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# Report on York Floods 2012

## Transport Resilience to Surface Water Flooding

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The views in the report are those of the authors.

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## **Report on York Floods 2012**

### **Transport resilience to surface water flooding**

#### **Goal of this report**

This report gathers together evidence from the flood that occurred in York and some villages and areas to the South of the city (Bishopthorpe, Acaster Malbis, Cawood and Naburn) during Autumn 2012. It draws on interviews and observation with residents and businesses and provides a set of recommendations aimed at increasing local resilience to floods. The main focus of this report and its recommendations is on the transport sector and on mobility issues.

It is clear however, that the impacts and responses go well beyond the transport sector. The non-transport implications are also considered and additional recommendations which go beyond the transport sector are made. The report does not address the longer-term debate about the provision of flood defences nor does it seek to address issues around the personal costs and distress of such events. It offers recommendations which reflect actions that could be taken in the event of further floods of a similar nature assuming no net change to flood protection.

The data was collected as part of the Engineering and Physical Sciences Research Council research project *Disruption* (EPSRC Award No EP/J00460X/1). We are grateful to the participants for their contributions. The views in the report are those of

the authors and do not represent those of the City of York Council or any of the Parish Councils of the affected areas.

The recommendations provided are fully explained in a dedicated section. A summary list is present below.

**Recommendation 1.** To limit the amount of damage caused by flooding, and the subsequent disruption, greater communication of easy to adopt resilience practices should be carried out.

**Recommendation 2.** Improve the quality and detail of the information provided on the extent of the event and work with communities on what to provide and how to communicate it.

**Recommendation 3.** Low frequency but high impact flood events remain a risk. New developments should only be undertaken where the infrastructures, buildings and residents are not vulnerable to such events. Exceptions to this should be carefully considered before implementation.

**Recommendation 4.** Revision and improvement of cycle network provision for flood periods.

**Recommendation 5.** Emergency services should commission research on how to engage with the public and businesses during flood events.

**Recommendation 6.** Develop organised systems of provision that reduce the need to travel during floods to acquire goods and access services.

**Recommendation 7.** Encourage individuals to work from home where possible during flood events and to facilitate organisations to do the necessary changes so that this can be integrated in their work practices.

## **Some clarifications on practical issues**

This report is based on a range of interviews made with people living or working in York, Bishopthorpe, Acaster Malbis, Cawood, Naburn and Fulford during the Autumn 2012 floods. These floods were the second most severe on record, topped only by those that took place in 2000. The quite extreme character of the 2012 flood facilitated designing a set of policy recommendations aimed at increasing the resilience of these communities to future floods.

The selection of recommendations was based on two criteria: expected **high value for money** and expected **good public acceptability**. Recommendations likely to perform poorly when considering these selection criteria were not included in this report.

## **Characterising flood-related mobility disruptions**

The method to characterise flood-related mobility disruptions proposed here is composed of two elements: type of disruption and level of disruption. These will be presented in dedicated sub-sections.

### **Types of disruption**

Four different types of flood-induced mobility disruptions were identified during the analysis. These types are symbolically represented in Figure 1. The first type (Type A) is concerned with buildings (e.g. residential, industrial, and commercial) that were directly affected by the water (see Figure 2). These events have a significant emotional as well as practical impact. Residents focus their efforts on protecting their

homes and possessions and forego anything but essential travel. This represented a short-run disruption of the order of a day or two in the 2012 floods and is unevenly distributed in an area. If a building is inundated then the impacts are longer-term and also generate a range of further mobility demands (clean-up, servicing, replacement).

