Spring 2021

National Water Resources Plan - Framework Plan
Technical Appendices

Appendix E
Drought Planning

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Data Disclaimer:

This document uses best available data at time of writing. Some sources may have been updated in the interim period. As data relating to population forecasts and trends are based on information gathered before the Covid 19 Pandemic, monitoring and feedback will be used to capture any updates. The National Water Resources Plan will also align to relevant updates in applicable policy.

1.1 Introduction

Droughts happen when a period of lower than average rainfall causes a shortage of water. The shortage of water affects both the natural environment and sectors such as agriculture and water supply. The duration, timing and intensity of a drought can vary considerably, and these factors combine to affect different sectors in different ways.

The late spring and early summer of 2018 saw some of the lowest rainfall totals on record, resulting in low river flows and stress to water supplies. Demand for water was also higher than normal during this period, driven by high temperatures.

In 2018, disruption to customers and environmental impacts were minimised as a result of emergency plans and activities carried out by Irish Water and Local Authority operational staff, including:

- Convening a crisis management team;
- Tracking drought indicators and planning responses and activities ;
- Optimising existing supplies;
- Tankering water to maintain storage levels;
- Commissioning back-up supplies;
- Controlling pressures networks to improve water availability;
- Night-time restrictions in critical areas to conserve supplies;
- Communication campaigns to promote water conservation;
- Introduction of the first ever National Water Conservation Order; and
- Working with stakeholders including the DHPLG, NFGWS, EPA, ESB, IFI, NPWS, Met Éireann.
- Providing alternative water supplies to customers (Bowsers, stand pipes and bottled water, attention to critical customers, healthcare customers and vulnerable customers.
- Engagement of Key Account Managers with large customers.

Unfortunately, customers experienced some impacts, including reductions in water pressure and some temporary loss of supplies, principally as a result as a lack of capacity in our existing infrastructure.

Valuable learning on strategic and tactical drought management was gained during this period, which helped to improve our response during drought conditions experienced in spring of 2020. These two drought periods confirmed the fact that our existing asset base is not as resilient as it should be and need emergency interventions in order to supply water to customers. At present, many of our water supplies can only provide a reasonable level of service during normal weather conditions. A key learning from the two drought periods, was that we need to put in place further tools to plan for and manage our supplies during dry conditions, including sufficient:

- Understanding of the hydrology and hydrogeology relating to some of our water sources
- Site specific level and flow monitoring
- Live operational data
- Controls within some areas of our distribution networks to allow us to manage supplies more effectively

Through the National Water Resources Plan, our aim is to provide a reliable supply of water to customers with a Level of Service of 98% (equivalent to allowing water supply failures one year in every 50), and we have identified the challenges predicted in achieving this standard this over the next 25 years.

As summarised in Chapter 7 of the Framework Plan, when we assess our current asset capability against this Level of Service, up to 68% of our supplies are currently at risk of failure during drought conditions (DYCP- Dry Year Critical Period).

The purpose of the NWRP is to ensure that through delivery of solutions under the three pillars of **Use Less**, **Lose Less** and **Supply Smarter** we transform our asset base to provide safe, secure, reliable and sustainable water supplies. Delivery of the NWRP will improve Levels of Service to our customers and systematically reduce potential environmental impacts during drought periods. However, as it will take many years and multiple investment cycles to transform our supplies, in the interim we will need to rely on drought planning activities to maintain supply continuity, even after relatively short spells of dry weather.

Our drought planning activities at present are based on the assets currently available to us, and these activities will need to be updated as improvements to infrastructure are completed.

This appendix provides:

- An overview of drought risk in Ireland;
- Proposed framework for managing our water supplies during drought periods; and
- Proposed steps for developing a tactical drought planning process for public water supplies.

1.2 Drought Risk in Ireland

There are various definitons of drought availabe, including:

- Meteorological drought – a lack of precipitation, often a relatively short duration;
- Agricultural drought – a lack of soil moisture, typically affecting crop growth; and
- Hydrologic drought – lower than average rainfall for a longer period, leading to reduced river flow or groundwater levels.

From a water supply prespective, hydrological drought is the most useful definition. The period over which a drought develops and the corrosponding impacts on water supplies can be highly variable even within Ireland. For example, some events of reletively short duration can significatly reduce water availability in small or flashy surface water catchments or groundwater sources with poor storage, while the same event may not significantly impact a large reservoir or groundwater source with good geological storage characteristics. In contrast, a protracted but less intense period of low rainfall can affect long term storage levels, but may make a less obvious differnace to a small surface water supply.

Although Ireland is considered to be a country with large amounts of rainfall, the country does, from time to time experience drought events. However, weather conditions in recent years have been dominated by relatively wet conditions, with the last nationally significant historical drought occurring in 1995[1].
In Figure 1.1, we summarise historically significant hydrological droughts that have occurred in Ireland between 1850 and 2020, using information from ten rainfall monitoring locations with long data records. The red colour on the diagram indicates a significant drought period, whilst the blue areas indicate wetter conditions. As can be seen in Figure 1.1 and Figure 1.2, there have been far more serious drought events in the past, and that these events occurred at a greater frequency than those we have experienced over the past 30 years.

