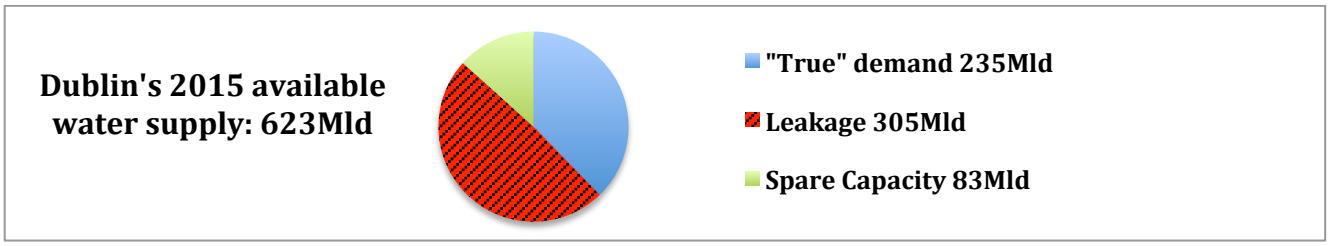
SUMMARY OF THIS KENNEDY PAPER ON DUBLIN'S LEAKAGE (APRIL 2017)

- Dublin has brand new water treatment plants but corroded, leaking water supply pipes. Dublin City Council stated a decade ago *"…these mains are so ancient that leaving them alone is not an option"*. New Irish Water data (published in November 2016) shows that **Dublin's total leakage rate is not 33% but rather is almost certainly at least 57%**. This is far from normal: a 2016 OECD study of 43 cities around the world (excluding Dublin) showed only 4 cities with leakage levels above 40% - all of them in Mexico.

- The biggest element of Dublin's "demand" is water that is put into the supply system but pours through holes in the pipes into the ground. **Dublin's "true" demand (water actually *used* by consumers) amounts to well under 50% of its supply.** As leakage is *reduced* "spare capacity" is *increased* – e.g. Paris has a large spare capacity, but its leakage rates are around 5%: **if Dublin's leakage rates in 2015 had been 5% it would have had 152% spare capacity.** The chart below shows how Dublin's 2015 water supply was split between "true" demand, leakage and spare capacity – it can be seen that as leakage decreases spare capacity increases.



(Mld – million litres per day)

- Irish Water has confirmed that over the past ten years only around EUR100million has been spent on addressing leaks. This is an average of only EUR 10million per year which is a shockingly low figure given the scale of the problem - it equates to **an annual spend on addressing leaks of only 0.8% of the projected EUR1.2billion cost of the Shannon project.**

- Irish Water presents leakage targets in its analysis for the Shannon project which it describes as "ambitious": on the contrary, they are **highly misleading and extremely un-ambitious** and the projected costs for recovering water through addressing customer side leakage have been proven to be **three times overstated.**

- Irish Water states that one of the risks of having such damaged pipes carrying water at low pressure is "contaminated groundwater" (from the water-logged ground around the pipes) flowing *into* the pipes carrying treated water to Dubliners' taps. **One potential contaminant is raw sewage from the sewage pipes that are also leaking. Irish Water mitigates this risk by adding high levels of chlorine to the water.**

- Dublin's pipes will only get worse with each cold winter and the passage of time. Irish Water cites the inconvenience for Dubliners as a justification against mains replacement yet ten years ago London (with leakage levels less than *half* those in Dublin) deemed replacing its *entire* mains system a necessary evil. The *sooner* Dublin's mains are replaced the *fewer* people will be inconvenienced if Irish Water's projections of population and economic growth are correct. **The Shannon project is an extremely expensive sticking plaster when major surgery will be required down the line in any event.**

The Shannon project would cost up to EUR1.2billion to pump yet more water into Dublin's ancient water pipes to offset the fact that most of it leaks straight into the ground. This fails to address a key issue: the consumer demands not only a guaranteed *quantity* of water but also a guaranteed *quality* of water. Repairing Dublin's water pipes would (1) recover far more water, far more quickly and for far less money than Irish Water factored into its analysis, and (2) simultaneously address the *quality* issue.

