NOT KATRINA: THE THAMES BARRIER DECISION

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INTRODUCTION

- The Katrina debacle encouraged us to look at other flood protection projects. We were decided to focus on the Thames Barrier completed in 1982.

- Via serendipity, we were able to access Sir Herman Bondi’s personal papers housed at Churchill College, Cambridge. He was almost solely responsible for pushing the Thames Barrier project through.
Planning for Flood Risk Management in the Thames Estuary

Continued protection of 1.25 million people and £80bn property value in flood risk area
MORE ON THE FLOOD ZONE

• The flood zone of the Thames Estuary contains 1.25m. people and 80b. GBP of property spread over 45 square miles

• The zone also includes 400 schools, 16 hospitals, 30 mainline rail stations, 68 subway and DLR (Docklands Light Rail) stations and 8 power stations, and the Port of London (with annual revenues of 2.7 billion pounds sterling)

• The business interruption cost of a major flood in the Thames flood plain (especially London) could be as high as $55 billion, without counting physical structure damage and the human costs in terms of lives and injuries.
THE “BIG FLOOD” OF 1953

- There is a long history of floods (or, more accurately, tidal surges) in London, e.g. 1009, 1236, 1663, 1894, and 1928 (when only 15 died)
- The flood of 1953 never reached Central London, but killed 307 people in England, plus 1,835 in the Netherlands and 22 in Belgium
- This was the motivation for the Thames Barrier concept, even though it took 30 years to come to fruition
THE SURGE PROBLEM

• The risk is a tidal surge, especially one that coincides with late winter or early spring high tide
• These surges start with a depression in the Atlantic that whips around the North of Scotland and carries the surge down the North Sea to the Thames Estuary
• The surges typically take about 17 hours from N. Scotland to reach the Thames, so there is plenty of time to take a Barrier closure decision
THE THAMES BARRIER

• The Barrier is at Woolwich Reach. It is 520 meters wide, has 10 gates (4 are 60 meters high [each of these weighs 3,700 tons], 4 are 31 meters high and there are 2 smaller gates)
• The gates lie on the River Thames, and can be closed at will creating a 5-storey barrier to tidal surges (the typical flood risk)
• The Barrier has been closed about 80 times since its creation; in general, they are increasing in frequency
THAMES BARRIER (cont.)

• Capital cost 535 million GBP (1.4 billion GBP at today’s prices. Cf. Millenium Dome which cost 365 GBP (at 2001 prices), and has been given away free by the British Government

• Operating costs are 11 GBP p.a. with 80 employees

• The Barrier was started in 1974, and finished in 1982
Gate Operation of the Thames Barrier
Thames Barrier Closures, 1983-2005
OTHER FLOOD DEFENSES

• The Barrier was backed up by several flood defenses, primarily raising the banks (e.g. 80 kilometers between Putney and Purfleet in 1971-2, 32 kilometers downstream including the 60 meters high Barking Barrier, and upstream of Putney on the South Bank and Hammersmith on the North Bank)

• In total, there are about 330 kilometers of river bank defenses, many of them going back to the nineteenth century.

• The Barrier could have been avoided at a much lower price by building much higher permanent walls which are easy to maintain, but at a severe cost in terms of river views and amenities
SYSTEM FAILURE?

- The monitoring system is almost foolproof with the possible exception of a national (or even European) computer and telecommunications blackout.
- However, a well-researched recent disaster novel [R. Doyle, *Flood*, 2003] outlines a scenario in which a 20,000 tons tanker crashes into one of the Barrier gates.
- The vulnerability of the Barrier to terrorism is unclear. The stainless steel housing is not very strong, but it would take a large bomb to damage permanently the gates, the concrete casings and the heavy machinery.
- For maximum impact, an attack would need to be carried out when the gates were closed at a time of unusually high tidal surge. It would require substantial technical knowledge, long-term planning and readiness.
- A symbolic attack with minimal damage is much. The level of protective security is very modest.
SIR HERMANN BONDI, THE PERSON

- Astronomer, not an engineer: Co-Founder of Steady State Theory, since replaced by Big Bang
- In his later years, Master of Churchill College, 1983--1990
- A multi-tasker and a Renaissance man, he explained it well: “A rut is like a grave, only longer.”
- He said he was more lucky than brilliant. “I am the luckiest man alive. I walk around with a wide-open mouth and roast ducks fly into it with monotonous regularity.”
- Why did he take the bureaucratic dead-end job as President of ESPRO in Paris: “It catered to my two vices – talking and traveling.”
- This extreme Anglophile was interned for 15 months as an Austrian Jew in World War II.
- He managed his own septic tank, and designed the kitchen and heating system in his Cambridge house.
- The joke is that he never turned down a speaking invitation, provided it was more than 3,000 miles away
SIR HERMANN BONDI, THE MANDARIN

• He had many scientific advisor posts over 20 years, but here we focus on his role as a “committee of one” re. the Thames Barrier
• He was very critical of the consulting engineers who considered only one length (1,400 feet) at one site.
• Re. Katrina, he would have recommended protection, both before and after, for a Category 5 hurricane.
HB (continued)

• Written in 1966, his key report focused on risk (mainly damages), probabilities and cost
• His conclusion: the risks were immense (perhaps 55 billion pounds), the probabilities did not matter, because sooner or later, the event was inevitable, and the costs were manageable (in the event, about 1.4 billion pounds at today’s prices)
• Compared with the US Senate, he was not concerned about too many resources being devoted to one area, in this case Central London: “It is the nerve centre of the country.”
• His counterpoint analogy: a meteorite falls on Central London (the probability is very low and cannot be calculated). The damages would be immense, but we have no way of protecting against the event, so it would be foolish to consider it
As for location, he recommended no higher than Woolwich Reach.

