6 Infrastructure: Utilities

To appraise the losses from electricity, gas, water, waste water and telecommunications

Electricity and Gas

Estimating the losses to electricity and gas assets caused by the disruption to supply

OVERVIEW

This sub-section introduces methodologies for the estimation of losses to both electricity and gas assets. This focuses mainly on the losses caused by the disruption to the supply of services as well as some comment on direct damages to these infrastructure types. The impacts of the loss of electricity are particularly significant as the consequences can radiate beyond the immediate vicinity of a flood area and the high number of associated interconnections. Appraisal is primarily based on estimating the amounts that customers are willing to pay to avoid the disruption to service.

There are many assets potentially at flood risk with HR Wallingford (2012) reporting that there are 10,600 electricity and 250 gas assets at significant risk of flooding in England which account for 6.6% or 8.3% of all assets. The 2007 floods highlighted the severe consequences and disruption that can occur if electricity infrastructure assets are flooded or threatened and have provided some key lessons for the appraisal of both gas and electricity infrastructure. In total, there were an estimated electricity supply losses of £138-9m which accounted for 20% of all infrastructure losses or over 4% of all economic losses.

LESSONS FROM EXPERIENCE

- Of all the utility assets electricity is the most important to appraise due to the inherent interconnectivity within the system.
- Due to the serious repercussions of severe power outages and high interconnectivity with other essential services, both electricity and gas companies are under a legal duty to ensure security of supply (HM Government 1996; 2002).
- Since 2007, the need for increasing resilience in utility supply has been highlighted and efforts have begun and more are planned (Pitt, 2008; National Grid Gas, 2010). These measures need to be considered within a project appraisal.
- The 2007 floods illustrate that the loss of perceived value to users accounted for more than 90% of the total economic costs of flooding in the electricity sector and highlights the importance of assessing the likely value of this disruption of power supplies to large numbers of customers.
- Prioritisation in appraisal is essential with assets on the Protected Site List (PSL) or large populations having higher priority; however, the higher up the distribution chain for electricity the greater the degree of redundancy. Therefore, the risk matrix should be applied.

- Flooding risk to gas infrastructure and/or the continuity of supply is considered to be low with high transferability of service within the gas network. The highest risk is posed by a failure of communications or equipment reliant on electricity supplies.

ESTIMATING DIRECT DAMAGES TO ELECTRICITY AND GAS INFRASTRUCTURE

Depth/damage data are not available for the distribution and grid substations because in these instances damage is potentially highly variable and depends on the configuration and siting of transformers, switch gear and other equipment. Site surveys and further discussions with infrastructure owners would be required to assess the direct damages to grid and distribution substations.

Readers are referred to Chapter 5 for guidance on assessing direct damages to primary substations. In addition to this, we recommend that appraisers discuss the costs of direct damage owing to the flooding of gas assets with National Grid Gas or other distributers.

METHODOLOGY FOR ESTIMATING THE LOSSES DUE TO THE DISRUPTION OF A SERVICE

Step One: Identify the locations and types of substations

Identify with the typology all electricity substations in the floodplain under consideration and for which the National Grid or Distribution Network Operator (DNO) is responsible.

The table below illustrates the different types of electricity substation and permits the prioritisation of assets to consider.

Table 6.4 *Types of electricity substations (ENA, 2009; 2018)*

Substation type	Typical Voltage transformation levels	Approximate number in UK	Typical size	Typical numbers of customers supplied
Grid (Super grid)	400kV to 132kV	377	250m x 250m	200,000 to 500,000
Grid (Bulk Supply Point)	132kV to 33kV	1,000	75m x 75m	50,000 to 125,000
Primary	33kV to 11kV	4,800	25m x 25m	5,000 to 30,000
Distribution	11/kV to 400/230V	230,000	4m x 5m	1 to 500

NB. This is Table 6.6 in the MCM 2013

Using Table 6.4 above, identify the risk for each substation based on the likelihood and impact of flooding using the following risk matrix (Table 6.5) to prioritise those assets which should be quantified – only those which are categorised as **high** or **very high** risk should be examined further.