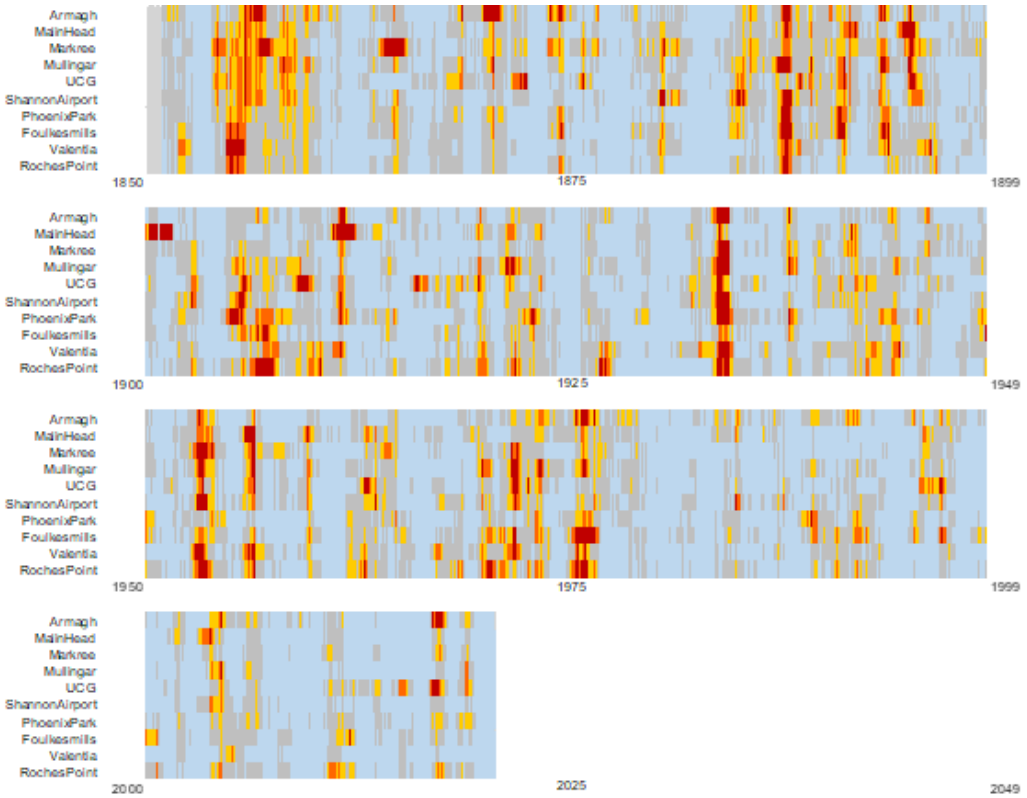

Figure 1.1 A heat map of drought severity from 1850 to 2020 for ten rainfall gauges used to as drought monitoring sites

[1] The drought events experienced in 2018 and 2020, although severe, were short in duration, and therefore would not register as nationally significant when compared to historical droughts

We need to ensure that our supplies are resilient and can withstand a wide range of drought scenarios including historical events.
However, many of these historical droughts occurred before the setting up of the river gauging stations used to support the surface water yield calculations in this Framework Plan (described in Chapter 3). In order to understand the significance and impact of these types of events, we will need to develop rainfall runoff models for our water sources in order to quantify the potential impacts of these on water availability. As our current water supply infrastructure does not deliver the desired level of service at present, even during relatively wet conditions, the risk of interruptions to supply during drought periods is greater than we would like.

Droughts can occur in winter and summer seasons. The drought events experienced in 2018 and 2020, although severe, were short in duration, and therefore do not register as nationally significant when compared to historical droughts, and they do not stand out in Figure 1, which highlights droughts likely to affect our key supplies. The multi-year drought of 1975/ 1976 and the summer drought of 1995 in particular are important drought years to consider, as they are amongst the most severe that occurred within the flow records we have and should be considered in the development of drought responses. However, given that the last of these events is now 25 years ago, substantial infrastructure changes have occurred in the interim.

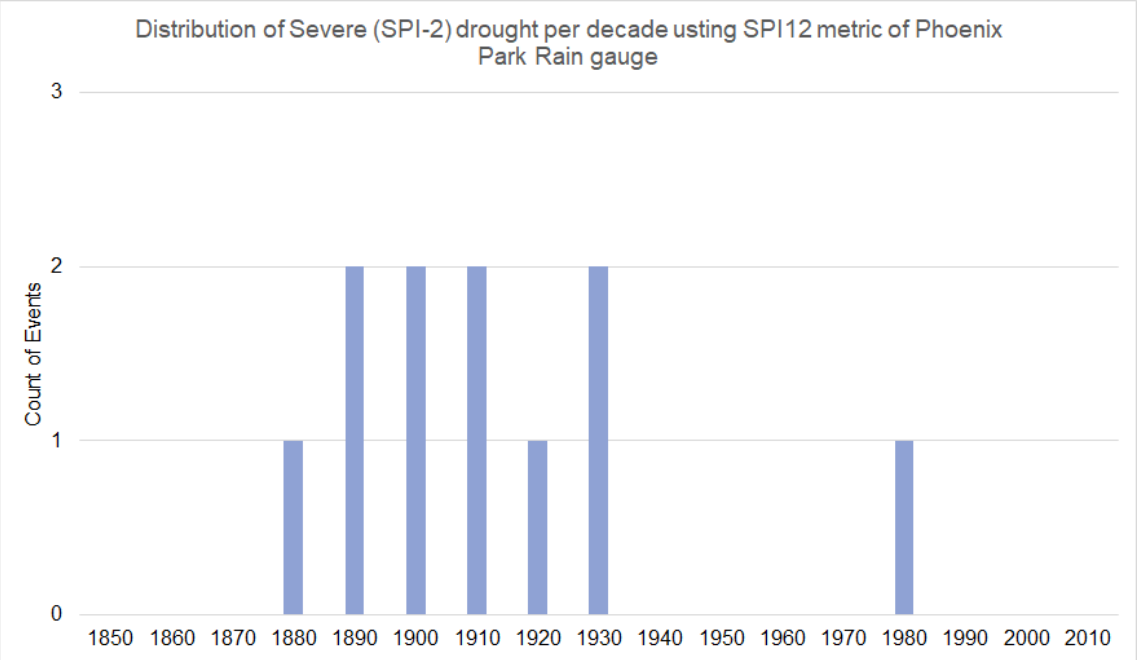

Figure 1.2 Count of number of events of 'severe' drought in by decade from 1850 to 2020

As part of drought planning Irish Water must consider the impact of dry weather periods on water services, in terms of:

- Impact on water availability at individual supplies, and across wider regions;
- Increased customer base as Group Water Schemes and Agriculture may need to be supported by public water supplies;
- Water quality which can deteriorate significantly during or immediately after drought events; and
- The assimilative capacity of waterbodies for wastewater discharge .

Irish Water also carries out significant forward planning activities to try to avoid the need for tactical measures during drought periods.

1.3 Proposed framework for managing our water supplies

1.3.1 Practical framework

The Regional Water Resources Plans that will be consulted on in Phase 2 of the NWRP will identify the preferred approaches to address interim and long-term infrastructure needs across our supplies. Subject to funding and once delivered, these preferred approaches will largely address the types of drought conditions we experienced in 1995, 2018 and 2020. The level of service within these Regional Plans is based on what is affordable or cost effective. However, a tactical drought planning process will be required to manage potentially frequent events whilst we invest to achieve a 1 in 50 LoS across all of our supplies. It will also be required to manage events of greater magnitude than 1 in 50, once we achieved this LoS milestone. As our asset base is transformed over time we will update our tactical drought planning processes to reflect updated asset capability and organisational change.

Typically tactical drought plans are focussed at Water Resource Zone (WRZ) level, but given the large number of small zones in Ireland and data limitations, this is not practicable at present. The current tactical drought planning process has been developed on the basis of the three Irish Water Operational Regions, but work is underway to provide a finer level of resolution. The principles of preparing and managing drought remain the same regardless of the size of the area.

The broad approach to managing drought is to:

- Define the triggers that will indicate drought is developing
- Identify the plausible drought management options and assign these to escalation points
- Monitor current conditions and operations against those escalation points on a routine basis
- As drought develops implement actions in line with the Framework Plan
    - Reduce system demands – voluntary, then mandatory customer restrictions, enhanced leakage management
    - Increase outputs – recommission dormant sources, alter licence constraints, reduce compensation flows, introduce emergency sources.