In Irish Water's analysis (with its existing un-ambitious leakage targets) the recovery of water through addressing leaks is the key factor off-setting Dublin's projected growth in water demand. If Irish Water were to adopt *ambitious* leakage targets, as would be appropriate given the scale of Dublin's problems, it would recover significantly more water over and above its current assessment. That water would then be available to increase current headroom and meet future demand.

The Kennedy Analysis has already demonstrated that, once errors in Irish Water's analysis are corrected, there is no mathematical need for the Shannon project. This Kennedy Paper on Dublin's Leakage undermines the need for the Shannon Project yet further.

PART A
BACKGROUND: THE KENNEDY ANALYSIS OF THE SHANNON PROJECT

The Kennedy Analysis concluded that a much less expensive option than the Shannon pipeline would suffice to safeguard Dublin's future water supply and would provide Dublin with the benefit of *diversification of sources*, which the Shannon option does not offer.

The Kennedy Report and the Kennedy Response identified many errors in Irish Water's analysis

The Kennedy Report (September 2016) identified that (a) Irish Water's public messages about the need for the Shannon project contained falsehood after provable falsehood, and (b) its analysis was littered with **errors and incorrect maths**. Once these errors are corrected Dublin's projected 2050 water deficit is a fraction of that calculated by Irish Water (indeed it is highly possible that Dublin will have a significant water *surplus* come 2050) and the *need* for the enormous Shannon project is eliminated.

Irish Water sent a written response to the Kennedy Report on 28 October 2016. Its response failed to address multiple specific examples of i**ncorrect maths** identified in the Kennedy Report, and avoided addressing many of the specific issues raised in the Kennedy Report by making unrelated and irrelevant statements. It contained **false statements**, cited data that was then **known to be incorrect** and claimed that Irish Water had adopted certain methods in its analysis that it had *not* adopted.

The Kennedy Response was sent to Irish Water on 23 December 2016 in response to Irish Water's response to the Kennedy Report. By the time that the Kennedy Response was produced yet *more errors in Irish Water's analysis had come to light* than had been flagged in the original Kennedy Report. **Two of those newly identified errors have a particularly significant error on the bottom line (i.e. the need, or not, for the Shannon project)**:

(1) Irish Water's analysis was informed by two sets of projections produced by two separate advisors: Indecon and Jacobs Tobin. Importantly, Indecon's analysis for projected non-domestic demand adopted a detailed, sectoral, internationally accepted methodology that took account of the ongoing decline in industrial water intensity. Jacobs Tobin's analysis, on the other hand, simply grew projected non-domestic demand in line with Dublin's projected population growth. This population growth method is an out-dated method that the Indecon report itself was highly critical of – it takes no account of the ongoing decline in industrial water intensity and is particularly inappropriate for a city like Dublin that relies heavily on international trade (so its own population has a very limited bearing on the need for water in its industrial sector). Irish Water repeatedly claimed in its public statements that it had used Indecon's projection data on non-domestic demand taking account of the decline in industrial water intensity but **in fact it used Jacobs Tobin's data on non-domestic demand which took no account of this and was significantly higher than Indecon's equivalent projection**, and

(2) the Q2 2016 results of the First Fix scheme (Irish Water's recent scheme for fixing leaks on customers' properties) show that the level of Dublin's customer side leakage in 2011 (which was the base year for Irish Water's analysis) can *not* have been **40.8 Mld** (as Irish Water assumed) but rather must almost certainly have been at least **100 Mld** - this means that, in meeting its 2050 customer side leakage target of 29.6 Mld, **Irish Water will recover an additional 59.2 Mld of water over and above that assumed in the Project Need Report**.