Table 6.5 *Risk matrix for electricity substations*

IMPACT	Sig: Grid substations with serving a population of > 125 000	Medium Risk	**High Risk**	**Very High Risk**
	High: Primary substations those with > 10000 *population supplied*	Medium Risk	**High Risk**	**High Risk**
	Mod: Primary substations with 5,000 to 10,000 population supplied	Low Risk	Medium Risk	**High Risk**
	Low: Distribution substations with fewer than 500 people supplied.	Negligible Risk	Low Risk	Medium Risk
		Very Low	*Low*	*Medium/High*
		LIKELIHOOD		

NB. This is Table 6.7 in the MCM 2013

Step Two: Estimation of population served

Estimate the population served based on length of perimeter using the table below and the presence of any "Protected Sites" designated as part of the Protected Sites List (PSL) process (from DNO, see Department for BEIS, 2019) examples of which are provided in Figure 6.2.

This is a broad estimate. The results from discussions with National Grid or the appropriate DNO will, of course, be more accurate.

Table 6.6 *Estimations of population served based on the perimeter fence length (after ENA, 2018b)*

Substation type	Average Perimeter Fence	Ratio customers to metres of perimeter
Grid (Super grid)	1000m	225:1
Grid (Bulk Supply Point)	300m	183:1
Primary	100m	150:1

NB. This is Table 6.8 in the MCM 2013

Step Three: Assess whether an asset is defended against flooding

Establish whether the site is within an existing flood-defended area and determine the condition of the defences and their actual standard of protection. Since 2013, there has been a lot of ongoing work to improve the resiliency of substations and associated infrastructure so it is likely that some assets will have protection, with a programme of improvements scheduled to be completed by c. 2026 (National Grid, 2022). The third round of Climate Change Adaptation Reporting in accordance with the Climate Change Act 2008, provides the updated information on climate resilience for each supplier (Defra, 2022).

Where defences are below the Environment Agency's set target condition grade and/or the standard of protection is below the resilience levels set by ETR 138 (Issue 3; ENA, 2018a) and Engineering Design Standard (UK Power Networks, 2019) (Table 6.7) establish the flooding threshold for key parts of the substation that will trigger disruption of supply to customers and critical infrastructure.

If an asset is not in an existing flood-defended area move to Step Four.

Table 6.7 *Resilience levels for electricity substations**

Flood type	Protection level			Allowance for climate change rises	Freeboard
	Grid Substation	Primary Substations† > 10,000 unrecoverable connections	Primary Substation† < 10,000 unrecoverable connections		
Fluvial	1:1000 Flood level	1:1000 Flood level	1:100 Flood level	Flood Depth x 20% or use of EA CC factored levels	300mm
Tidal	1:1000 Flood level	1:1000 Flood level	1:200 Flood level	105mm or use of EA CC factored levels	300mm
Surface	1:1000 Flood level	1:1000 Flood level	1:100 Flood level	Flood Depth x 20%	300mm

Source: UK Power Networks (2019, 10); ENA (2018a, 20).

* Please note that critical infrastructure resilience is a priority area following recent floods and storms and the *National Flood Resilience Review* (HM Government, 2016) and so the resilience levels may be subject to change. Furthermore, some DNOs have issued guidance recommending additional safety factors are applied (e.g. Electricity North West, 2017). In particular, the updated ENA (2018a) suggests that Network Operators should ensure that they utilise the most recent guidance available. It is recommended that appraisers also check for updated information.

† ENA (2018a) suggests that network operators should focus on the resilience of service provision to sites supplying significant local communities (SLCs) (which are defined as those comprising at least 10,000 customers/connections) and to the level of the EA's Extreme Flood Outline (i.e. 1/1,000 flood risk). Therefore, those primary substations which are likely to serve a customer population of over 10,000 should have the same protection level (1:1000) as grid substations.

Step Four: Assess presence and importance of resilience measures

If not in an existing flood defended area establish whether the site has been made resilient against flooding with either permanent or temporary locally-installed measures. If the measures are temporary establish whether the site is in receipt of a flood warning (provided by organisations such as the Environment Agency, Natural Resources Wales or SEPA) and that the erection of temporary measures is practical within the lead-time of warnings provided.