From the drought plan development process a number of new options may become apparent to be considered in the 25 year plan as permanent options.

1.3.2 Legislative framework

The practical framework for tactical drought planning in some cases involves alterations to normal operating regimes. Therefore, consideration must be given to the Water Framework Directive, Habitats Directive and drinking water quality requirements, when developing approaches.

As described in Chapter 3 of the Framework Plan, many of Irish Waters abstractions developed during a period where it was not a legislative requirement receive a consent to abstract water. Therefore, many of our supplies have no formal abstraction consents, and many of those that do are governed by the Water Supplies Act 1942. Within this piece of legislation there is no process to allow for new temporary supplies or for timely alterations to operating arrangements during drought periods. In practice, administrative/legal/paper constraints on operations at our water supply abstractions are more likely to be included as planning conditions for individual Water Treatment Plants, than as licence conditions under the 1942 Act.

In some larger reservoir sources, the operations and compensation flows may instead be set in primary legislation. Maintaining water supplies during periods of drought, may in reality require this legislation to be amended and these limits to be modified for short durations, subject to a period of consultation, a demonstration of need, and suitable mitigation if required.

An activity to increase supply during a drought needs to be coupled with effective powers to restrict demand. There are powers available under the Water Services Act 2007, and in 2018 and 2020, Water

Conservation Orders were issued under this Act. These powers will clearly be used sparingly and would form part of long-term behavioural change activities to alter attitudes to water. It is anticipated that over time, water savings will come less from restrictions themselves but instead from the communications opportunities they create.

1.4 IW's Tactical Drought Management Process

A significant amount of work is undertaken on site preparedness by our operational teams to limit the need for tactical measures during a drought; however, due to limitations with our current asset base, this is not always possible.

This section explains the tactical Drought Management Process within Irish Water. The tactical process is based on having an effective drought management framework to operate within. However, at present all of the requirements for an effective tactical plan may not be available to us (for example we do not have abstraction legislation that allows us to modify abstractions in a timely way during drought periods.

The purpose of Irish Water's tactical process is to provide an effective and systematic means of assessing drought conditions as they emerge and developing and instigating mitigation actions to reduce drought impacts on the provision of water services. The process sets out to answer the following questions:

- How will Irish Water monitor and measure drought impacts?
- What triggers will Irish Water use for indicating drought and what actions will they take at each stage of drought?
- How will Irish Water communicate drought?
- What new powers would allow Irish Water to enhance its capacity to respond to droughts?

The operational function within Irish Water includes an Operational Planning and Emergency Management team, whose role is to work with the Regional Operations Teams, Asset Management, Environmental Regulation and Communications functions, to develop contingency plans for planned and unplanned events. During the drought events in 2018 and 2020, this team has developed and evolved the tactical drought management process within Irish Water, including:

- Monitoring drought indicators on an ongoing basis and ensuring business preparedness
- Convening the Water Scarcity(Drought) Management team, (Asset Ops, Environ Reg, Asset Management, Asset Delivery, Asset Planning, Workflow, Business Support) as dry periods emerge
- Convening the Crisis Management Team (a subset of the senior management team) in the event of an emerging significant drought
- Controlling the Drought Tracker (a live register of incidents, emerging need, activities and actions during a drought period)
- Coordinating activities between the Regional Operations teams, Local Authorities, and the Crisis Management team
- Ensuring appropriate drought communications
- Post event review and analysis.

This tactical process has been developed to allow us to ensure continuity of our water supplies during drought periods, whilst we transform our asset base, recognising the that continuous water supply is essential for public health.

As part of this process, we have proactively assessed the issues with our current supplies and identified the types of options that may be used to mitigate against drought risks. To support and reinforce the tactical response team requires us to complete the following activities:

1. Develop appropriate drought indicators
2. Identify a series of monitoring activities and drought prevention and response escalation points
3. Develop drought management actions to correspond with escalation points
4. Outline a drought communications plan for Irish Water including management structure (key roles and responsibilities)

1.4.1 Drought Indicators

Effective drought planning requires the identification of appropriate indicators for both Environmental conditions and our Water Supplies, to ensure that Irish Water is prepared as drought conditions emerge.

The varying definitions of drought imply different measurement methods. With the focus on hydrological drought in this plan, given its more direct relevance to water supply, a number of indicators are required to represent the different source types. These are tabulated in Table 1.1 and shown in Figure 1.3.

Table 0.1 – Drought Indicators selected for use by Irish Water

Source type	Indicator	Operators	Comments
All	Rainfall	Met Éireann	A wide range of locations measured at daily and monthly frequencies
All	Soil Moisture Deficit	Met Éireann	All Ireland, for three soil categories
Rivers	Flow	EPA, OPW, ESB	As discussed in Chapter 3 there are relatively few flow gauging stations with a long-term record that includes several significant droughts
Reservoirs	Current storage volume	ESB, IW	This is available and reported upon. Although there are relatively few reservoirs, they provide a significant proportion of public water supply nationally
Groundwater	Groundwater level	EPA, GSI	The number of sites and length of records groundwater sources varies regionally, with a comprehensive network only established in the late 2000s.
Water Resource Zones	Demand	IW	Measured routinely by IW