Correcting just these two basic errors (and none of the other errors that the Kennedy Analysis identified) results in a projected 2050 deficit in Dublin of just 57 Mld (as opposed to the 215 Mld that Irish Water has been using to justify the enormous Shannon project). Appendix 1 to this paper contains a table setting this out – note that **this retains all of Irish Water's other assumptions** (so retains its ambitious population and economic growth projections, its assumption that the number of households in Dublin will *double* over the next 35 years, its unambitious leakage targets, and its questionable inclusion of a requirement for a stand-alone volume of 100Mld of extra water to be available for contemplated new high-water-using industry *over and above* organic industrial growth). It also includes the three "safety buffers" (peaking, headroom and outage) which total 35% of extra water over and above average demand that Irish Water's analysis requires to be made available *every day of the year* (the three buffers are cumulative).

What is more, this calculation of a 57Mld deficit **assumes only *conservative* levels of future water treatment capacity at Dublin's existing water treatment plants after ongoing increase/improvement projects are completed**. The Kennedy Response shows that the Project Need Report contained repeated *double counting* of headroom/outage/peaking on both sides of the supply/demand equation - Irish Water added it in to the "demand" side while simultaneously deducting it from the "supply" side. As an example, Irish Water accounted for "headroom and outage" on the *demand* side (15% in the Project Need Report, increased to 20% in the November 2016 Final Options Appraisal Report) but took no account on the *supply* side of the *brand new extra treatment capacity* at Ballymore Eustace and Leixlip over and above their licensed limits (this totals 122Mld of extra capacity over the licensed limits). One would certainly hope that these extra brand new water treatment units would indeed be called upon in the event of an outage or mechanical failure at one of the other water treatment units at the Ballymore Eustace/Leixlip facilities such that, without calling upon these new treatment units, those facilities would not even be able to treat their full licenced amount of water. Arguably this extra treatment capacity should also be available to treat amounts of water from the reservoirs (which hold tens of *billions* of litres of water) *over* the licenced limits of the Liffey to cover short-term, non-sustainable "peaking" provided that the reservoir be replenished with an equivalent volume of water within a defined subsequent period of time[1]. However this extra capacity at Ballymore Eustace and Leixlip is not factored into the "supply" side figures at all. If one accounts for this extra 122Mld of capacity and assumes that Irish Water *would* indeed use that capacity in the event of an outage event at Ballymore Eustace of Leixlip (and perhaps to cover short-term, non-sustainable peaking, as discussed in the Kennedy Response) then the projected 57Mld deficit in 2050 becomes a projected **65Mld surplus**. Again, this is adopting Irish Water's (arguably aggressive) assumptions on everything else. As is shown in the Kennedy Analysis, if one corrects more of Irish Water's errors then one arrives at an even larger projected 2050 water *surplus*.

The Kennedy Response identified many misleading public messages made by Irish Water about the need for this project

The concept of there being no "need" for this project may sound improbable given that Irish Water's messages about the "need" have been so widely disseminated. Here are some of the statements that Irish Water has made: *"There is currently less than 2% spare drinking water capacity in Dublin"…. "The present infrastructure is struggling to meet current need as evidenced by a number of significant and costly outages in Dublin over the past 5 years"…. "The Project Need Report identified that projected demand for water in Dublin alone is expected to increase by over 50% by 2050"…."recent outages in Dublin (2010 - 2014) typically cost the Irish economy in excess of EUR78m per day".* **Every one of these statements is provably false, according to Irish Water's own documents published for this project**[2].

Messages that are not widely disseminated in discussions about the proposed Shannon project include that Dublin currently operates with *significantly increased treatment capacity* and *brand new, state of the art water treatment plants* as a result of the recent/ongoing investment of hundreds of millions of Euros in Dublin's water infrastructure. Once the Vartry upgrade is completed *four out of Dublin's five major water treatment facilities will be operating with brand new water treatment plants*. More projects are ongoing that will increase capacity even further and will address Dublin's current *deployment* issues (i.e. the ability to freely deploy water around the water supply system). Irish Water is currently pursuing four separate network "resilience" projects which, it states, will "*ensure that existing water treated at several sources, can be made truly available wherever it is needed in the network*" (source: Irish Water, Final Options Appraisal Report, November 2016).

