



Managing London's Changing flood risk

London is at risk from several different types of flooding. These flood risks are constantly rising, as a result of local land-use modifications and global climate change. Together, both factors increase the likelihood of hydro-meteorological hazards occurring in the Thames estuary and drainage basin. Rising numbers of people, property and assets also means rising vulnerability to flooding and increased disaster potential. This article looks at how the agencies responsible for making London safe from flooding are planning for the growing challenge ahead.

Risk can be modelled in various ways. One well-known version is the Risk Equation. This states the risk a society faces is proportional to [*Hazards x Vulnerability*] but is inversely proportional to *Capacity to Cope* (Figure 1). Another way of modelling risk is to take probability, consequence and vulnerability (PCV) as the three main components.

The PCV risk modelling approach is favoured by the Greater London Authority, where Alex Nickson is

Strategy Manager for Climate Change Adaptation and Water. He is developing the first Climate Change Adaptation Strategy for a World City (London) using the three risk elements. According to Nickson, sustainable risk management must focus on all 3 PCV components, as follows:

■ **Probability** 15% of London is located in flood risk areas where flooding is probable. Maps show the existing standards of flood protection

that exist. Standards generally decrease upstream along the Thames' tributaries.

■ **Consequences** Modelling the consequences involves asking who and what is at risk on the flood plain? What would the consequences and costs of flooding be?

■ **Vulnerability** Costs are never evenly spread through a population that has experienced a flood disaster. Some people will have been exposed to greater risk and suffered more.

When modelling risk, authorities need to ask: Who lives in a basement or ground floor flat? Who lives in the areas with the shortest warning times? Some parts of London have less than a 3 hour lag time between rainfall and peak flooding. Risk is therefore higher in these places. We can also ask: Who has the greatest and least capacity to react? Do all people know they are at risk? Will they know what to do? Do they have insurance?

$$\text{RISK} = \frac{\text{HAZARDS} \times \text{VULNERABILITY}}{\text{CAPACITY TO COPE}}$$

Figure 1 The Risk Equation

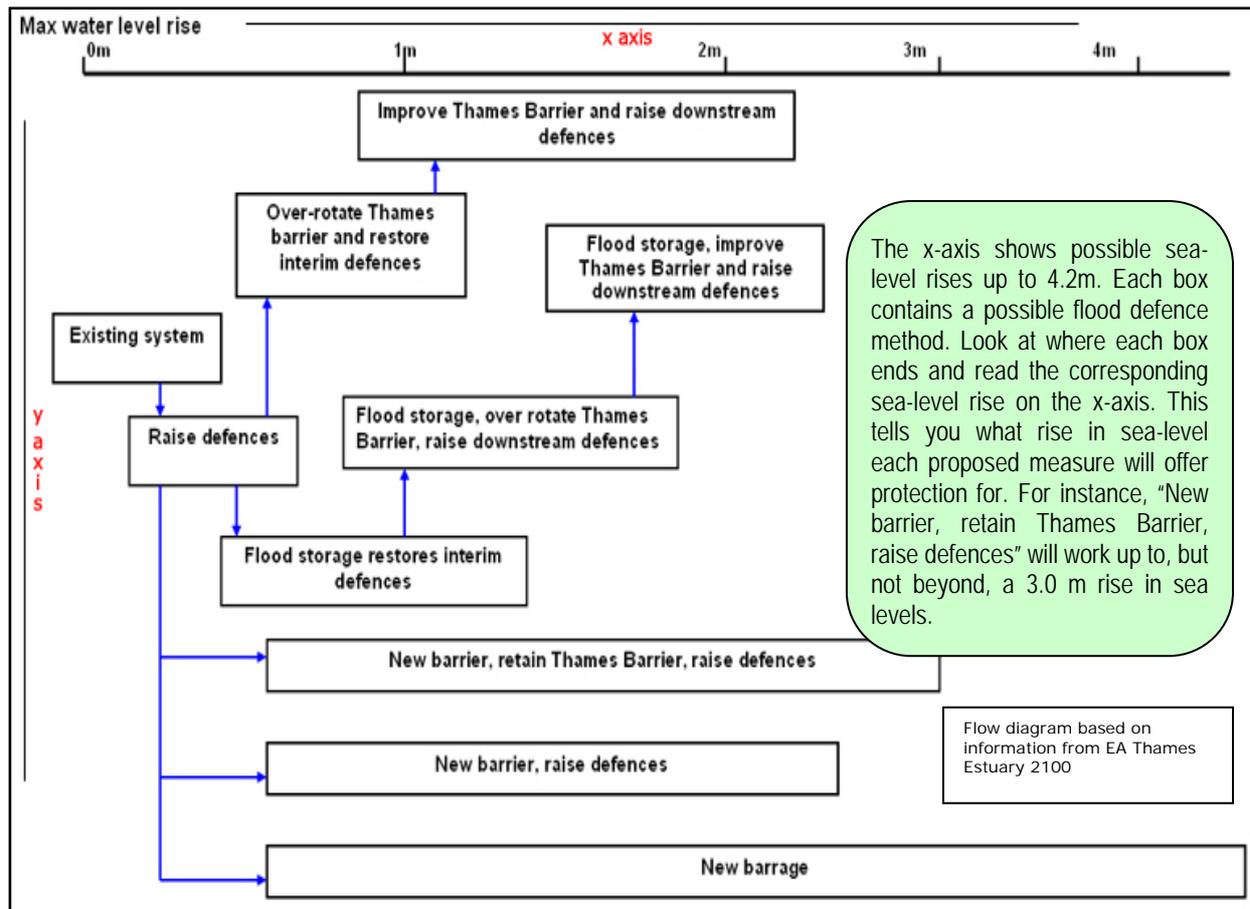


Figure 2 Possible responses to rising sea levels in London

The concept of *residual risk* is also very important for the analysis of a city like London's flood defences. This is an estimate of what would happen, and what costs would be incurred, in the event that the flood defences should ever actually fail.