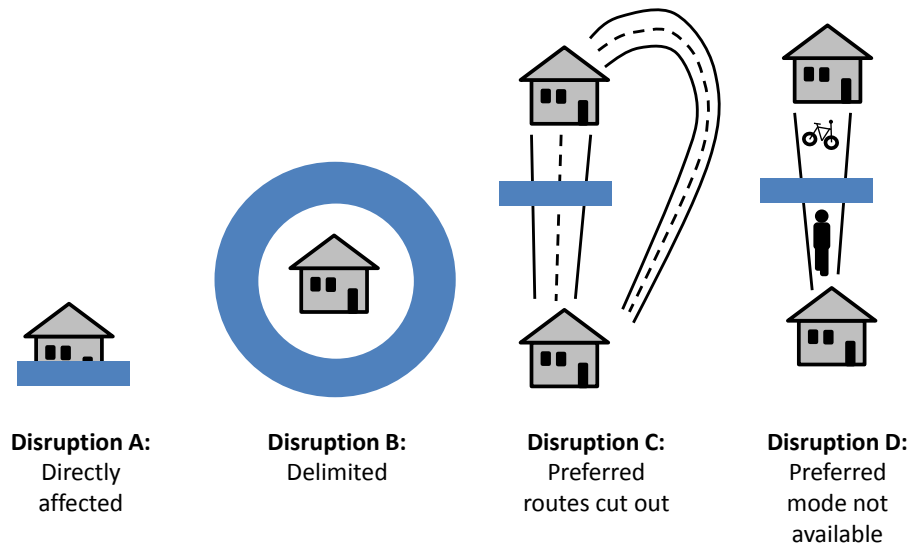


Figure 1: Types of flood-related mobility disruptions



Figure 2: Flooded properties to the right (disruption type A)

The second type (B) concerns people or institutions that were delimited by water. This represents an obvious reason for mobility disruptions to happen as many people are not equipped to travel through the flood water, see Figure 3.



Figure 3: Properties cut off by floods (disruption type B)

Note that Type B often but does not necessarily include situations when buildings become directly affected by flood water (as in Type A). It is important to distinguish Types A and B because due to geographical features buildings might be flooded and continue being accessible (Type A). Conversely, buildings might not be flooded but become totally delimited by water (Type B).

Type C concerns situations where people had their preferred route (e.g. for commuting, to go shopping) cut out by the water (Figure 4). This means extra travellers on the routes which still can be used. Situations like this can lead not only to much longer trips for some individuals, but also to substantial delays for all travellers. In many cases people feel intimidated by the difficult conditions



encountered en route under these circumstances and choose not to travel. Those travelling can endure a stressful journey and considerable time delays.



Figure 4: Access routes closed (disruption type C)

Finally, Type D is associated with situations when the preferred transport mode becomes unusable due to the water. People have then to travel using other transport means. An example of this is when cycle paths and streets become submerged but it is still possible to wade or float through them (Figure 5). This can lead many people not to travel or to experience difficulties accessing their destinations. Note that the types of disruption presented in Figure 1 can combine in various ways. The most extreme combination is when Types A, B, C and D overlap.



Figure 5: Wading and floating (disruption type D)

### **Levels of disruption**

Additionally to considering types of mobility disruption it is also important to distinguish levels of disruption. For simplification this report only considers four levels: Level 1 (no disruption), Level 2 (disruption), Level 3 (major disruption) and Level 4 (permanent disruption).

Under a Level 1 disruption the water might cause some problems; however these problems do not change in a significant way how people perform their daily social and economic activities. Under Level 2 these activities become partially disrupted, but it is still possible to maintain them to some extent as long as extra efforts are endured to cope with the challenges imposed by the water. This stops being possible under a Level 3 disruption. In this case normality is completely lost. Level 4 differs from Level 3 in the sense that in the latter normality can be resumed after a relatively small period of time and without having to perform significant investments in

attempts to return to that normality. In contrast to this, under a Level 4 disruption normality is permanently lost and returning to it will require a long time period and significant investments. It might also happen that a return to the normality experienced before the flood becomes impossible. Level 4 disruptions happen when the water destroys infrastructures (e.g. the Workington bridge collapse). Such instances are extremely rare and may not be relevant to the York area. Level 3 can be associated to situations when the water partially or totally submerges infrastructures (e.g. Cawood bridge) without affecting in a significant way their longer term structural integrity and usability.

### **Brief description of the Autumn 2012 flood in York and nearby villages & the data collection exercise**

Persistent heavy rain over a period of several days in late September 2012 saw a sustained period of flooding affecting York city centre and outlying villages. 25<sup>th</sup> September<sup>1</sup> saw flooding affecting areas to the north of York (e.g. Knaresborough) with widespread traffic disruption resulting from flooding of the east coast rail mainline (between York and Darlington) and the closure of the A1 (near Catterick). Flood warnings were issued for York and surrounding areas, as St George's Field and Monks Cross car park started to flood. Overnight<sup>2</sup> saw heavy flooding in Tadcaster and flood warnings issued for 2,000 properties in York and specifically for Fulford, Naburn, Acaster Malbis, St George's Field, Skeldergate and Huntingdon Road. As the flood water rise there was again large scale disruption to the roads

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<sup>1</sup> See [www.yorkpress.co.uk/news/9947117.Live\\_flooding\\_coverage/](http://www.yorkpress.co.uk/news/9947117.Live_flooding_coverage/)

