London severe drought scoping study

FINAL REPORT (OCTOBER 2017)
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Foreword

The drought of 2010-12 is a distant memory for most people, but had it not started to rain at exceptional levels as it did in May, there was a good chance that by September we might have faced unprecedented water restrictions that would have crippled the economy, brought misery to millions of people and caused potentially irreversible damage to the environment and London’s world city status.

The concern is that we have not fully learnt and applied the lessons of the 2012 drought. This has prompted the London Resilience Partnership and Thames Water to undertake a scoping study to understand what we could do in the case of a severe drought and what might be the unintended impacts of the measures we may have to take.

At the time of writing this study, water resource conditions show that the risk of drought has not disappeared. While severe drought is not an immediate risk, now is the right time to be undertaking work to mitigate the risk of severe drought over coming years and decades.

In the case of a severe drought, national and London strategic coordination arrangements would be responsible for coordinating activity, working to deliver largely untested actions through currently untried delivery arrangements. As a severe drought would typically take at least two years to build, there is sufficient time to develop plans and test delivery arrangements if we start now, although adapting infrastructure and building on resources currently available would take a longer period of time.

This scoping study is just the start of extensive work which needs to be carried out if we are to improve our resilience to severe drought. We hope that the London Resilience Partnership will use it as a prompt and a starting position to lead the community we serve to a more sustainable position, suitable for a city of world class standing.

Steve Hamm
Head of Programme, London Resilience Forum

Sarah McMath
MD for Wholesale Water, Thames Water
Executive Summary

As the UK climate and London continue to change, it is important that we act now to make sure that London is resilient to the risk of severe drought. This is a matter for, and will require the support of, the full resilience partnership, all of whom would be affected by a severe drought and required to take action to respond.

Drought is a situation which occurs within a defined geographical area when a prolonged period of below average rainfall leads to low levels of groundwater and reduced river flows, affecting people and wildlife. Droughts affecting London build over a period of time – months, if not years - but despite advances in meteorology and hydrology, their onset, duration and ending are very difficult to predict.

A severe drought - one worse than we have experienced in living memory - is a real and present threat to the capital. Such a drought would have extensive economic and social impacts, potentially devastating the environment and affecting the health and quality of life of all those who live and work in the city.

A study presented to the government in 2012 estimated that the impact of a severe drought on London’s economy would be in excess of £250 million per day. Such a drought could last for months and even after the drought broke, it may take many more months before the impacts subsided.

The plans and responsibilities for managing an ‘ordinary’ drought - that within the scope of ‘normal’ drought planning - are well defined and tested. However, little has been done with regard to understanding the impacts and arrangements for dealing with a drought which lies beyond the responsibility or capability of a water industry response and which may threaten the provision of water services as we know them.

To address this risk, Thames Water have examined a number of options for maintaining a piped water supply and set out the two most probable response measures which could be used in a severe drought situation. Each aims to eke out the water held in the reservoirs whilst providing enough water to maintain at least a basic level of public health and hygiene. However, each in turn have their own associated risks and issues which are likely to have to be managed through London’s strategic coordination arrangements and require central government coordination. The proposed measures are:

i) Reducing mains water pressure to below statutory minimum pressure.

ii) Supplying non-potable water (water requiring additional treatment, e.g. boiling before consumption) through the water mains.

The views of key organisations on the impacts of introducing these measures were sought through interviews and a workshop held in London on 25th April, 2017. The impacts were prioritised by the participants, with the top expected impacts / issues including:

- An inability to use critical regional infrastructure (e.g. hospitals) due to low water pressure
- Loss of use of a proportion of social housing (low pressure in the water supply network would lead to a loss of supply in taller buildings)
- Reduction of firefighting capability - both hydrants and internal fire suppression systems, and implications for the use of buildings which require such systems
• The increased demand for social and health care in parallel to frontline staff managing their own domestic circumstances
• The challenges of determining what aspects make someone vulnerable to drought / drought management measures, identifying who they are in real life, and supporting them during the drought and drought recovery period.
• The potential for expensive and in some cases irreparable contamination / damage to facilities (e.g. heating and cooling systems) and equipment (e.g. medical) which require water

Most participants at the workshop, and particularly representatives from the business and finance sector, were strongly against the provision of non-potable water as a drought management measure, citing the unacceptable contamination of their water, heating and cooling systems and irreparable damage to medical and other sensitive equipment.