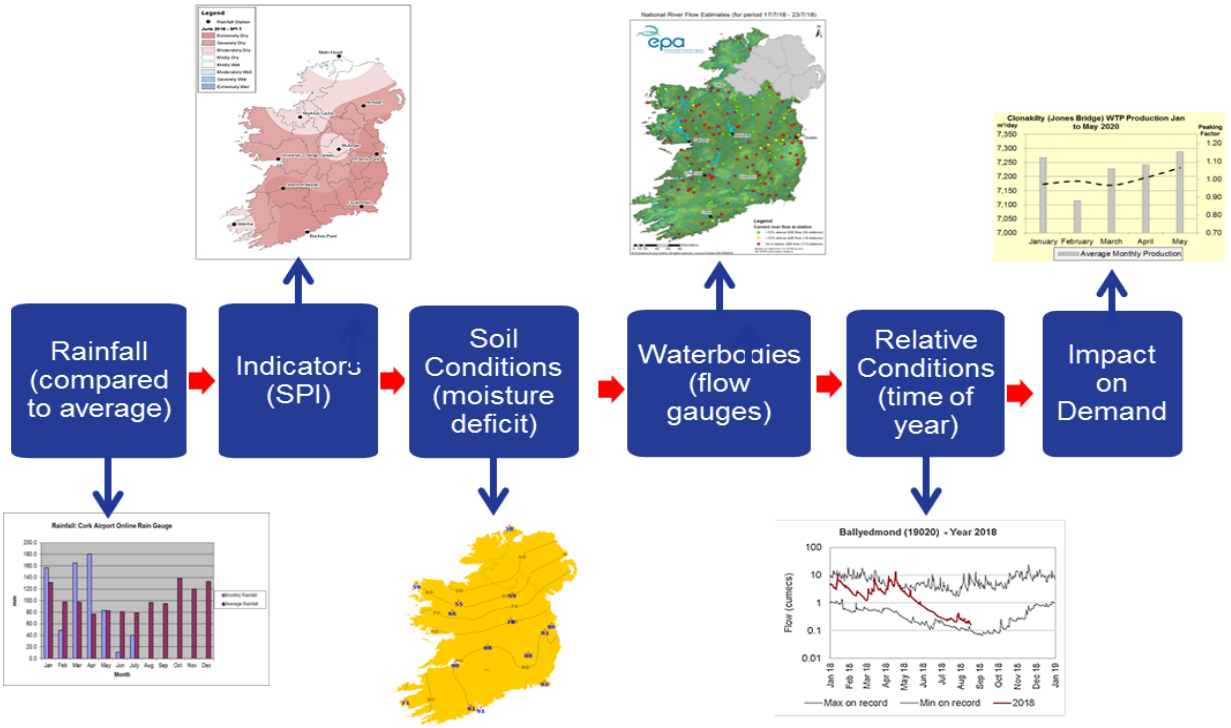

Figure 0.3 Drought Indicators for the Public Water Supply

To develop meaningful indicators the performance of individual sources, or a group of sources that will be impacted in the same way, needs to be calibrated to an appropriate indicator, and then the appropriate escalation points for that particular source or group established. With 1090 water sources feeding into 539 Water Resource Zones this is a considerable task. This exercise is underway for larger sources and will be completed for all sources over time. In the interim an alternative approach has been used to deliver a nationally consistent monitoring approach based on the Standard Precipitation Index (SPI), described in the following section.

In addition, for some of our larger reservoir sources, where data is available, we have also developed Target Operating Curves.

1.4.1.1 Standardised Precipitation Index

One of the key indicators used by Irish Water is the Standardised Precipitation Index (SPI). The SPI is a method for analysing rainfall patterns over time and can be applied at any scale from a single source, to the national supply on a countrywide basis. The indicator was developed in the 1990s[2] and is used widely internationally. It is a method recommended by the World Meteorological Organization.

SPI is a normalized index representing the probability of occurrence of an observed rainfall amount when compared with the data for long-term reference period at a given location. Negative SPI values represent rainfall deficit, moving towards drought whereas positive SPI values indicate rainfall surplus. The larger the negative SPI values are, the more serious the measured event is.

The method allows rainfall total over different time scales to be assessed (e.g. 3 month, 6 month,12 month, or 24 month rainfall patterns), meaning the drought impact on various water resources can be analysed. For example, SPI-1 measures rainfall conditions over a 1-month period, which would reflect small flashy river catchments; while SPI-6 measures rainfall conditions over six months, and is a better indicator for drought issues in regional groundwater sources and fresh water storage in reservoirs.

As part of the NWRP we have developed an SPI tool using monthly rainfall data from the Island of Island Precipitation[3] network to provide a reference period from 1850 to 2010. The network comprises 25 stations, from which we have selected 10 sites live data is available on a continuous basis (see Figure 1.4). The sites have been selected to ensure adequate national coverage, although potential improvements to the real time network have been identified and we will work with Met Éireann to further develop these over the coming years.

[2] Mackee 1993
[3] Homogenization and analysis of an expanded long-term monthly rainfall network for the Island of Ireland (1850–2010) S. Noone C. Murphy J. Coll T. Matthews D. Mullan R. L. Wilby S. Walsh First published: 05 October 2015 https://doi.org/10.1002/joc.4522

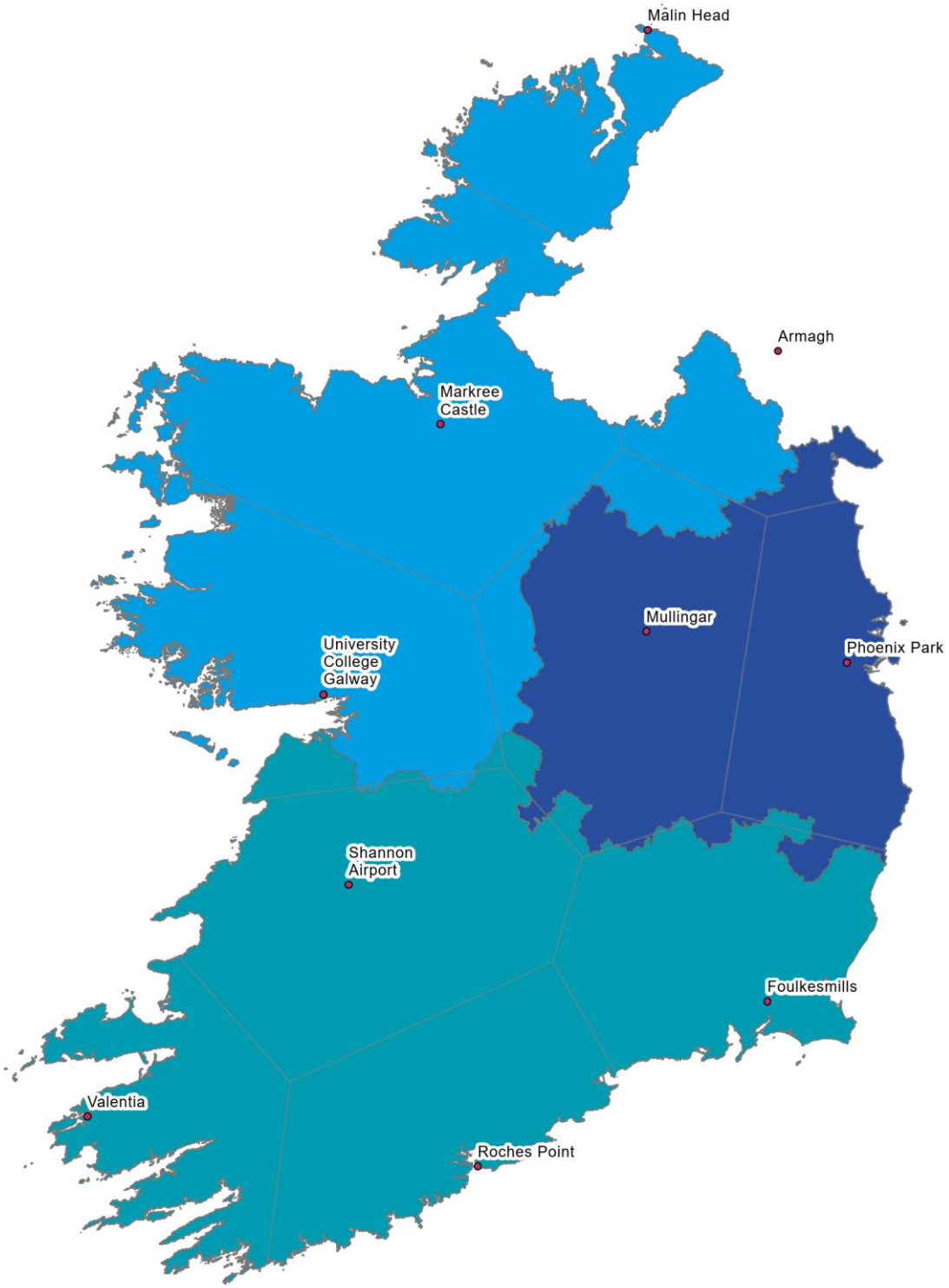

Figure 1.4 Map showing selected rain gauge locations and contributions to IW Regional SPI values.