<sup>2</sup> See [www.yorkpress.co.uk/news/9949264.Flooding\\_Day\\_2/](http://www.yorkpress.co.uk/news/9949264.Flooding_Day_2/)

(A19 - Fulford & A64 – Heslington) with a number of buses either cancelled or re-routed (e.g. services 10, 20, 42.). In the afternoon the bridge at Cawood was closed as well as Clifford Road & Tower St, (partial closures) with the Ouse due to peak between 8am and 10am the next day. The 27<sup>th</sup> September<sup>3</sup> saw the highest level of disruption to roads and bus services with the Ouse peaking at 8.40am (16 feet and 7.5 inches – the 2<sup>nd</sup> highest in modern history) with Tower St fully closed. The following day<sup>4</sup> (28<sup>th</sup> September) sees disruption to the road network and bus services continue. As the day unfolds, the disruption starts to ease slowly, with flood waters receding and key arterial routes reopening (e.g. Bishopthorpe Road). There were also indications that the A19 (Fulford) would reopen the following morning.

From a York perspective the key areas affected by the flooding were the city centre itself and then the outlying areas of Naburn, Cawood, Acaster Malbis, Bishopthorpe and Fulford. In order to gain an insight into the impact of the flooding for the businesses and residents of these areas a team of surveyors was dispatched in each location to conduct face to face interviews with those affected. A total of 75 interviews were undertaken with businesses and residents across a period of time covering 29<sup>th</sup> September to 2<sup>nd</sup> October. The timing of the interviews insured that the disruption caused by the floods was vividly imprinted on people's minds and in some cases was still ongoing, e.g. businesses in central York and residents of Cawood where the bridge was still closed.

The interviews varied in length from a few minutes to nearly half an hour and provided a rich source of data about the impacts of the flooding and the resilience of the subjects interviewed and the communities they live in.

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<sup>3</sup> See [www.yorkpress.co.uk/news/10074593.Flooding\\_Day\\_3\\_York\\_Yorkshire/](http://www.yorkpress.co.uk/news/10074593.Flooding_Day_3_York_Yorkshire/)

<sup>4</sup> See [www.yorkpress.co.uk/news/9955173.Flooding\\_Day\\_4/](http://www.yorkpress.co.uk/news/9955173.Flooding_Day_4/)

The disruption was experienced unevenly across York and the surrounding areas. Whilst there was significant disruption to flows in the city centre which affected many, the main areas that lost modes and routes which required significant detours were to the South of the city along the A19 and out to Cawood. The spill over impacts of the loss of a major route into York centre however were substantial which, combined with loss of capacity in parts of central York caused substantial delays. All four of the Disruption Types (A, B, C and D) were experienced in the area and we classify this as a Major Disruption Event (Level 3). However, there was no permanent loss of infrastructure.

## **Recommendations**

This section presents in detail the recommendations and the rationale behind them, drawing on the interviews conducted.

**Recommendation 1: To limit the amount of damage caused by flooding, and the subsequent disruption, greater communication of easy to adopt resilience practices should be carried out.**

One of the major and most obvious problems experienced by people living or working in areas affected by floods is water directly affecting their homes and other buildings they use or depend on (disruption Type A). This is a serious problem that can lead to a number of negative experiences. While people try to cope with this problem or recover from it they have much less capacity to conduct their daily activities in a satisfactory and effective manner. A number of interviewees mentioned

having their furniture and goods destroyed, having to dedicate tiresome efforts to reduce the impacts of the floods in their remaining possessions, and struggling for a relatively long period of time to recover emotionally, materially, and financially. In clear contrast, other individuals have reported feeling quite in control of the situation even though their buildings were (apparently) equally affected by the water. It was clear that different households and organisations are in possession of very different resources and skills when it comes to minimise the negative consequences of flooded buildings. Material gathered in the interviews suggests that this partially explains why people emotionally react so differently to floods.