As a result of the scoping study, the following recommendations are proposed:

Recommendation 1: Thames Water should review the impacts of a range of severe droughts on its ability to treat and distribute water.

Thames Water should undertake a study to better understand the impact a range of worse than historic droughts may have on their ability to treat and distribute water. This should include the impacts that a reduced availability and quality of raw (untreated) water resources may have on their water treatment works and the corresponding impact on their ability to sustain mains water pressure as raw water availability decreases. Thames Water should also model the impacts of a range of below statutory pressure water conservation strategies on their network.

Recommendation 2: London Resilience Partnership should review the risk assessment and ranking of severe drought in the London Risk Register.

The London Risk Register ranks drought as a ‘high’ risk. It assumes that a drought of sufficient severity to affect 385,000 businesses, but not interrupt domestic water supply, would have a likelihood of 1 in 2,000 years over 5 years. Thames Water’s recently published Drought Plan proposes that water supply interruptions could be avoided in up to a 1 in 500 year drought (1 in 100 years over 5 years), highlighting that the current risk ranking understates both the likelihood and consequence of a severe drought.

Recommendation 3: The London Resilience Forum should work with partners to commission further work to understand the following key risks and issues identified through the scoping study.

1. Map the impact of low mains water pressure on regional critical infrastructure: The scoping study highlighted that a potentially significant proportion of regional critical infrastructure may be affected by low water mains pressure. It is proposed that these should be mapped against a number of low water pressure scenarios to identify the scale of the impact and when and where unacceptable impacts may occur.

2. Understand what proportion of social housing may be vulnerable to low water pressure: One major social housing provider estimated that up to a third of their housing stock may be uninhabitable due to insufficient water pressure to supply their homes with water. This equates to approximately 20,000 people who would need to be supported or rehoused. If this proportion is similar across London’s other social housing providers, then this presents a significant challenge with hundreds of thousands of people requiring support.

3. Understand the strategic impact of significant low water pressure on firefighting capability: London Fire Brigade identified that in some cases low water pressure already affects their
ability to fight fires through having insufficient water pressure / volume from street hydrants. Effective mitigation and contingency measures are in place to manage this on a day-to-day basis. In addition, low pressure may affect buildings with mains-fed fire suppression systems or buildings with limited volume tank-fed systems. Further pressure reductions may make firefighting in some areas of London tactically challenging. The scale of this impact and possible remedial measures needs to be understood.

4. **Improve understanding of who is vulnerable to drought**: The London Resilience Partnership has developed arrangements for the identification of vulnerable people in the event of an emergency. In order to understand the potential scale of demand for support during a severe drought, these arrangements, based on current vulnerability indexes, should be reviewed against the context of a severe drought.

**Recommendation 4: Undertake a severe drought exercise.**

In the case of a severe drought, national and London strategic coordination arrangements would be responsible for coordinating activity, working to deliver largely untested actions through currently untried delivery arrangements. It is therefore proposed that once the management actions and associated impacts are better understood (through recommendations 1-3 above), that these are tested though an exercise and the outcomes of the exercise are used to inform the development of a Severe Drought Emergency Plan.

**Recommendation 5: Develop a London Severe Drought Emergency Plan.**

The LRF should commission the development of a Severe Drought Emergency Plan for London. The Plan should integrate the findings from the recommendations above and present a strategic framework for how London should prepare, respond and recover from a severe drought.