Figure 1.5 shows an example of the SPI Plots for one of the monitoring stations, Phoenix Park. These ten sites are then spatially weighted to determine the SPI values for the management *area* using Theissen polygons method.

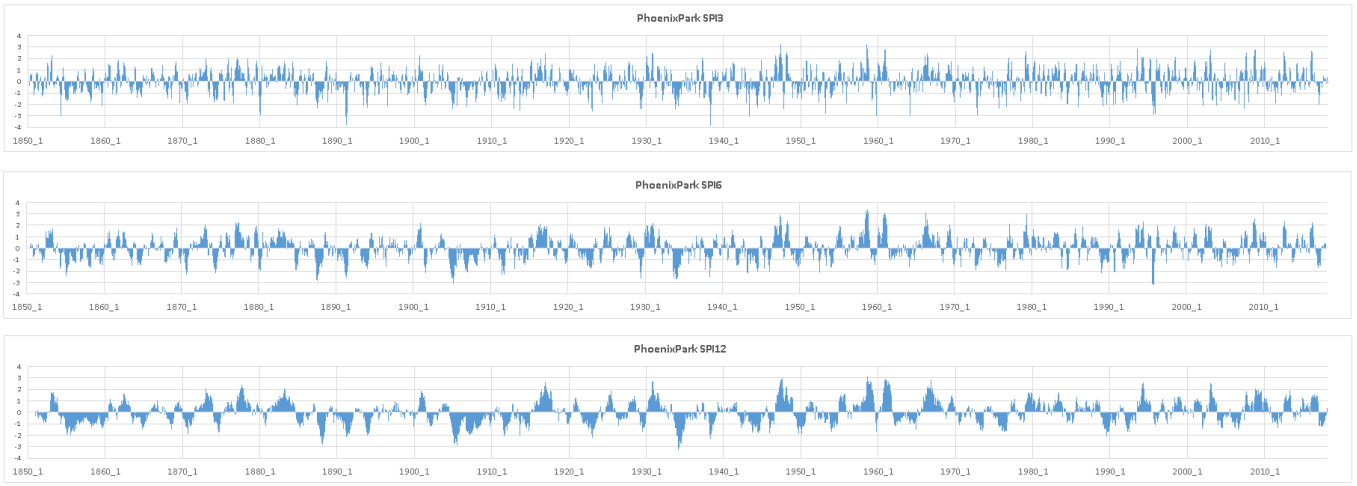

Figure 1.5 SPI plots for Phoenix Park in Dublin for SPI 3, 6, 12 month accumulations

1.4.1.2 Other Indicators – Target Operating Curves for Reservoirs

Raw water storage and impoundments along rivers increase the average daily amount of water that can be abstracted over an annual period, by storing water during periods of rainfall and then utilising this stored water during drier periods.

The raw water availability of a reservoir site can be calculated from:

- The catchment inflow to the reservoir;
- The amount of storage available (factoring in any flood storage or operational safety requirements);
- The amount of water that must be released on a continuous basis as compensation flow;
- Evaporation from the surface of the reservoir; and
- The 1 in 50-year Level of Service we aim to achieve (the higher the level of service, the lower the water availability).

For each impoundment site, a target storage curve profiles the optimal use of storage to achieve the maximum sustainable yield for the site. A target operating curve is also an excellent Drought Indicator, as when levels drop below the target curve, it means that the water source may not have enough capacity to sustain the volumes of water being abstracted in the event of dry weather. Figure 1.6, shows a theoretical Target Operating Curve for a reservoir site.

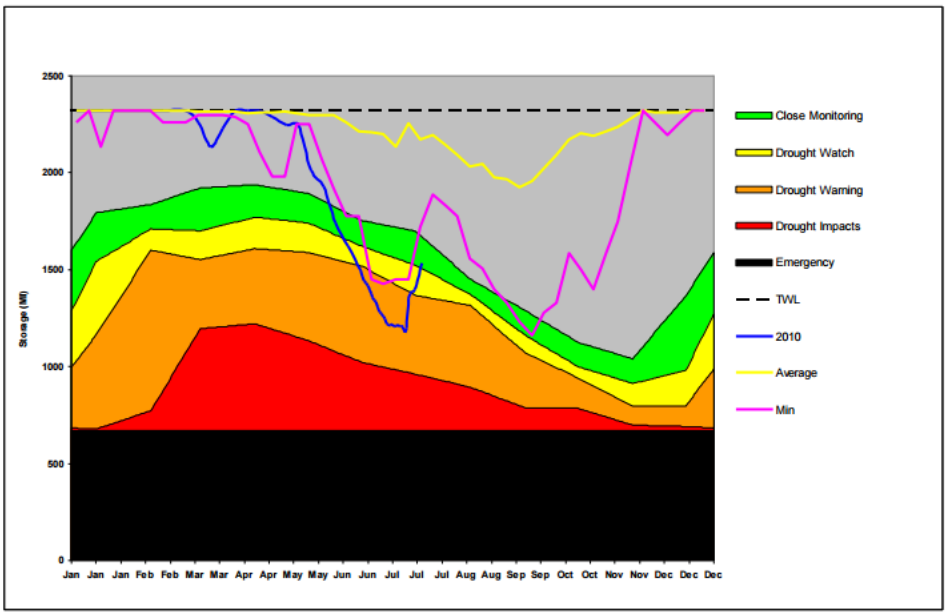

Figure 1.6 – Example Target Operating Curve for a raw water impounding reservoir

The target operating curve for the site is the zone above the green area on curved graph. The profile is based on a continuous volume being abstracted. If the water levels in the reservoir begin to encroach into the coloured areas below the curve, there is a risk that required abstraction rates will not be available later in the year.