Among other resourceful ideas, the most resilient participants mentioned having installed separate electric systems on the ground and upper floors, using only light furniture that is easy to lift onto trestles or to dismantle, permanently maintaining all small objects in water-tight boxes so that they can be easily stowed away, and using floor covers and wall paints that are immune to water. Such measures allow people to prepare their buildings for a flood in a quite short period of time and be able to carry on with their daily activities experiencing relatively minor disruptions and anxieties. It also allows them to return to normality having to perform much less strenuous and expensive arrangements. These and other similar measures can therefore be seen as powerful ways of improving individuals' and organisations' resistance to floods. This suggests that providing customised manuals or courses on how to make their houses and buildings more prepared to cope with floods is useful. Such guidance does exist (e.g. National Flood Forum) and is part of the actions promoted by the City of York Council through the Local Flood Risk Strategy. However, further work is needed to ensure that this is seen as additional to (and not instead of) other measures and that people see the need to engage. Some financial

or technical support might be needed so that people and organisations can actually operationalize these ideas. In addition, thought needs to be given to those in the rented sector and those new to an area. The level of preparedness and the actions that people knew to take were quite different between those who had experience of previous flood events and those that did not.

**Recommendation 2: Improve the quality and detail of the information provided on the extent of the event and work with communities on what to provide and how to communicate it.**

Improved access to information disaggregated at a very fine level was presented by many participants as a key factor in order for them to better adapt their mobility plans to flood events. There was a perceived need for more detailed knowledge related to how and where transport connections were disrupted. As an example of this, participants argued that knowing exactly where a certain road is cut out by the flood is what they appreciate the most, not a general indication that the road is cut out somewhere. This allows local people to plan very effectively their trips as they have an insider's knowledge of the local road networks and how traffic is likely to behave when certain routes are cut out. This could be self generated by a community. The same applies for other transport modes: exactly where a bus line is interrupted is the kind of information that individuals appreciate the most. A general indication that the bus line is not covering the full route was considered as not particularly useful. This kind of coarse information was actually considered as counterproductive by some people. Indeed, such information is likely to make a number of regular bus users to shift to their cars or cancel their trips when they could actually have travelled using

the bus service as their destination was still accessible by bus. Whilst it may remain necessary to give general warning signs to unfamiliar drivers, it is increasingly possible to communicate more tailored messages using different media.

It should be noted that local radio was depicted as a very important element in providing reliable, accurate, and comprehensive information with an insider's level of quality, in particular by participants who are less used to accessing the internet. Concerns were expressed about local radio broadcasts being replaced by national broadcasts during the evening and night. It was suggested by some participants that the maintenance of a strong local radio broadcast capability should be seen as an important measure for resilience purposes. We therefore recommend that the City of York Council and local public transport providers work together to understand what type of information people need, when, why and how they would like it to be distributed in the multi-media world we live in. The North Yorkshire Local Resilience Forum Media and Warning Information Group should continue to explore the use of a variety of media to disseminate flood-related information. This allows individuals to use the medium that fits them the best according to their personal needs, location, circumstance, and level of literacy. Examples of these proposed by the participants were: remote-controlled signs in public spaces, web-cameras located in a number of strategic places, a comprehensive internet site dedicated to flood response management, detailed radio broadcasts at pre-given times, and a mobile phone app. In addition to this, organisations and professionals which provide information to the public could be facilitated to engage with their end users to know whether the information provided is useful, easy to understand, and how it could be improved.

It is critical to note that the lack of information and awareness of travel conditions leads to people making choices which they regret and which contribute to already



heavily congested travel conditions in York<sup>5</sup>. People described journey times of one to two hours for journeys which would normally take 15 to 20 minutes. These were often for discretionary activities which they would have avoided. Whilst the car appears to offer a resilient solution to people, it very quickly becomes limiting in these conditions. Both information and provision of alternatives (see Recommendation 4) are critical.

It was frequently mentioned that there is the need to access information about water levels on an on-going basis. In ideal terms updates should be very frequent. This is important for individuals to make real time decisions and adapt their travelling to how the events are unfolding. It also helps them keeping calm and continuing their daily lives without feeling the need to directly monitor what is happening to infrastructures, properties or buildings which are important for them. These levels should be easy to compare to benchmarks that are meaningful to people (e.g. how high the water level was in previous floods and how fast the water is rising in relation to what happened in previous floods) as it was clear from the interviews that people tend to see the numeric values currently reported as difficult to interpret. Water level updates need therefore to be frequently updated, meaningful and easy to interpret.