**Recommendation 6: Consider the options for long-term prevention activity to improve London’s resilience to severe drought.**

The LRF should, as a result of the outcomes of the above recommendations, consider what preventative activity could be undertaken to improve the city’s resilience to a severe drought. This may fit well with the Partnership’s work to consider resilience against chronic stresses in addition to acute shocks, and with the ‘city resilience’ agenda.

These recommendations, while focussed on a severe drought, offer secondary benefits for resilience against a range of other risks such as those that could cause disruption to London’s water supply.

**Next steps**

This draft scoping study was presented to the London Resilience Forum in June 2017 for their information and comment. The LRF supported the recommendations 1-6 as set out in this study. The study will be published and the recommendations will be taken forward in line with relevant aspects of the London Resilience Partnership’s work programme.

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1 London Resilience Partnership Identification of the Vulnerable Guidance (January 2015)
Background

Where does our water come from?

London’s water is supplied by one of four water companies. They abstract water from rivers and groundwater, treat it at water treatment works and put it into supply. Each water company has a different resilience to drought, depending on where they get their water from and how much water they can store in their reservoirs. All of London’s water companies are dependent on rain falling to ‘recharge’ their water sources – winter rainfall is the most effective at doing this as less of it is absorbed by plants or evaporated by the sun. Winter rainfall is therefore critical to drought resilience in the South East of England.

What is a drought?

Drought is a situation which occurs within a defined geographical area (for example a river catchment) when a prolonged period of below average rainfall leads to low groundwater and soil moisture levels, and reduced river flow. The combination of these causes both environmental stress and a significant reduction in the amount of water available for human consumption.

How do water companies and others plan for drought?

Water companies are required to produce long-term plans, known as Water Resource Management Plans (WRMP), setting out how they will meet the water demands of their customers according to the water resources they can expect in an average dry year. They also have to produce Drought Plans setting out the actions they will take in case of drought. To date, Drought Plans have been designed to manage the ‘worst historic drought’ – that is the worst drought experienced in the reliable historic record (going back to the 1920s). However, the drought of 2010-12 highlighted that we need to prepare for more severe droughts, so water companies are now working to understand what is the likelihood of a ‘worse than the worst’ historic drought. The Environment Agency recommends that water companies should be resilient to at least a ‘severe’ drought (1 in 200 year or 0.5% chance in one year) and should test their resilience to even more extreme droughts, such as a 1 in 500 year drought (0.2% chance in one year).

Thames Water’s Drought Plan sets out two parallel courses of actions. One side aims to reduce water use through four sequential levels of ‘demand management’ activity. The other side increases water supply by bringing online drought-specific water resources (for example desalination) and abstracting more water from the environment. The aim of the Drought Plan is to conserve water in the reservoirs and avoid ever getting to emergency restrictions. Table 1 sets out how frequently Thames Water believes that drought measures may be required - known as its ‘levels of service’.
Table 1. Thames Water’s ‘Levels of Service’

<table>
<thead>
<tr>
<th>Activity level</th>
<th>Water supply and restrictions on use</th>
<th>Frequency of use</th>
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<tbody>
<tr>
<td>Level 1</td>
<td>Intensive media campaign to raise awareness of the drought and encourage water efficiency at home and at work.</td>
<td>1 in 5 years</td>
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<tr>
<td>Level 2</td>
<td>Sprinkler/unattended hosepipe ban and enhanced media campaign. Increased activity on finding and fixing leaks. Stand-by water resources brought online.</td>
<td>1 in 10 years</td>
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| Level 3        | Temporary Use Ban (formerly hosepipe ban) restricting a number of mainly external domestic water uses.  
                             Drought Direction 2011 (formerly non-essential use bans), approved by Secretary of State, restricting non-essential commercial water uses and permitting unsustainable levels of abstraction of water from rivers (causing environmental damage). | 1 in 20 years    |
| Level 4        | Extreme measures, such as major pressure reductions, severe restrictions on water use requiring the granting of an Emergency Drought Order by the Secretary of State. | ‘Never’          |

What is the likelihood of a severe drought and how could it be managed?