1.5 Drought Monitoring and Escalation Points

The Irish Water Operational Planning and Emergency Management teams, along with the Regional Operational Staff continuously monitor drought indicators throughout the year. The indicators are assessed against the five escalation stages summarised in Table 1.3 (Normal, Potential Drought, Drought, Emergency Drought and Post-Drought).

Table 1.3 – Drought Stages

Drought Stage	Description	Operational Performance during Drought Stages
Normal	Normal range of monitoring actions.	Water Available for Use (WAFU) is greater than current demand and no available yield deficits are foreseen in the short or medium term under current conditions
Potential Drought	Actions required to prepare for drought following a prolonged period of dry weather.	WAFU is just meeting demand. No impact on customer supply but river, lake or groundwater levels are lower than those recorded at the same period in recent drought critical years. Some interventions required to improve raw water availability (with no risk to environment).
Drought	Actions required to manage drought once conditions impact on customers and the environment.	WAFU is less than demand. Interventions (i.e. tankering or nighttime restrictions) are being undertaken to increase water availability and reduce demand, providing moderate water availability to customers. Proposed or ongoing interventions required to increase raw water availability that may involve low risk to environment (through consultation with key environmental stakeholders)
Emergency (Severe Drought)	Actions required when drought conditions cause water demand to exceed the amount of water available for customers and the environment.	Interventions (tankering or nighttime restrictions) are being undertaken to increase water availability and reduce demand. However, prolonged and significant supply restrictions are being experienced by customers or are likely in the short term. Proposed or ongoing interventions undertaken to increase raw water availability have been identified through the IFI Consultation and Environmental Assessment Process to be causing severe impact to the environment
Post-Drought	Actions required to monitor and manage recovery of water supplies and to review Irish Water's response to drought.	Available yield has recovered and Water Available for Use is greater than current demand.

The drought stages have been assigned escalation levels based on the relationship between SPI values and the return period of drought events (but also considering the operational performance). This range of escalation points is appropriate at a national level and forms a uniform way of drought monitoring across our supplies, as shown in Table 1.4. These enable us to maximize the service we can provide during drought conditions with our existing asset base, whilst minimizing impact on the environment. At a *management area* level additional metrics such as reservoir storage may be used to form the basis of escalation points.

It is important to understand that passing a trigger level does not immediately drive actions, but does drive the consideration of the actions. Factors such as the time of year, other water users needs and the general demand position may affect the timing of individual actions.

Table 0.4 - Drought stages and escalation triggers

Drought Stage	Trigger
Normal	SPI above -1.
Potential Drought	SPI of -1 or below
Drought	SPI of -1.5 or below
Emergency (Severe Drought)	SPI of -2 or below
Post-Drought	Recovery in supply position and easing of environmental stress

Given the variability in Levels of Service that our current infrastructure can deliver, it is not possible at present to deliver against nationally consistent escalation points, however, these will further develop over time. The tactical drought planning process for each *management area* set will set the actions the actions that must be taken at specific sites during specific events.

1.6 Drought Management Actions

The options described below are measures that have been or can be utilized at present in order to manage drought. These encompass both supply side and demand side actions. It must be recognised that there is no mechanism to introduce some of the supply side measures at present in a fast enough way to be of benefit.

As a drought becomes more severe, the yardstick for what is practical or acceptable in costs or environmental terms will change so some options will only become tenable during a very severe event.

1.6.1 Demand- side measures

Demand side measures have been developed in line with Irish Water's desired/ actual levels of service and policies contained in the WSSP. There are a number of reports examining the effectiveness of drought measures from events in England from 2005/6 and 2012, but it is difficult to quantify the effectiveness of single measures from an overall observed total. It is likely that many of the savings occurred as a result of press coverage rather than the specific measures, as demand savings were also observed in areas where there were no restrictions in place, but bordered areas with restrictions. The areas affected are also more used to experiencing droughts and are generally in receipt of stronger water saving messages. The receptiveness to appeals for savings is likely to be more positive than in Ireland where public perception is significantly different. The assumptions surrounding the effectiveness of water saving measures have been treated similarly until an evidence base in Ireland is established.

There are four main themes:

- Consumer savings from voluntary actions;
- Large water users;
- Additional leakage reduction;
- Consumer restrictions.
- Alternative water supplies (during drought periods)

1.6.1.1 Consumer savings from voluntary actions – all stages of drought

Given that Ireland is perceived to be a wet country, it can sometimes be difficult to communicate the need to for people to take action to save water. However, changes in customer behaviour are likely to deliver far greater savings than the limited restrictions available.

In order to gain maximum reach, communication throughout the drought event (before, during and post-event) is primarily based on public information campaigns. The use of a full 360 information campaign that covers TV, Radio, newspaper and stakeholder engagement (local and national), , web and social channels(Website, Facebook, Twitter) acts to raise customer awareness about the risk/status of drought and therefore the need to reduce water demand. In addition to National Public Information Campaigns, Regional and Local drought specific communication activities are used to complement the tactical drought planning process, reflective of the escalation stages. This also allows for supportive messaging from regulators and local authorities to deliver a complementary effort to reduce customer water use. Further details of the steps taken to outline a Communications Plan for Irish Water are discussed in Chapter 7 of the Framework Plan.

1.6.1.2 Large water users – All stages of drought

Industries that rely on a quality, reliable water supply form a key part of Ireland's economy. It is important that we work with these companies to ensure that their own planning includes assisting with water saving efforts without affecting production capacity. We work with large water users to try to establish what efficiencies can be made and if alternative supplies can be offered at times of drought without affecting production. Water audits can be used to engage with customers to lower use and the effort surrounding these can be intensified in times of drought.

1.6.1.3 Additional leakage reduction and pressure management – Potential, Drought and Emergency drought conditions

While we have set out ambitious leakage targets as part of the 25-year NWRP to deliver a sustainable economic level of leakage, we will go further during times of drought. This will give a high priority to visible leaks, although in itself this may not achieve a large water saving. Visible water leaks significantly detract from the water saving messages that are so important to the overall response. The Communications around activities to repair leaks are also essential to ensure customers report leaks when observed and understand that sometimes leaks can appear to take some time to fix because of the complexities involved in any repair.

It is important to understand these activities are over and above the measures to reach SELL set out in the water conservation strategy. They cannot be sustained for a long period of time given the intensity of effort required, but are a practical means of managing limited supply availability during drought conditions.

1.6.1.4 Consumer Restrictions – Drought and Severe drought

The Water Services Act 2007 gives Irish Water the powers to restrict the consumption of water it supplies during drought periods.

The communication of any restrictions is through our communications channels, and includes newspaper, website, social media and potentially radio and television advertisements or broadcasts.