If the site is either not in receipt of flood warnings or these are inadequate to secure the site consider the flooding thresholds for key parts of the substation and the potential for transferring other supply to customers and critical infrastructure. If no flood intervention measures are in place or planned imminently by the DNO establish the flooding threshold for key parts of substation likely to disrupt supply to customers and critical infrastructure.

Step Five: Assess the importance of network interconnectivity

Establish the degree of network interconnection to minimise loss of supply to customers and critical infrastructure. Where transferability of supply is 'seamless' losses associated with flooding are only direct damages to the substation.

Step Six: Identify appropriate flood intervention measures

If the project appraisal is specific to the substation, establish the most appropriate flood risk management system, in conjunction with the DNO, to protect the substation. Table 6.8 provides the potential intervention measures for electricity infrastructure with their advantages and disadvantages.

Step Seven: Cost-benefit analysis

Conduct a cost-benefit analysis methodology of preferred solution(s) including an assessment of societal risks. This includes the evaluation of damages by flood depth for critical plant and equipment and the cost of customer supply losses.

'Customer/minutes' loss as a result of flooding during the accounting period including the 2007 floods were only 4.2% of total (with lightning and wind and gales contributing to over 20%). However, the widespread losses of electrical power extend well beyond the obvious consequences and the following should be included where possible as part of the assessment of societal losses.

- Loss of traffic lights can lead to traffic gridlock with knock-on effects on the ability of emergency services to respond.
- Mobile telephony will overload and fail within 6 hours.
- Domestic central heating (even gas fired) will fail and hypothermia is a real threat during winter flooding.
- Disruption of water supplies and sewage treatment and disposal could pose a serious health hazard.
- Petrol pumps, cash tills and cash machines will fail.
- Radio and TV broadcasts will fail to reach the affected population.
- Use of candles and alternative cooking practices could pose potentially serious fire hazard and dangers of asphyxiation.

The appraiser should create a template about when each of the above benefits is worthy of further analysis. The ratio of property within the floodplain to those outside the floodplain serviced by a distribution substation subject to flooding (within Flood Zone 3) may determine whether induced losses should be assessed. Appraisal is probably only worthwhile if more than 50% of the properties served by a flooded distribution substation are largely flood free (i.e. in Flood Zones 1 and 2).

Step Eight: Quantify the potential costs due to the disruption of services (using the equation below).

Equation 6I.1

CD = P * EC * WTP * D

where:
CD is Estimated cost of disruption (£)
P is Number of properties affected by power outage[1]
EC is Hourly electricity consumption (kWh)
WTP is Willingness to pay value to avoid power outage (£)
D is Estimated duration of disruption to supply (hours)

Some indicative values of average energy consumption and willingness to pay to avoid a disruption in service are provided in Figure 6.3.

DURATION OF ELECTRICITY DISRUPTION

In general, most repairs to distribution substations would be achieved within a 24 hour period and therefore power restored to properties relatively quickly. However, those properties and businesses which are themselves flooded will suffer electricity outages for longer, because the property-level electrical fittings will also need repair. The specific impacts of these outages will depend upon whether residents are in temporary accommodation (and therefore may be less impacted by the lack of supply) or whether they are remaining in the affected property. Therefore, in some situations it may be appropriate to estimate the number of households that might be flooded within the area served by a distribution substation and remove these from the total number of properties affected by the power outage.

DISRUPTION TO GAS SUPPLIES

Overall, the pressurised gas network is far more resilient than electricity distribution. National Grid Gas have been working to increase the resilience of its assets to flooding including activities such as reinforcing river banks and further research about what the impacts of flooding are on pipelines and other equipment (National Grid Gas, 2010). As part of this process risks have been categorised (on a four point scale) according to the degree of material risk they pose to different assets and how robust business process and/or action plans are to deal with these risks. For flooding, the majority of risks are considered either to be low in terms of the damage likely to be sustained or that the continuity of supply would not be threatened. National Grid Gas (2016) reports on the progress of resilience efforts and the Climate Change Adaptation Reporting (under the Climate Change Act, 2008), third round reports highlight the progress on climate resilience by each supplier (Defra, 2022). However, the following should be considered for appraisal:

- A gas compressor station was considered to be at risk of flooding, but supply was not thought to be threatened if it was inundated.
- National Transmission Pipe work (~70 barg). These were considered to be at risk as there is the potential for these pipes to float if the ground around and above them is flooded. However, the main concern is that there is insufficient information about these risks and therefore further research is required to be able to quantify fully their susceptibility to flood water

[1] i.e. total number of properties served by the substation or infrastructure affected

- The main concern remains the pipework and their pressure gauges where the ingress of flood water may necessitate a mass purge of the affected pipeline.