A severe drought would typically occur after 24-36 months of below average rainfall. The need to implement severe drought management measures could significantly reduce this timespan if during this period:

- There was a prolonged heatwave (which would significantly increase the demand for water)
- Thames Water had to increase its supply of water to its neighbouring water companies
- Any of Thames Water’s main water resources or treatment works became unusable/inoperable
- Early drought management measures were less effective than planned or there were delays in implementing Temporary Use Bans, Drought Permits and Drought Directions.

In case of a severe drought, Thames Water has reviewed a range of options to boost supplies (e.g. bringing water in by sea tanker) and further reduce demand (e.g. rota cuts) and identified the most probable options to be:

a) Reducing water pressure in the mains to below the statutory minimum water pressure:
   Reducing the pressure at which water is pumped around the water mains network would reduce leakage from the network and further encourage people to use less water. The pressure reductions could be done in a number of stages, from just below to significantly below statutory pressure. It should be noted that water pressure is not the same across the network, with low pressure areas occurring during normal circumstances in higher elevations and at the ends of the network. It should be noted that water companies may struggle to maintain a consistent pressure due to their water treatment works having to treat poorer quality raw water from low-flowing rivers and the bottoms of their reservoirs.

b) Supplying ‘non-potable’ water: Currently, all mains water has to be treated to standards which are regulated by the Drinking Water Inspectorate (DWI). As a drought progresses, it may be impossible to maintain these standards and / or necessary to provide water that may
be below the standards approved by the DWI to sustain sufficient pressure in the network. This may be due to the inability of water treatment works to sufficiently treat poor quality raw water, or because alternative sources of water (such as water brought in by tanker) may have to be used, bypassing the water treatment works. Non-potable water standards could vary from just below DWI minimum standards, requiring boiling or additional chlorination before use, to the provision of water which would be only suitable for flushing toilets and cleaning clothes. Once non-potable water has been put into the mains, it would take many months to flush and cleanse the network before it could be considered clean enough to supply potable water again.

Who is in charge during a severe drought?

A severe drought would be a regional, if not a national, emergency. It is anticipated that in such a situation strategic decisions would be taken by COBR based on information and advice provided by a number of partners including and not limited to water companies, the Environment Agency, the Fire and Rescue Service and Public Health England, with delivery co-ordinated at LRF level.

Scoping study findings

Information for the scoping study was gathered through interviews with organisations and through a cross-sector workshop held on the 25 April 2017. Representatives of organisations from London’s key sectors were asked to identify and prioritise potential impacts resulting from the two drought management measures proposed by Thames Water.

Interview findings

Transport for London (TfL) envisaged a number of potential impacts likely to result from the proposed drought management measures. The key concerns included:

- Business continuity within TfL’s offices may be affected by low mains water pressure impacting on fire suppression systems and welfare facilities (toilets, showers and kitchens). TfL operates from many buildings across London, most of which are modern offices with their own pumped systems that should be unaffected by low mains pressure. Older buildings may not have pumped / tank supported systems, so may be unusable if fire suppression systems are not adequately operable or if staff cannot use welfare facilities.
- Dust suppression systems using spray irrigation would likely to be included in the Non-Essential Uses restrictions, affecting major construction projects (Crossrail, Northern and Bakerloo line extensions), non-emergency general engineering works and road maintenance works.
- The provision of non-potable water could affect the operation of cooling for computer systems (eg signalling systems), through the effect and impact needs to be better understood. Poor quality water may also impact on concrete batching, leading to delays in repairs and building new infrastructure.
- Fire suppression on the London Underground was not felt to be a significant issue as the Underground’s firefighting system is independent of mains water pressure.

GLA Air quality team representative noted that a severe drought would have a negative impact on London’s air quality through both increasing the generation of air pollutants and in reducing the effectiveness of measures to manage poor air quality. The key impacts included:
• An increase in the likelihood of wildfires (creating smoke and particulate matter), potentially combined with a decrease in the fire brigade’s ability to put them out due to lack of available water.