Upstream, it would have been much cheaper, but more people would have been at risk, and Greenwich (a World Heritage site) would have been threatened.

He recognized that technology and location were making access to the Port of London Docks less important: Port construction downriver at Tilbury, the Europort at Rotterdam, bigger ships and more container traffic.
HB (cont.)

• He faced severe institutional opposition
  – especially from the Port of London Authority (who objected to interference with shipping and additional dredging costs)
  – and the predecessor of TfL [Transport for London], which seemed unconcerned about subway flooding

• The resolution was national legislation in 1972 (the Thames Barrier and Flood Protection Act)
THE THAMES 2100 PROJECT

• London is sinking (tectonic plate movement), the sea level is rising (perhaps global climate change, a British obsession), human development (dredging, etc) is having an effect.

• The rise in the sea level is the most problematic. The Barrier designers assumed a 0.4 meters rise in the high water level in the first 50 years, 0.22 meters of it because of the rise in the sea level. A 0.31 meters is considered the most likely.

• This results in the 1000-years event probability falling to 500 years in 2030 and 100 years by 2070. This is the thinking that governs the view that additional protection beyond the Barrier will be required by 2030.
• What then? More protective walls; rehabilitating developed land as flood retention zones; and the final option: building a new 10-mile barrier from Shoeburyness near Southend in Essex to Sheerness on the Isle of Sheppey in Kent. Most of it would be permanently closed with a relatively narrow shipping channel, and there would be a road
THAMES 2100 (cont.)

• Costs of additional protection estimated at 4b. GBP over the next 20 years
• If the current floodgates are breached, Central London might be under 6 feet of water within a hour
• A new flood risk management plan intended in 2008
• The proposed new Barrier is unlikely to built soon because of the availability of the alternative near-term lower cost options.
RATIONALE FOR THAMES 2100

• Why the situation is deteriorating is a complex issue.
• The surge at the mouth of the Estuary (Sheerness/Southend) in 1953 was 2.59 meters. This was not the highest on record (the three highest were 3.66 meters in 1943, 3.0 meters in 1905 and 2.9 meters in 1894); they did not result in a disaster because they did not occur at a high spring tide. In 1953 the sea level rise was 4.69 meters.
• On the other hand, if you add the peak historical surge of 3.66 meters to the peak spring tide of 3.2 meters you get 6.86 meters, that approximates the peak capacity of the Barrier, 6.94 meters.
The Barrier designers planned for a 5.5 meter rise (a 1,000 year event); because of the amplification of the surge as the tide funnels up the river, they added 1.5 meters, 1.2 meters for the differential between London Bridge and Sheerness-Southend, plus another 0.3 meters for wind and wave freeband.

Alternatively if, instead of the 1.5 meter differential, you apply a plausible 35 percent upper river differential to the 5.5 meter Sheerness-Southend standard, you end up with 7.43 meters, i.e. higher than the Barrier’s protection.
IMPLICATIONS FOR POST-KATRINA

- Community participation, stakeholder involvement and political consensus are ideal in some circumstances, but not all.
- The concept of a Katrina czar was compelling. There are situations where expertise (or at least the ability to understand the experts) and leadership count.
- Without HB’s drive and insight, the Thames Barrier would never have been built. Most of the stakeholders were opposed to the project, but he had the complete trust and support of the UK government at the time. The Environment Agency considers him its great hero.
IMPLICATIONS FOR POST-KATRINA (cont.)

• If there is a measurable risk, a high level of protection is probably worth it in the long run

• Sharing out national resources is not always the best strategy: the importance of London and the uniqueness of New Orleans could justify higher priority
POST-KATRINA (cont.)

• HB was very concerned about costs, but they had to be evaluated in the context of risks. However, he would have demanded an evaluation, monitoring and auditing system in place that would avoid the corruption for which Louisiana is famous.

• He was skeptical about engineers, and would not have taken the US Army Corps of Engineers on trust (seeking out 2nd and 3rd opinions).

• He would have argued that New Orleans levees like London’s Thames Barrier were national-scale projects deserving a high share of national rather than local financing (75% of the Thames Barrier financing came from the central government).
POST-KATRINA (cont.)

• We are certain that HB would have recommended building the levees in New Orleans (both then and now) to cope with a Category 5 hurricane. He would have argued that the unique amenities of New Orleans justified it. This might not be justified on strict cost-benefit grounds. However, HB would have dissected the problem in the following way: the costs of another Katrina would be huge, in societal as well as monetary terms; the probabilities are uncertain, but another Katrina is quite possible and perhaps likely so the estimation of probabilities is almost irrelevant; and the consequences are preventable.
POST-KATRINA (cont.)

- His views were echoed in a recent media interview by Sarah Lavery, who is in charge of the Thames Estuary 2100 Project at the Environment Agency: “There is a very small probability of the Thames flooding, but if it does the consequences are enormous. New Orleans is a nasty reminder to us all of the difference between the probability of something happening and the consequences if it does” (http://news.bbc.co.uk/go/pr/fr/-/2/hi/science/nature/5092218.stm).
POST-KATRINA (cont.)

• A qualifier: comparison between the Thames Gateway project (at least 200,000 houses plus many mixed-use projects) and New Orleans: is it wise to build (or rebuild) on a flood plain? Could a new New Orleans be inland? Could the projects planned for the Thames Gateway be built on released Greenbelt land?