Should a gas installation be located in a floodplain under investigation then discussions with the National Grid Gas or other distributers may be appropriate on the lines of the step-by-step guide above for electricity. In those situations where further analysis of a loss of gas supply is required the calculation provided for electricity may also be adopted. An estimation of the annual gas energy consumption for the average UK home is provided in Figure 6.3.

KEY ELECTRICITY ASSETS FOR APPRAISAL FROM EXPERIENCE

A summary of the relative importance of all utility and infrastructure measures adopting the risk matrix approach (with the addition of scale) can be found in Table 6.1. Although not an exhaustive list (and appraisers should undertake their own filtering approach) we suggest a full monetary quantification of utility damages/losses is required (i.e. proportional) and will contribute significantly to the present value of benefits in the following situations:

- Tidal inundation of electricity transmission lines greater than 132 kV unless flooding thresholds are less frequent than 1 in 75 years (1.3%).
- Tidal inundation of electricity transmission lines of less than 132 kV but only if flooding is more frequent than 1 in 25 years (4%).
- Flooding of electricity grid substations (including super grid and bulk supply point installations) when the risk of flooding is moderate (i.e. more frequent than 1 in 200 years; 0.5%) as these serve greater than 125,000 and up to 500,000 customers.
- Flooding of primary and grid substations where when the risk of flooding is more frequent than 1 in 75 years (1.3%); thereby serving a dependent population of greater than 5,000.

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Water and Waste Water

Estimation of potential losses due to the flooding of water infrastructure

OVERVIEW

This sub-section provides a methodology for estimating the potential losses due to the flooding of water infrastructure. Appraisal in this sub-section is based on the Ofwat (2008) guidance on the costs imposed on households when water is cut-off and on willingness-to-pay valuation of customers to avoid a disruption to either water supply or waste water services. In addition to this, the Security and Emergency Measures Direction (SEMD) 1998 provision about the minimum requirement of water which should be provided (per person) when water supply is cut-off is also utilised.

HR Wallingford (2012) has reported that there are 970 sewerage and 290 assets located in areas at moderate or significant risk of flooding in England. The floods in 2007 served to highlight the susceptibility of the water supply network and the potential large scale disruption that can occur when only one major single source of water supply serving a large number of users is flooded. The overall costs to Severn Trent Water alone were in the order of £30 million with supply being interrupted for approximately 350, 000 customers (Chatterton et al., 2010).

LESSONS FROM EXPERIENCE

- Generally, sewage treatment and pumping facilities are not as susceptible to flooding as water supply facilities.
- In 2004, the Water UK Council established a mutual aid protocol for all members to ensure delivery of water by companies during an emergency. The protocol (amended after 2007) includes agreements to share emergency equipment and to support affected member companies during incidents and enhances the resilience and contingency options of the sector.
- Regulators have a key role in supporting the UK's resilience agenda, and the Pitt Review recommended that this was recognised by "placing a duty on economic regulator to build resilience". These resilience activities (and future planned activities) need to be included within project appraisal. Of particular use to appraisers are the indicators some companies have used for defining and measuring resilience.
- Similar to electricity the interconnectivity of water infrastructure means that losses can extend widely beyond the flooded area.

ESTIMATING DIRECT DAMAGE TO WATER INFRASTRUCTURE

Readers are referred to Chapter 5 for guidance on assessing direct damages to sewage treatment works. The data contained on MCM-Online provide sector average indicative values only and therefore site surveys or discussions with the infrastructure owner are recommended to verify these estimations and to appraise the potential damages to water supply infrastructure which are not included as depth/damage curves in Chapter 5.