• Water restrictions may reduce the frequency and/or effectiveness of street cleansing, creating dustier streets where air pollutants are constantly being circulated.

• Water restrictions would limit the use of dust suppression systems used in the construction and demolition of buildings. This would significantly impact on development in the city.

• Water is used to manage dust and odour at waste and waste transfer stations. As these are essential services that would need to be maintained even in a drought, the impact would be an increase in odour and dust from these sites.

Peabody Housing are one of London’s largest social housing providers, owning and managing over 29,000 properties across London. The key impacts identified were:

• Low water pressure being insufficient to supply taller buildings (3 floors and above) without pumps. This was estimated to possible affect up to one-third of their housing stock, potentially affecting 20,000 people.

• Housing associations provide accommodation for many vulnerable people who would need special support to cope with drought management measures – particularly treating non-potable water and sourcing bottled water.

• Low water pressure is expected to impact on the operation of combination boilers, with most boilers cutting out between 0.7-0.4 bar water pressure. Most housing associations are moving from communal heating systems to each property having its own combination boiler.

Workshop findings

The following impacts / issues were identified and prioritised at a ‘sectoral’ level at the workshop:

Local authorities and government

• Defining, identifying and supporting vulnerable people will be a significant challenge.

• Maintaining local authority services (adult and social care services, education, waste and street management etc.) when frontline staff are facing increased demand whilst in parallel having to manage the impacts on their own domestic circumstances.

• Communicating with vulnerable and not-vulnerable but non-English speaking residents and visitors.

• Managing the impact of loss of hygiene and sanitation (washing, laundry and toilet flushing) for people in social housing affected by interruptions to water supply.

• Maintaining hygiene standards in schools to enable schools affected by low pressure to remain open during the drought.

• The capacity of the voluntary and charity sector to support public services may be reduced if voluntary and charity sector members face domestic water supply challenges.
Business and finance

- Most large businesses have business continuity plans (BCPs) that plan for and manage extreme events. Most small to medium-sized enterprises (SMEs) do not have, or only have limited BCPs and would struggle to maintain operations during a severe drought. The impacts on the SMEs may therefore affect larger businesses through the supply chain.

- Many businesses operate from rented workspaces managed by third-party facility management organisations. The impact of low water pressure on welfare facilities and fire suppression systems in these circumstances is therefore poorly understood and may be difficult to resolve due to the differing interests of the parties involved.

- Loss of productivity as staff focus on securing water for personal / domestic needs.

- Loss of income as visitor and tourist numbers decline.

- Sensitive equipment (e.g. IT systems, cooling systems and manufacturing processes) may be irrevocably damaged by non-potable water.

Emergency Services

- The police and military may face an increase in demand for their services to maintain order during heightened public tension, especially during a heatwave.

- Resource implications for the police and military if they are needed to support whatever arrangements are necessary to secure and deliver water to vulnerable people.

- Day to day operational capacity may be affected if the buildings the emergency services are located in are themselves affected by low water pressure impacts.

- The London Fire Brigade will not be able to maintain normal fire-fighting capabilities in the face of lower water pressure and limited alternative sources of water, whilst in parallel facing increased fire risk due to drier environmental conditions. This will increase the health and well-being risks to fire-fighting staff.

- Emergency services personnel may be directly affected by a loss of water / interruptions to supply at home.

Health

- There will be greater demand on health services due to dehydration, poorer public hygiene and sanitation (lower water pressure) and burns and scalds (from people boiling non-potable water).

- Low water pressure may close sections of (taller) buildings, affecting service delivery. Provision of non-potable water will affect sensitive medical equipment, such as dialysis equipment.

- Direct impacts on staff due to lack of water at home and at work provided accommodation.

Utilities and Infrastructure

- Some energy generation plants use river water for cooling, so energy generation capacity may be affected by lower river flows and warmer river water.