The Kennedy Analysis established that there is no mathematical "need" for the Shannon project (which is predicted to cost up to EUR1.2billion: EUR724 for every Irish household) and that a smaller, less expensive alternative would serve both Dublin and the Irish people better.

[1] See the Kennedy Response.
[2] See the Kennedy Response.

PART B
THIS KENNEDY PAPER ON DUBLIN'S LEAKAGE (APRIL 2017)

Irish Water projects a significant increase in Dublin's water demand between now and 2050 – however this is offset by the very significant amount of water that it projects will be recovered through fixing Dublin's leaks *even assuming only its current unambitious leakage targets*. The water recovered through fixing leaks will become available at Dubliners' taps to meet future demand instead of pouring through holes in Dublin's ancient and corroded water pipes into the ground as is currently the case.

If Irish Water were to adopt *ambitious* leakage targets (instead of its current *un-ambitious* leakage targets), which would be appropriate given Dublin's extreme levels of leakage and the ancient and decayed state of its water pipes, then it would recover *significantly more water over and above its current assessment.* That water would then be available to increase current headroom and meet future demand.

(1) Irish Water's messaging on Dublin's leakage levels and on its leakage targets are inaccurate

The Irish Water online homepage for this project currently states the following:

"Tackling leakage is a very important part of minimising water demand, but even reducing leakage levels from the current estimated 33%, to 20%, a level which took over two decades to achieve in the UK, would recover less than one fifth of the projected water need, at a significant fraction of the project cost and take three times as long as the Water Supply Project to achieve the savings. Irish Water plan to reduce leakage levels to 25% by 2026, and drive it progressively downwards below 20%. This is an ambitious target and is certainly part of the solution, but would still not result in a water supply fit to meet future demands…. There are two components to leakage, household leakage and watermain network leakage. The early data from the water metering programme clearly shows that between 5% and 6% of households exhibit significant household-side leakage. Irish Water, working together with customers, aims to drive household leakage down and these efforts have been factored into the water demand review."

Each of the statements highlighted in red above is either **false, unsubstantiated or misleading**. For full details see Appendix 2.

- Dublin's total leakage rate is not 33% but rather, according to leakage data published by Irish Water in November 2016, *is almost certainly at least 57%.*
- According to its own data published for this project, Irish Water has no plan to reduce total leakage "to 20%".
- Irish Water's 39-year *customer side leakage* targets were so *un-ambitious* that **they were achieved within only one year** of operation of the recent First Fix scheme.
- Irish Water's targets and timeframes for reducing *distribution side leakage* are extremely *un-ambitious* if one compares them to leakage reductions recently achieved in the UK (London and Scotland) and in other EU member states (as per the 2015 EU Reference Document "*Good Practices on Leakage Management*").
- Irish Water's estimates of the cost of recovering water through addressing leakage have already been proven to be *three times over-stated*: fixing leaks through the First Fix scheme has cost less than a third of the amount predicted by, and still being cited by, Irish Water.
- Comparing its leakage targets for Dublin to leakage levels in the UK is highly misleading. Leakage in the UK is reported on the basis of "total leakage" i.e. distribution side leakage *plus "supply pipe losses from consumers' pipes"*[3]. By contrast, Irish Water's 20% "target" figure (which itself was based on a flawed calculation) was a reference to target *distribution side leakage* only.
- The water that Irish Water will recover through addressing leakage does not amount to "*less than a fifth*" of the projected water need. On the contrary, *142Mld* is expected to be recovered through addressing leaks based only on Irish Water's *existing* 2050 leakage targets but correcting the *base level* of customer side leakage from 40.8Mld to 100Mld (as indicated by the Q2 2016 First Fix