APPRAISAL FOR WATER RELATED ASSETS AT FLOOD RISK

The Cabinet Office (2011, 28) suggests a benchmark that "as a minimum essential service provided by Critical National Infrastructure (CNI) in the UK should not be disrupted by a flood event with an annual likelihood of 1 in 200 (0.5%)". The guide goes on to indicate that the costs and benefits of individual projects should be considered when deciding which projects to fund and whether the benchmark can be achieved. The benchmark does not apply to other infrastructure that is not designated as Critical National Infrastructure. The Climate Change Adaptation Reporting (under the Climate Change Act, 2008), third round reports highlight the progress on climate resilience by each supplier (Defra, 2022a).

There is a fundamental difficulty in creating a definitive listing of water supply and sewerage infrastructure at risk from flooding (or any critical infrastructure, e.g. electricity substations, for that matter). Any reference to sites/assets being critical infrastructure indicates that the asset is important and could provide useful targeting information for those with a 'terrorist' intent. Such information may require a protective marking (e.g. "RESTRICTED"). Consequently, an appraiser must rely on the often incomplete data provided by the Environment Agency's National Receptor Dataset as a starting point and follow up the results with direct contact with the water supply and sewage treatment providers.

The process of evaluating the contribution of a water supply or water treatment works to the total flood losses of a community is similar to the step-by-step procedure outlined for electricity installations (Section 6b) but with different impact filters to account for.

Step One: Apply the relevant risk matrix

Identify the risk based on likelihood and impact of flooding using the appropriate risk matrices for sewage treatment and water supply works below. Using this as a decision filter – only consider steps 2 onwards for High and Very High Risk assets.

Table 6.9 *Risk matrix for sewage treatment works*

IMPACT	*Sig: > 30,000 cumecs effluent dry weather flow*	Medium Risk	**High Risk**	**Very High Risk**
	Mod: 5,000 to 30,000 cumecs effluent dry weather flow	Low Risk	Medium Risk	**High Risk**
	Low: < 5,000 cumecs effluent dry weather flow	Negligible Risk	Low Risk	Medium Risk
		Very Low	*Low*	*Medium/High*
		LIKELIHOOD		

NB. This is Table 6.12 in the MCM 2013

Table 6.10 *Risk matrix for water supply*

IMPACT	*Sig: > 20,000 population supplied or PSL customers*	Medium Risk	**High Risk**	**Very High Risk**
	Mod: 5,000 to 20,000 population supplied	Low Risk	Medium Risk	**High Risk**
	Low: < 5,000 population supplied	Negligible Risk	Low Risk	Medium Risk
		Very Low	*Low*	*Medium/High*
		LIKELIHOOD		

NB. This is Table 6.13 in the MCM 2013

Step Two: Assess whether an asset is defended against flooding

Establish whether the site is within an existing flood defended area and determine the condition of the defences and their actual standard of protection. Where defences are below the Environment Agency's set target condition grade and/or the standard of protection is below the optimum design standard proposed by the Environment Agency establish the flooding threshold for key parts of the works likely to disrupt supply to customers and critical infrastructure (see Protected Site List established for electricity in Figure 6.2).

Step Three: Assess the presence and importance of resilience measures

If not in an area already benefiting from flood risk management measures, establish whether the site has been made resilient against flooding by the Water Company with either permanent or temporary locally installed measures. If the measures are temporary establish whether the site is in receipt of flood warnings and that erection of temporary measures is practical within the lead-time of warnings offered.

If the site is either not in receipt of flood warnings or these are inadequate to secure the site consider the flooding thresholds for key parts of the works and the potential for transferring other supply/treatment capacity to customers and critical infrastructure. If no flood intervention measures are in place or planned imminently by the water company establish the flooding threshold for key parts of works likely to disrupt supply to customers and critical infrastructure.

Step Four: Assess the importance of network interconnectivity

Establish the degree of network interconnection to minimise loss of supply/treatment to customers and critical infrastructure. Where transferability of supply is 'seamless', losses associated with flooding are only direct damages to the works.

