risk than they have been used to. If they don't they will have to pay for the consequences. Both the insurance industry and the government need to put much more effort into getting public understanding of risk and developing regulation and market practices which are accepted as fair and reasonable. Quite separate defence systems were required for river and sea flooding, and it was mistaken to assume that one system could cover all eventualities.

But, without being complacent, Londoners could have some comfort in the continuous success of the existing Thames barrier. It was possible, although at this stage the evidence did not indicate a strong likelihood that a second barrier needed to be built to protect areas below the existing barrier and reinforce it. Studies were still proceeding. Of course, if the barrier were breached, the damage would be very extensive and the underground systems (not only transport) would be severely affected. That is why continuous assessments of water and weather movements are vital.

Sir Geoffrey Chipperfield KCB

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