Outcomes from the Third Modelling Workshop

25th March 2015 – Southwell

Aim

The aims of the third workshop were to:

1. Show how different factors affect the vulnerability and exposure of receptors* at the eight locations identified.
2. Show how the risk to these receptors changes with flood depth.

In addition to the above we also explored the weightings of different receptors at each site.

*A receptor is anything that can be affected by a hazard, be it people, property, access, assets, community building (e.g. school), etc…

Opening presentations

An opening presentation explained where we were in the workshop schedule, with workshop three at roughly the half way point. The workshops so far (including this one) have focussed on collecting information to build a model of risk perception and understanding. The fourth and fifth workshop will change emphasis slightly and look at the model itself, how it works, how we can improve and/or amend it, and how it might be useful going forwards.

A worked example of the modelling task was presented. The task involved defining three things:

1. How factors affect vulnerability/exposure* of receptors;
2. how vulnerable/exposed different receptors were during the 2013 event; and
3. how these receptors contribute to the overall risk level at a location; and
4. how risk to each receptor changes with water depth*.

*Flood water depth was used as a proxy for hazard

*Exposure = contact with a hazard (factors affecting level and length of contact)

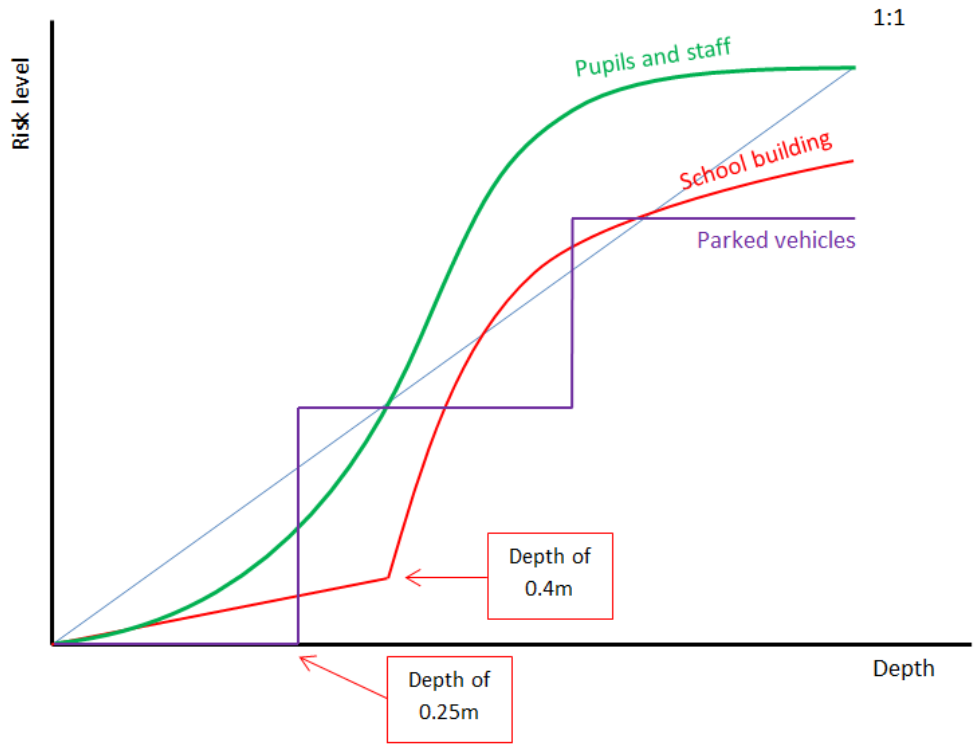
*Vulnerability = susceptibility to harm (factors which increase or decrease the amount of harm)

The worked example explained how the risk to different receptors at a site depended on the depth of flood water, and was not the same for all receptors. The risk to a pedestrian in the street will start to rise after only a small amount of depth, whereas the risk to properties may come at a greater depth (depending on their elevation). Understanding what is at risk at a location and when helps us to plan and implement interventions targeted at reducing those risks. Participants were asked to work through the four-step process explained below.