Step Five: Identify appropriate flood intervention measures

Establish the most appropriate flood risk management system in conjunction with the water company (see Table 6.8 for examples established for electricity which provides a starting point for these)

Step Six: Cost-benefit analysis

Apply a conventional cost-benefit analysis of preferred solution(s) including societal and environmental risks. This includes the evaluation of damages by flood depth for critical plant and equipment and the cost of customer supply losses using cost of water under Security and Emergency Measures Direction (SEMD) (Defra, 2022b) provision as a minimum cost, supplemented with willingness to pay data/surveys as appropriate. MCM (2005) (Penning-Rowsell et al., 2005) provides an example of appraisal for the Newport Waste Water Improvement Scheme which highlights the process that could be applied.

Under the Guaranteed Standards Scheme customers are entitled to financial recompense when water is disconnected without prior warning (Ofwat, 2008; Ofwat, 2017a). Ofwat (2017b) provides a minimum amount that companies must provide; £20 for domestic customers plus an additional £10 for each 24-hour period the supply remains cut-off and for non-domestic customers £50 plus an additional £25 for each 24-hour period the supply remains unrestored. This compensation agreement is often waived in extreme weather conditions or exceptional circumstances; however it may be used to estimate the potential costs of disruption of supply. Water UK (2017) provides a Technical Guidance Note detailing operational principles to be considered by water undertakers when fulfilling their responsibilities under licensing requirements (Defra, 2022b as per Section 208 of the Water Industry Act 1991) which requires all water companies to provide 10 litres of water per person per day or 20 litres per person per day in incidents lasting more than 5 days.

KEY WATER ASSETS FOR APPRAISAL FROM EXPERIENCE

A summary of the relative importance of all utility and infrastructure measures adopting the risk matrix approach (with the addition of scale) can be found in Table 6.3. Although not an exhaustive list (and appraisers should undertake their own filtering approach) we suggest a full monetary quantification of utility damages/losses is required (i.e. proportional) and will contribute significantly to the present value of benefits in the following situations:

- Flooding of sewage treatment works when the risk of flooding is more frequent than 1 in 75 years (1.3%) and the effluent dry weather flow is greater than 5,000 cumecs.
- Flooding of sewage treatment works when the risk of flooding is moderate (i.e. more frequent than 1 in 200 years; 0.5%) and the effluent dry weather flow is greater than 30,000 cumecs.
- Flooding of water treatment works when the risk of flooding is more frequent than 1 in 75 years (1.3%) and the population affected is greater than 5,000.
- Flooding of water treatment works when the risk of flooding is moderate (i.e. more frequent than 1 in 200 years; 0.5%) and where the dependent population is significantly large (i.e. >20,000).

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Telecommunications

Appraising potential losses owing to the flooding of telecommunications infrastructure

OVERVIEW

This sub-section explores the potential losses caused by the flooding of telecommunication assets. CIRIA (2010) report that British Telecom has approximately 8,000 sites including telephone exchanges, with 500 major assets located within floodplain areas. It is unclear how many assets from other telecommunications providers are located in areas at risk. The 2007 floods highlighted that “the interconnected nature of the network provided a degree of resilience and helped prevent significant failures” (Pitt Review interim report, 2007; 97) and Chatterton et al. (2010) reported that during the 2007 floods there were few reports of failures or damages to the telephone network or exchanges.

In general, most telecommunication assets are considered to be quite resilient to flooding and there is a higher degree of redundancy than in other infrastructure sectors. There is much uncertainty about the total damages within the telecommunications sector in the 2007 floods as there is little data available; however they were considered to be lower than £1 million (Chatterton et al., 2010). This sub-section describes those situations where an appraisal might be appropriate and proportional.

LESSONS FROM EXPERIENCE

- There is in general very little data about the impact of flooding on the continuity of other communications infrastructure (e.g. broadband services), the possible length of any disruption and the subsequent impacts in particular on local businesses.

- However, there is considered to be a great deal of redundancy in the system, in particular in relation to telephone systems and the transfer of services to mobile communications.

- The largest potential danger from flooding is the knock-on impact of a loss of electricity supply on telecommunications, rather than flooding directly impacting the telecommunication assets.

- The Pitt Review (Pitt, 2008) discusses that flooding did cause some degradation of local network infrastructure; however British Telecom reported that there was less failure and impact occurred than was expected. This was in part due to the increasing use of glass fibre (rather than copper cabling) which is more resilient to water damage. This highlights that the network may become even more resilient in the future.