When considering the implementation of temporary restrictions, we take into account the following:

- Prioritising and sequencing restrictions based on different categories of water use.
- Potential exemptions and concessions e.g. sensitive customers such as hospitals, nursing homes etc.
- How priorities, exemptions and concessions will balance expected water savings with adverse impacts on customers and businesses – whether direct or indirect
- Ways for communicating with customers and interest groups to provide clear and timely information about the phasing in and subsequent lifting of water restrictions on particular categories of use.
- Ways for demonstrating to customers and other stakeholders that water restrictions are proportionate and reasonable.

1.6.1.5 Interruptions to Supply – Drought and Severe drought

As access to an uninterrupted water supply is driven by public health, interruptions to supply are serious incidents and are only planned when our water supplies have failed or are in imminent danger of failing. In these cases, Irish Water first tries to limit interruptions to supply to nighttime only outages, in order to conserve remaining water reserves for day-time use. Where possible, we tanker water from neighbouring sources to augment sites that are failing. As a drought escalates to emergency drought level, Irish Water endeavours to identify sensitive customers to ensure that they have access to water for consumption purposes, that appropriate standpipes or public water stations are set up and that emergency helplines are in place. Measures that involve interruptions to supply require significant planning in advance, to ensure that mitigations measures such as water tankering, bottled water reserves, logistics and plug in points, emergency helplines ,have been identified and are on standby.

1.6.2 Supply-side

As well as drought actions designed to reduce demand, a range of possible supply-side measures have been identified. These generic actions are based on common practices implemented in other countries/ water companies that could be potentially utilised by Irish Water to manage drought. The following

descriptions are aimed at a high-level with the recommendation that a more detailed supply-side options appraisal is carried out in line with the development of a practical and legislative framework for managing drought in Ireland.

1.6.2.1 Optimisation of existing sources – Potential Drought

As the early stages of a drought develop, Irish Water reviews the operation of its sources across water resource zones in order to assess the potential effects of increased pressures on sources and to define optimised operating regimes until the post-drought stage.

A typical optimised operational measure would be the conservation of storage in reservoir sources during the early stages of drought by maximising abstractions from river sources. Therefore, reserving storage to be utilised during the more severe drought stages when river flows have reduced to the point that abstractions are constrained by minimum flow conditions specified in the license.

1.6.2.2 Optimisation of Intakes – Potential Drought

In certain cases we may need to temporarily alter the way we abstract water from the natural environment during drought conditions. This may involve the use of submersible pumps, channelization, and temporary modification of our intake structures. Where such actions are required Irish Water works with the IFI and environmental stakeholders to ensure measures are proportionate to conditions and give to full consideration to environmental impact including Appropriate Assessment requirements.

1.6.2.3 Rezoning – Potential Drought, Drought, Emergency Drought

Another typical supply-side measure during stages of drought is the rezoning of supplies from more resilient sources to reduce demand and pressure on vulnerable sources. This involves altering the water supply network for the area that a particular water source supplies. Similarly, to the optimisation of existing sources measure, Irish Water can act to meet demand during times of drought by implementing temporary changes to the distribution system operation to utilise more resilient supply sources available to them.

Rezoning requires detailed discussions with Operations to take place to identify restrictions in the existing system which could be removed by quickly implemented engineering works. Through a more detailed assessment, where appropriate, rezoning measures can be identified as potential supply-side actions.

1.6.2.4 Recommissioning disused sources – Drought, Emergency Drought

It may be possible for Irish Water to recommission disused sources during stages of drought. This requires an examination of existing water sources in Ireland which have been decommissioned in recent years. Irish Water should maintain a register of these sources and their site plans which can be reviewed during drought events. This identification and monitoring process should be developed alongside the wider ongoing rationalisation work.

However, the legal status of sources will also dictate whether they can be reintroduced.

1.6.2.5 Increasing abstraction at existing sources – drought, emergency drought– currently not possible

In most cases the amount of water that can be abstracted from a source is constrained by an abstraction license, the hydrological yield, or a physical limitation (capacity of the treatment works or distribution system). Where the constraint is the hydrological yield or physical, then Irish Water should examine how further investments can increase the available yield. Whilst if the license is the main constraint, Irish Water should consider all legal avenues available to them for seeking an improved allowable abstraction conditions e.g. UK water companies can apply for a Drought Permit/Order.

1.6.2.6 Tankering – Drought, Emergency Drought

In the most severe stages of drought, Irish Water can tanker water from nearby WRZs to the most vulnerable areas affected by drought. The feasibility of this measure can have practical constraints such as road access and tanker capacity issues, as well as the water availability in the neighbouring zones.

1.6.2.7 Construction of new satellite boreholes – Drought, Emergency Drought – currently not possible

For existing groundwater sources, Irish Water should consider developing new boreholes to distribute the abstraction and reduce the pressure on existing boreholes from failing. However, the required implementation timescales could be too long for drought events and there could be environmental impacts risks due to lower groundwater levels.

1.6.2.8 Inter-zonal bulk transfers - Potential Drought, Drought, Emergency Drought

The movement of water in bulk from areas of very secure supply to those that are in deficit is an efficient utilisation of available water resources for both meeting demand during drought and for building resilience for future dry events. The ability to transfer bulk supplies between WRZs can play an important role in maintaining a balance between supply and demand across different areas for Irish Water.

1.7 Potential Environmental Impacts

Some supply side drought measures have the potential to affect the environment, either through the associated construction activity or as a consequence of the additional water taken. Furthermore, wastewater discharges during drought periods of low flow and reduced assimilative capacity have the potential to cause pollution incidents.

In some areas it may not be possible to deliver a drought response that does not include a temporary environmental impact, and the acceptability of that impact must be judged against:

- the degree of risk to supplies;
- the potential recovery post-drought;
- the possible impacts in the drought situation without interventions;
- Irish Water's legal obligations under the Habitats Directive and Water Framework Directive.

Existing Environmental Assessment, Appropriate Assessment or Environmental Reports relating to abstraction will be reviewed to check for any known environmental effects of abstraction. Working with the relevant stakeholders, Irish Water will ensure that drought actions comply with relevant statutory requirements.

In the normal operating state Irish Water will carry out a review of water supply sources and will use a risk based approach to prioritise sources where environmental assessment might be required in advance of drought management actions. The environmental assessments will include, as a minimum:

- the likely changes in flow/level regime, due to implementing the drought management action;
- the features that are sensitive to these changes;
- the likely impacts on sensitive features;
- mitigation that may be required to prevent or reduce impacts on sensitive features.

Key factors in identifying environmental risk include the potential to impact on the following environmental sites:

- Special Protection Areas (SPAs), Special Areas of Conservation – European protected areas;
- Ramsar (most 41/46 are covered in SACs or SPAs) – Internationally protected sites;
- Natural Heritage Areas (NHAs) – National protected sites;
- Proposed NHAs – Nationally protected sites;
- Flore and Fauna protected under the Wildlife Act, 1976 as amended – National legislation for species protection;
- European protected species (e.g. bats and otter).