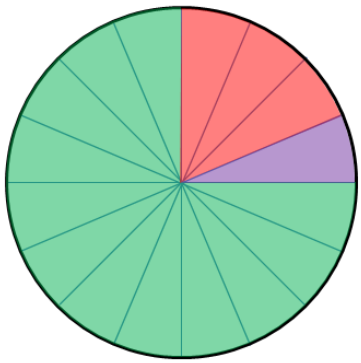
Modelling activities

Step 1: Participants sketched on a graph the relationship between risk and depth for each receptor. For each location, several receptor curves were sketched on the same graph, which helped keep

them relative to one another. The focus here was on identifying the shape of the curves, and understanding the risk-depth relationship (example below).



Step 2: The second part involved deciding, as a group, how much risk at each location is attributable to each receptor. An empty 16-segment pie chart was provided for participants to fill in to apportion risk between the different receptors (example below – colours match graph shown above).

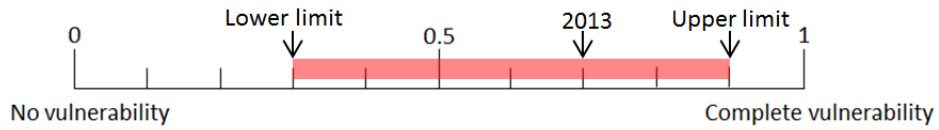


Step 3: The third part involved giving each receptor an exposure and a vulnerability rating based on their knowledge of the 2013 event. These were both scored on a scale of 0 – 10 (0 being no exposure/vulnerability and 1 being total exposure/vulnerability).

Step 4: The fourth part was postponed due to time constraints, and it is likely that it will be completed through a small number of discussions with local residents. This part involved investigating how far the different factors that can affect exposure/vulnerability. To do this we will give each factor a lower and upper limit* to its influence (see example overleaf).

*Lower limit – this is the best case – (i.e. how much can we reduce vulnerability by doing X?)

*Upper limit – this is the worst case – (i.e. how much exposure could increase if we didn't do X?)



Workshop outputs

- A set of receptor curves that cover all eight locations, with equations that describe them.
- E-Bulletin#6 explaining the work behind the scenes in brief for all stakeholders
- Technical notes to accompany this summary explaining the modelling work in more depth for stakeholders, including curves/equations for the four locations that have been computed (Halloughton Road, Nottingham Road, Church Street and Potwell Close)

To follow:

- Curves and equations for The Ropewalk, Archers Field, Merryweather Estate and Crafts Way

Next steps

Work behind the scenes will continue on the locations listed above. It is hoped that once the curves and equations are complete, then a series of short discussions can be arranged (mid-April) to get detailed information on the different factors that influence exposure and vulnerability at each site. If this is not possible, then this activity can be carried out at workshop four.

Workshop four will take place from 7pm – 9pm on Wednesday 29th April in Southwell Library Meeting Room. The aim is for participants to experience a practical session working with the modelling software, to test out different ideas, and provide feedback and comments to support model development.

If you have any questions before the fourth modelling workshop, please get in touch.

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[Technical notes follow]

Technical Notes

These notes accompany the Workshop 3 Summary and e-Bulletin #6.