It is worth mentioning that among the participants there were people quite well informed about the mechanisms of flooding. Some individuals were able to meticulously explain the relationship between rainfall at the Yorkshire Dales in particular and in the hydrographical basin upstream of their local area in general, sea tides, local geographical features, land use characteristics which influence water absorption capacity, and the probability and severity of flooding. Others were taken by surprise by the news that a flood was about to happen. Residents that have not

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<sup>5</sup> Note that the information may sometimes be available but not accessed and can be both a supply and demand problem.

previously experienced flooding are more at risk of poor decision-making and were, quite frequently, the ones most affected by the flood. For example, in Naburn it was possible to park cars to one side of the village and avoid being delimited by water. However, some new to the village had vehicles trapped on their drives and, as they relied on them for work lost pay. This seems to suggest that it would be desirable to educate these people regarding flood mechanisms and how to interpret flood-related information. This would contribute to raise understanding about when floods are likely to occur and therefore reduce the probability of uninformed people to be surprised by rising water levels. It is important to mention that some participants were actually unaware of where information about floods is available. One argued that an “idiot’s guide” (sic) to floods would be quite useful as this participant’s knowledge about the topic and where to find more information about it was too limited. To make sure that people are educated on how and why floods occur is therefore a potentially valuable initiative. The Environment Agency is promoting a community flood warden system which could be explored further to do this.

**Recommendation 3: Low frequency but high impact flood events remain a risk. New developments should only be undertaken where the infrastructures, buildings and residents are not vulnerable to such events. Exceptions to this should be carefully considered before implementation.**

In particular after long time periods when floods do not occur there is a certain tendency to assume that floods no longer represent a serious issue. This can lead to the relaxation of precautionary measures such as regularly cleaning drains and checking whether the drainage pipelines are operational. It can also lead to the construction of transport infrastructures and buildings in areas that will flood. If

individuals become dependent on transport infrastructures which flood they will see their daily mobility patterns disrupted as soon as the water levels rise. Disruption Types B, C and D become then very likely. There are, however, reasons and circumstances in which to build transport infrastructures that are vulnerable to floods constitutes a sound line of reasoning. For example, people typically enjoy to cycle and walk near rivers and lakes. So providing walking paths and cycle lanes near water makes it likely that people will use them more because of the aesthetical pleasure of doing so. In this case it actually makes sense to build infrastructures that will occasionally flood due to the benefits they bring most of the time. However the implementation of new infrastructures or buildings that will flood should always be carefully considered. The negative impacts that these new developments will suffer in the case of floods should not be underestimated. There was much concern over the construction of new homes around Germany Beck where the A19 floods. On the one hand the scheme allows the raising of the A19 to avoid closure during the floods. However, people were concerned about the wider knock ons of taking up land which currently floods for housing as the water has to go somewhere.

**Recommendation 4: Revision and improvement of cycle network provision for flood periods.**

Cycling was repeatedly depicted as a very useful and easy way of travelling during floods due to the versatility of bicycles both on off-road routes and on roads congested by motorised vehicles. Some of the cycling routes became flooded (e.g. riverside routes) and this led many cyclists to use the main roads. People reported that to cycle along main roads during periods of heavy rain can in some cases be a

quite stressful experience though. This happens because of fast-moving cars and heavy vehicles splashing on them large quantities of water accumulated on the road surface. Potholes become impossible to see so high quality surfacing is necessary to be safe. It would be useful to develop a flood event cycle network map and therefore, to provide cycling routes that are available and high quality during flood events. We suggest it would also be sensible to explore a 20mph advisory speed limit on roads where cyclists are particularly vulnerable to the presence of motorised vehicles during these events.

**Recommendation 5: The emergency services should commission research on how to engage with the public and businesses during flood events.**

A number of people experienced difficulties when interacting with the police and rescue services during the most critical moments of the flood. Some people emotionally reported police officers barring access to their businesses when the water was still rising and therefore preventing them to undertake actions that could have helped critically minimise damage. There is here an obvious tension between the need to protect people from hazardous circumstances and the need to empower people and communities to develop their own responses to threats. As critical comments against police and rescue services intervention were not uncommon, perhaps more research on how these services could deal with the specific challenges imposed by floods and people reactions to them would be beneficial. The benefits would be not only experienced immediately (i.e. this would benefit the flood management process) but would also be deferred (i.e. this would benefit the

establishment of better relationships between local people and authorities in the long term).

**Recommendation 6: To develop organised systems of provision that reduce the need to travel during floods to acquire goods and access services.**

A number of interviewees reported using home delivery services from major supermarket chains to top up their supplies without having to travel themselves. The drawback of this approach is that some delivery services struggle to arrive to their destinations as the vehicles being used are not particularly suitable for flooded roads. Note that there is no extra charge (and therefore no extra motivation) to deliver goods to areas affected by rising water levels.