1.7.1 Environmental monitoring and mitigation

Mitigation measures may be possible on a temporary basis which could limit the nature of impact or aid recovery post drought. The mitigation will be site and time specific and will be developed in consultation with stakeholders.

The following are generic mitigation measures that Irish Water will consider:

- Fish rescues;
- Fish ladders regularly checked;
- Increased presence to restrict poaching and protect spawning reeds;
- Habitat restoration;
- Reductions of abstractions, if possible;
- Freshet releases;
- Flow augmentation structures to enhance water depth/flow velocity;
- Ensure adequate post-drought monitoring.

1.8 Drought Monitoring

Alongside the use of the SPI tool in developing drought indicators and triggers, a series of monitoring activities are required to develop a comprehensive picture of a developing drought. These need to be capable of providing rapid information and move from a routine frequency in normal conditions to more intensive actions in time of drought.

Irish Water will continuously engage with its stakeholders to obtain up to date data relevant for detecting onset and progression of droughts. The national drought team will be responsible for collating information, reporting, coordinating a consistent approach across different regions.

Routine monitoring will be carried out for various types of data including:

- Weather forecasts;
- Rainfall levels;
- River flows;
- Groundwater levels;
- Reservoir levels;
- Network demand through Distribution Input (DI) data.

The collection of hydrometric data in combination with the demand will allow the understanding of the current supply demand balance.

As a drought develops, Irish Water will increase the level of hydrometric monitoring, to track the development of the drought and its impacts. Enhanced monitoring will be carried out on a case-by-case basis focussing on specific sites showing the most stress. Associated with certain options may be additional environmental monitoring requirements to protect key features.

1.9 Drought Communications

In times of drought, the amount of water we have available for supply in our water sources comes under pressure as there is not enough rainfall to replenish the reservoirs, rivers and aquifers from which we abstract. During the drought of 2018, Irish Water undertook an extensive national and local integrated public awareness campaign to educate the public about their personal water use. This campaign combined media, advertising and online information campaigns and stakeholder and customer engagement, and focussed on the daily estimated water consumption with a view to encouraging simple steps to reduce it. Daily water demand, especially in the Greater Dublin area reduced significantly during the period of the campaign (July and August) and while it is difficult to directly attribute this reduction in demand solely to the campaign, the widespread media coverage and associated advertising across all channels along with direct engagement with large water users was very likely to have positively impacted behaviour and encouraged greater water conservation by customers. Research undertaken after the campaign confirmed that household water users did think more about their individual use based on the campaign but their perception was that the extent of the drought may have been exaggerated.

In 2020, water shortages began to emerge in spring due to a prolonged period of dry weather the national paid water conservation public information campaign needed to begin earlier than in previous years due to significant water supply challenges in some parts of the country. The impact of changed water use due to Covid-19 was also significant with an increase in domestic water consumption due to increased home hygiene and hand washing. Irish Water's water conservation messaging had to take account of critical public health messaging related to hand washing in particular while still encouraging households to reduce non-essential use, at the time a National Water Conservation Order was being imposed. As in previous years an integrated campaign approach was adopted to maximise the impact and effectiveness across all channels, paid and earned, with local and national media coverage, paid online and radio advertising. Direct dedicated stakeholder engagement was also undertaken with key stakeholders including An Fóram Uisce, the Irish Water National Stakeholder Forum and all local authorities through the Local Government Management Agency. Local Authorities across the country supported and amplified the water conservation campaign by sharing key campaign messages and collateral on their own online channels broadening the reach and impact of the campaign messages. While media coverage and stakeholder feedback on water conservation messaging were positive, it is difficult to accurately quantify the direct impact of the 2020 water conservation campaign given the wider context of the Covid-19 pandemic and its impact on personal behaviour, including water use.

Water conservation public information campaigns continue to be a key component of Irish Waters tactical drought planning activities.

1.10 Post-Drought Activities

1.10.1 De-escalation of drought activities

The final drought stage is Post-Drought, which marks the stage at which drought has ended and it is safe to de-escalate drought related activities. This de-escalation process may have different timelines across our supplies and will depend on how they are recovering.

As the drought status is stepped down to a reduced level of 'Post-Drought', we will discuss which actions are no longer necessary and these will be stopped. During the de-escalation process, we will aim to firstly prioritise the reduction of those actions that cause the most significant social and environmental impacts.

It is important to understand that there is a difference between when a drought event has 'broken', when the period of low rainfall has ended, and when sources have truly recovered and when levels/flows have returned back to a recognised normal range of conditions. As discussed earlier, drought events are characterised by a cumulative deficit of rainfall. When a drought 'breaks', typically this is from the effects of a period of much higher than normal rainfall event. However, it will typically take time for sources to fully recover as there needs to be a sufficient amount of rainfall to firstly remove the soil moisture deficit, restore river flows, recharge reservoir and groundwater levels.

The end of a drought could be typically defined as when the risk of impacts from drought is no greater than during a normal year and where normal conditions have continued for a period of time. Therefore, we will use the various drought indicators and triggers discussed previously (SPI, river flows, groundwater levels, reservoir levels) to define when these have returned to a 'normal' condition e.g. when there has been several months of average or above average rainfall.

1.10.2 Post-Drought Review

After the decision to end drought measures is taken, as part of our tactical drought planning process, we conduct a review of how the drought was managed and develop any post incident reports required. This allows us to continually improve our processes outcomes for future drought events. It also allows us to understand any capital investments that may be required to reduce risk during future events.

The areas the Post-Drought Review may consider include:

- A record of the drought;
- A summary of impacts and actions taken;
- A record of lessons learnt;
- A review of the environmental impacts of the drought by analysing baseline, in-drought and post-drought data. This should be carried out in conjunction with the EPA and other relevant stakeholders;
- A review of the measures and actions taken and mitigation measures in place;
- An assessment of sources and how they coped during the drought scenario including the time taken to reach escalation points and the periods required for recharge. This can also include a review of the performance of any emergency sources utilised during the drought;
- A review of the escalation points in place including refinement of the levels if they were considered to be overly ambitious or onerous.
- Estimates of demand reductions achieved from the implementation of demand-side drought management actions;
- A review of the communications plan implemented and its effectiveness.
- A review of Irish Water demand forecasts and if demand patterns experienced during a drought are different to those in the drought plan or in other Irish Water strategy reports;

1.11 Next steps

Through the National Water Resources Plan, Irish Water will:

- Develop programmes to deliver the required studies and monitoring/measurement activities to enable us to understand our water sources;
- To ensure that our activities and decision making are based on continuously improving tactical processes, driven by good data and information;
- Our asset base is transformed over time to ensure that our we can achieve a 1 in 50 LoS for our supplies, based on minimal environmental impact; and
- We progress interim measures to protect vulnerable sources.