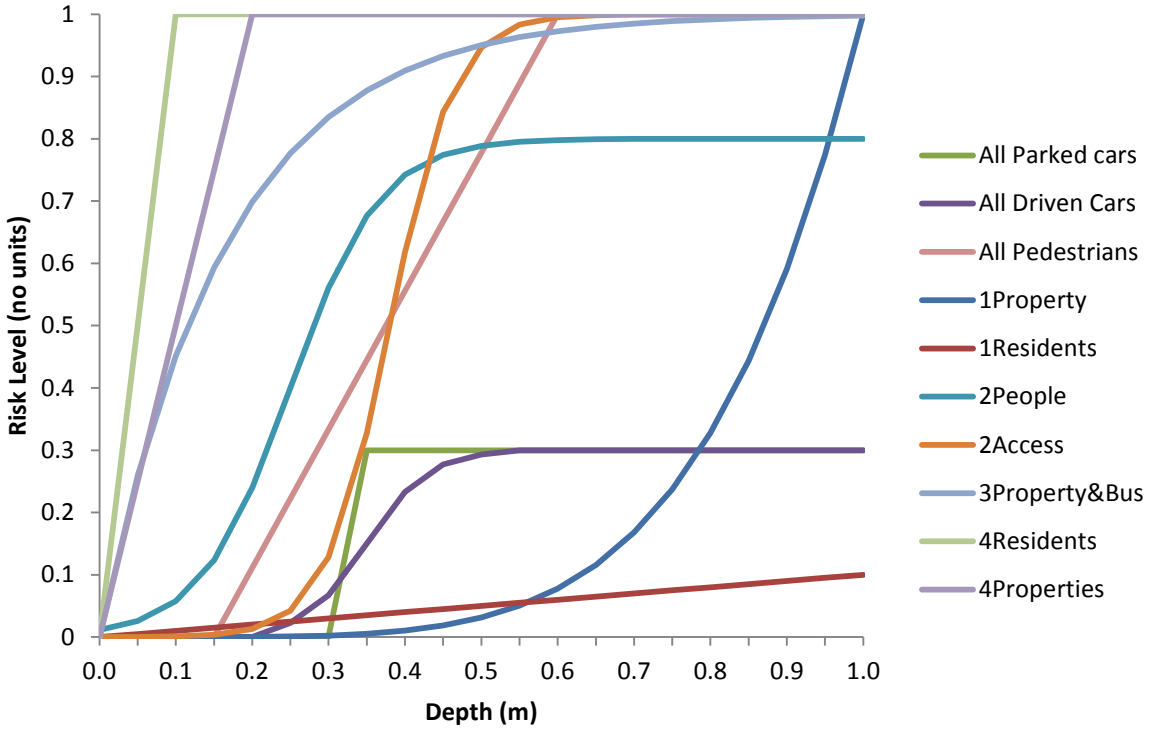
Curves for the following locations have been computed:

1. Halloughton Road
2. Nottingham Road
3. Church Street
4. Potwell Close

The others will follow in a second report in early April.

Receptor curves

All curves were plotted for a depth of 1 metre. This helped with working out equations that represented the sketched curves from the workshop. The specific shape of curves and their location within this space can be easily adjusted and any comments on this are welcome.



Equations for receptor curves (Potwell Dyke flow path)

All curves are plots of risk (y) as a function of depth (x)

The number before the receptor refers to the location:

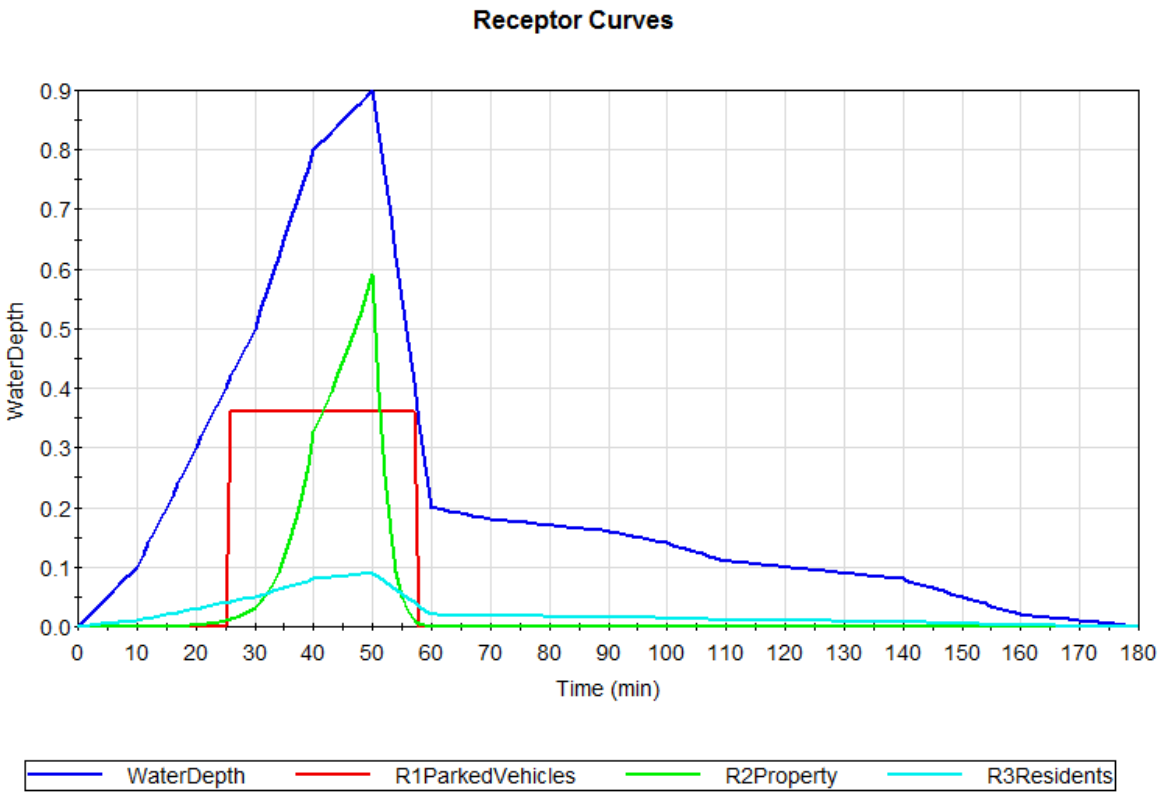
1. Halloughton Road
2. Nottingham Road
3. Church Street
4. Potwell Close