Another possibility that could also be considered is to deploy vehicles with home supplies to local communities. These vehicles could function as mobile shops for basic supplies during floods. These could not only reduce the negative impacts of floods on vulnerable people but also provide an alternative to travel through disrupted transport networks. In both situations, it would also be sensible to look at options for the 'last-mile' or even 100m for delivery such that residents are able to get their goods across roads that are flooded. Some aspects of this may be best coordinated at a community level.

**Recommendation 7: To encourage individuals to work from home where possible during flood events and to facilitate organisations to do the necessary changes so that this can be integrated in their work practices.**

The accounts provided by individuals who are allowed to work from home using the internet and other digital resources provided clear evidence that being able to do this not only helps them personally but also contributes to business continuity. These people and organisations are almost perfectly adapted to the eventuality of a mobility disruption caused by floods. Even though working from home is not possible in a variety of economic activities and for a wide range of professional categories, for those who can do it this seems to be an excellent way of reducing the need to travel through disrupted transport systems. Even though working from home is not something that can be fully applied to professional activities which require workers to be at the worksite or physically visiting clients, there are nevertheless some preparation and training activities that could be done at home during occasions which are particularly adverse for travelling such as floods. To explore these possibilities seems to us a strategy that organisations could follow while taking into consideration the nature, needs and characteristics of their economic, social and technical activities. For example, one participant has clearly established for herself and her employer that some weekdays she stays at home doing management and planning work. Other weekdays she heads to her office to do face-to-face work and other activities which require her physical presence. The same person mentioned how important it is to be informed about potential mobility disruptions caused by floods with some days in advance so that she can plan her week accordingly. By means of promoting these flexible practices individuals and organisations seem to significantly increase their capacity to adapt to mobility disruptions. It seems

therefore quite useful for organisations located around areas potentially affected by floods to dedicate some thinking to how they can adapt to this flexible logic.

As a final note, in Naburn it was mentioned that the broadband speed is currently slow and the service unreliable. This has caused issues to people who attempted to work from home during the floods. It is perhaps sensible for communities vulnerable to floods to have some priority for e-communication quality improvements.

## **Concluding remarks**

It is easy to think about the main flood impacts being about roads being cut off. People are only travelling in order to do something elsewhere. One of the key adaptations that people exhibit when the roads are flooded is to change what, where and when they do things. This tends to be seen as a significant cost to households and there are examples where this can be so. For example, attending a Christening is a one off opportunity which cannot be shifted. However, for many other activities there are adaptations that people were quite prepared to make and these actually worked relatively well. For example, in some jobs, working from home is possible, at least for a couple of days. Another example is shopping. People might choose to shop more locally during floods, or to buy different items from what they usually prefer. Here, individuals and families manage to negotiate a change in activities. This means that resilience to floods can be achieved by transport systems that perform well even when there are floods taking place. However, resilience to floods can also be achieved by means of changing how and where people do things. As long as individuals and organisations achieve their goals without making much more effort or spending much more time or resources then this is also a suitable solution. As an

example of this one can mention people who instead of going shopping to the supermarket have bought food online and then just went to the edge of the flooded area to collect their shopping bags from the delivery van.

There are also direct impacts on activities themselves such as the closure of sports pitches or restaurants that stop some activities happening as they would normally have. Of particular importance in the surveyed area was the closure of Naburn School due to the backing up of the foul water system and potential risks to health and safety. So, whilst most people in Naburn were able to exit the village (provided they had access to a bike or had moved their car), they had to stay at home with their children as the school was shut. Similarly, in Stillingfleet, most exit routes were open but children from the school were still not allowed in. It seems from the evidence that more days of working time were lost from the school closure than from any of the transport route problems.

What this points to is a need for an integrated approach to flood management. Thought needs to be given to the activities that are preserved and whether these can be adapted and done in a different way or at a different time or place. Investment, planning and communication around the transport networks also needs to be continually re-examined. However, these two activities are interrelated. If York, for example, wishes to avoid losing economic output during floods then it would perhaps be best to encourage large scale home working to then avoid the more limited transport network becoming overwhelmed which then makes retail and leisure trips less feasible.

More generally, a longer term perspective is also required. The further we need to travel to fulfil our everyday activities, the more vulnerable we are to a whole range of events (floods, snow and ice, road closures). Disruptions are inevitable and whilst



public authorities have a critical role to play the solutions do not all lie with them. Individuals, households, and organisations can also reflect on how the decisions they make about their every day activities can affect them in more extreme flood conditions. We hope that the measures suggested above will provide some ideas on how this can be better achieved.