London at risk

The Environment Agency believes there is still only a one-in-a-thousand chance of London being flooded in any given year, due to the Thames Flood Barrier (TFB) being overwhelmed by a tidal storm surge. However, now that global climate is changing, the TFB may in future no longer offer the level of protection it was originally designed to give. This would be worrying news for the population of London.

If major flooding did occur, Westminster could be under two metres of water and 75 underground and Docklands railway stations would be flooded, as would 16 hospitals and 400 schools.

- 343,000 London homes are at risk of *tidal* flooding
- 133,000 have a *fluvial* risk

- An unknown number have a *pluvial* (surface water) flood risk

Meanwhile, London's total level of risk exposure is growing all the time, as more people migrate there and new housing developments increase the total value of vulnerable property. With 200,000 new homes planned by the government below the high tide mark in the Thames Gateway area for 2016, the issue of dependable flood defences is clearly a major concern for London's policy-makers.

Thames Estuary 2100 project

A range of adaptation measures are currently being proposed to raise the future level of protection against all types of flood risk. The Thames Estuary 2100 project (TE2100), is headed by Dave Wardle. It is a cross-regional Environment Agency (EA) project that aims to develop a tidal flood risk management plan for the Thames estuary through to 2100.

The strategy will take into account increasing flood risk due to:

- climate change and rising sea levels (by 2030, the Thames Flood Barrier may no longer be guaranteed to offer 1:1000 protection)
- changes in land levels (the South is down-tilting by 1-2 mm a year)
- the natural ageing of defence infrastructure (currently £15 million is spent each year on repairs)
- new development in the tidal flood plain

The EA makes recommendations to the UK government concerning what flood risk adaptation management measures will be required in the Thames estuary, where they will be needed and when they need to be built by (based upon estimates of the degree of climate change and sea level rise the capital will face).

The EA has been considering four possible climate change scenarios.

- Firstly, government department DEFRA has told them to definitely anticipate a 0.94 m rise in sea level by 2100.
- Next, there is a medium-high risk scenario of a 1.5 m rise.
- Finally, there are two high-risk UKCIP scenarios called TE2100 H+ and TE2100 H++. Both of these factor in the possible effects of stronger storm surges, combined with high tides.



In the event of a major flood, water would surge down escalator shafts into the underground network causing enormous damage to London's infrastructure

TE2100 H++ is the worst case scenario. It includes a significant global eustatic sea level rise due to ice melting. This takes the possible sea-level rise for London up to 4.2 metres!

As Figure 2 shows, the higher sea-level scenarios will require major expenditure on either a second new flood barrier (costing £2-4 billion) or a tidal barrage for the estuary (£20-30 billion). This is a lot of money to find, especially for construction of a barrage. However, a simple cost-benefit analysis suggests it could be money well spent, as there is an amazing £80 billion worth of property at risk of flooding in London.

Adaptation and mitigation measures

Speaking recently at London's Royal Geographical Society, Dave Wardle said that the Environment Agency will be advising government to "maintain the risk at an appropriate level, but don't do what you don't need to do, as we may not need it." If sufficient effort is made now to mitigate the effects of climate change (by saving energy and lowering CO₂ emissions), then society may be able to avoid spending more on expensive

hard engineering adaptation measures later this century.

There are other objections to building a tidal barrage. It would change the ecology of the whole Thames estuary, which has only lately recovered after centuries of pollution and over-exploitation. 120 fish species recently returned to its waters.

The EA is also keen to emphasise it is not just central government's responsibility to spend money protecting London; Londoners need to do their bit too. There is an urgent need to raise public awareness of all types of flood risk in a way that enhances people's capacity to act positively when threatened.

Future flood risk planning is also sure to incorporate much more involvement from Local Authorities, who will need to undertake and regularly update their own flood risk assessments.

Increased monitoring of the changing permeability of urban environments needs to take place at the local level so that accurate hydrological models can be maintained. Local urban planning and renewal projects will almost certainly be required to incorporate more green spaces than in the past. In the Twenty-First Century, green spaces are being seen as an important part of London's infrastructure response to all types of flooding, alongside traditional drains and sewers.

Conclusions

By beginning to plan for a sea level rise of up to 4.2 metres, London is a leading World City in terms of its engagement with the reality of climate change. The threat is very great and action needs to be taken both to mitigate the problem of further greenhouse gas emissions and to adapt to the unavoidable changes already underway.

Flooding – whether it is fluvial, pluvial or coastal in nature – is a rising hazard that requires people living in London, as well as in other major cities across the world, to build resilience if they want to be able to cope with its worst effects. Individual citizens also need to realise that they are active stakeholders in this equation - and people increasingly need to consider how their own individual actions, such as paving over gardens and green spaces, are contributing to a growing problem.

Key points

- London is at risk from fluvial, pluvial (surface water) and tidal (storm surge) types of flooding.
- Climate change is making the situation worse by bringing more extreme rainfall events and storm surges.
- Land-use changes, as people pave over their gardens, rob the city of permeable green spaces that soak up the different types of flood water.
- Potential negative consequences are escalating as the value of assets, as well as people and property numbers, keep rising.
- The management response so far has been proactive, with a range of adaptation measures already on the drawing-board.
- But more needs to be done to make individuals take greater responsibility for protecting their own homes from flooding.