Site.Receptor	Equation	Type	Description
All Parked Cars	IF(x>0.3,0.3,0)	Step-change	Below 0.3m risk is 0, above 0.3m risk is 0.3
All Driven Cars	IF(x>0.5,0.3, IF(x<=0.2,0, $\frac{0.3}{1+exp^{-25(x-0.35)}}$	Nested IF, sigmoid function	Above 0.5m risk is 0.3 Below 0.2m risk is 0 Between is S-curve centred on 0.35m depth, with risk maximised at 0.3m
All Pedestrians	IF(x<=0.15,0, IF(x>0.59,1, 2.2222x-0.3333)	Nested IF, linear	Above 0.59m risk is 1 Below 0.15m risk is 0 Between these is a linear increase with depth
1.Property	x^5	Exponential increase	Risk increases slowly at first then at an exponential rate
1.Residents	$x * 0.1$	Linear	Low rate of linear increase with depth
2.People	$\frac{0.8}{1+exp^{-17(x-0.25)}}$	Sigmoid function	S-curve centred on 0.25m depth, with risk maximised at 0.8m
2.Access	$\frac{1}{1+exp^{-24(x-0.38)}}$	Sigmoid function	S-curve centred on 0.38m depth, with risk maximised at 1m
3.Property	$1(1-exp^{-6x})$	Exponential decay (increasing form)	Risk increases rapidly at first with depth then slows, reaching its maximum at 1m.
3.Businesses	As for 3.Property		
4.Residents	IF(x>0.09,1, 10x)	IF function, linear	Above 0.09m risk is 1 Below this is a linear increase with depth
4.Properties	IF(x>0.19,1, 5x)	IF function, linear	Above 0.19m risk is 1 Below this is a linear increase with depth

Note: these are up for debate and modification to better represent reality

Modelling the curves

In the model, these curves are then applied to a graph of how the water depth changed in each location, so the shape of the curves in the model will look very different. Take for example this rough mock-up of Halloughton Road:



The water depth curve is merely illustrative – but with event data this would be replaced with the 2013 water depth. We see that the risk associated with parked vehicles (red) is only present when the water depth is over 0.4m. We also see that risk to residents (light blue) starts to increase before risk to property (green). Risk to property increases very rapidly at a depth of c.0.5m. Understanding these values (the thresholds) is key to making the graphs as representative as possible.

When the weightings are added to these curves, the equation for the overall risk curve in a location is:

$$Y = ar_1 * br_2 * cr_3 \ldots xr_n$$

Where a, b and c are the weightings and r_1, r_2 and r_3 are the different receptors.