ROLES AND RESPONSIBILITIES OF TELECOMMUNICATION PROVIDERS

Telecommunication providers have responsibilities as part of the Civil Contingencies Act 2004 and as Category 2 responders include: any person who provides a public electronic communications network which makes telephone services available (whether for spoken communication or for the transmission of data) (HM Government, 2004; 25).

Additionally, the Communications Act 2003 (HM Government, 2003) permits the telecommunications regulator Ofcom the scope to impose specific requirements regarding the availability and use of the communications network and services during an emergency situation. There are also standard requirements as part of licensing conditions to maintain services and restore services as quickly as possible, where practicable.

INCREASING TELECOMMUNICATION RESILIENCE

CIRIA (2010; 90) identify the components most vulnerable to flooding include the following:

- *Telephone exchanges*: Back-up generators, diesel supply storage, cables entry, IT software, any other equipment located at a low level.
- *Broadband antennae*: Transmitters, cables, IT software, control systems (switch gear) and the structure itself.

The telecommunications sector, similar to other utility and communication providers, has many legacy assets potentially located at risk from flooding (CIRIA, 2010). However, they remark that it is unclear how vulnerable or resilient the ‘next generation’ of networks are to flooding nor how or whether flooding is being considered into the design and implementation of the updated systems. Therefore, appraising the potential impacts of flooding on these new types of networks is problematic.

In recent years much work has been done to ensure the resilience of the telecommunications sector (Cabinet Office, 2009); however much of this work has rightly prioritised ensuring a continuity of service for critical services such as the 999 service and other needs by emergency responders. Telecoms companies work across company boundaries and have provided much telecommunications assistance during flooding (e.g. BT civil resilience teams) including efforts during the 2007 and 2012 floods (FloodProBe, 2011 British Telecom, undated 1).

British Telecom (as well as other providers) have well-formulated plans for reacting to flooding including the use of Emergency Response Teams (ERT) and adopt an internal Bronze, Silver, Gold structure during a flood. This permits them to more effectively liaise and support the multi-agency response, to assess potential risks to their assets, where possible try to maintain a service and to plan recovery efforts (British Telecom, undated 2). BT has also invested in emergency infrastructure to enable them to better respond to a telecommunications failure. This includes pre-training over 500 staff to deal with incidents as well as purchasing hardware (such as containerised exchanges and investing in back-up power supplies) which can be deployed to maintain services.

APPRAISING THE POTENTIAL FOR DISRUPTION TO TELECOMMUNICATIONS

Chatterton et al. (2010) describe the origin of the additional costs due to flooding in this sector as including:

- Repair costs due to direct damage of the infrastructure asset.
- Additional maintenance costs.

- Extra operating costs during an emergency.

Disruption costs due to the loss of a telecommunications service are difficult to appraise. Many communications providers suggest in their customer charters or terms and conditions that customers are entitled to compensation (via a reduction in their bill or service charge) if their service is discontinued for any lengthy period of time. However, the majority of these agreements have exclusion clauses related to severe weather and it is unlikely therefore that a customer would receive much or any compensation.

Additionally, telecommunication providers are also able to temporarily ‘reroute’ or divert an existing telephone number to another device (such as a mobile telephone or other landline number); thereby establishing continuity in the service with little increased cost to the supplier.

There is less clarity about the costs of the disruption to broadband services; in particular to businesses that were not directly flooded. Evidence from telecommunications providers in 2007 suggested that any disruption was minimal and that service was restored relatively quickly; however there might be considerable knock-on impacts to the local economy (and potential claims for compensation) if disruption to services affected a number of businesses. More research however, is needed in this area.

Telecommunication assets are generally considered to be quite resilient to the effects of flooding as although the dependency of assets might be considered to be of a medium risk, the susceptibility of many assets is low. Additionally, there is a high degree of redundancy in the network; particularly in the case of telephone communications. Proportionally, damages to this sector will be lower than to other utility and transport networks and indeed the telecommunications providers argue that a power failure may be more problematic than direct flooding of their network.

Therefore, appraisal investigations are only recommended if there are major telecommunication assets located within the benefit area (e.g. major exchanges). In these situations we strongly propose speaking with infrastructure owners to understand the vulnerability of the asset from flooding and potential damage and losses accruing.

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