[3] "*In England and Wales, leakage is treated water lost from the distribution system. It includes water lost from the companies' distribution networks and supply pipe losses from consumers' pipes.*" (Source: OFWAT)

results). This equates to ***249%* of Dublin's projected 2050 deficit** of 57Mld (which itself is adjusted for *only two* of the many errors that the Kennedy Analysis has identified – once additional errors are corrected this 57Mld deficit become a surplus – see the Kennedy Analysis). **This is a huge volume of water that will be available in 2050 that is not available today. What is more, if Irish Water were to adopt *ambitious* leakage targets then even more water would be available at Dubliners' taps in 2050 instead of pouring into the ground as is currently the case.**

For full detail on the above, see Appendix 2.

(2) Dublin's leakage levels and the condition of its water mains are far from normal or acceptable

A **57% leakage rate** is neither normal nor acceptable, as can be seen from these examples:

(a) In a 2016 study based on a 2014 survey the OECD[4] reported leakage rates in 43 cities around the world (not including Dublin): only 4 cities had leakage levels over 40%, all of them in Mexico[5].
(b) The United Kingdom, which itself has very poor leakage levels versus comparable countries, has average leakage levels *well under half* of Dublin's level. Irish Water's June 2015 Consultation Submissions Report referred to a chart based on OFWAT data showing that the highest level of leakage among the 22 major water companies in England and Wales was 27%, 16 of them had leakage levels of 22% or below, and eleven (half) of them had leakage levels of 18% or below[6].
(c) In its 2010 demand review Dublin City Council (Irish Water's predecessor in the Shannon project) presented water analysis for 6 comparable countries/cities, including their leakage rates. They found that the leakage levels for the countries/cities that they selected were:

Country/city	**Approximate leakage rate**
Denmark	**6%**
The Netherlands	**6%**
Germany	**7%**
Sydney, Australia	**8.5%**
Lithuania	**15%** (in 2000)
United Kingdom	**23%**

(3) Leakage is by far the biggest element of Dublin's water demand

The term "water demand" as used by Irish Water includes "true" demand (i.e. water actually used by the consumer) as well as water that is put into the supply system but leaks out of the pipes into the ground before reaching the taps. The new November 2016 leakage data shows that "true" demand (i.e. domestic and non-domestic demand) is significantly *lower* than was thought and leakage demand is significantly *higher* than was thought.

Dublin's average demand (including leakage) has plateaued at around **540Mld** (million litres per day) for the past ten years (source: Irish Water – see Kennedy Response). This is not unusual: demand in many cities has plateaued or declined over the past decades and is projected to continue to do so, driven partly by the recovery of water through addressing leakage and partly by the downward trend in industrial intensity of water use (which Irish Water failed to account for in its analysis for the Shannon project because it accidentally used the wrong set of data on non-domestic demand – see the Kennedy Response).

The Final Options Appraisal Report and First Fix results show that, of this 540Mld average demand, at least 304.7Mld is almost certainly made up of leakage - **only around 235.3Mld is "true" demand** (i.e. water that

[4] The Organisation for Economic Cooperation and Development.
5 OECD (2016), *Water Governance in Cities*, OECD Studies on Water, OECD Publishing, Paris.
6 See page 36 of the Consultation Submissions Report (Appendix A to Irish Water's June 2015 Water Supply Options Working Paper).

is actually *used* by domestic and industrial consumers at the tap). Jerry Grant reinforced this on 15 February 2017, as stated in Appendix 3.

Reference this **235.3Mld "true" demand** against Dublin's water supply which, as stated at page 30 of Irish Water's Project Need Report (March 2015), was **543Mld in 2011**, had been increased to **623Mld in 2015** and will be increased (through ongoing projects) to **658Mld by 2026**. Over and above this is an **additional 122Mld** of brand new capacity at Ballymore Eustace and Leixlip over their licenced limits that could (and, one would hope, would) be called upon in an outage situation.

Dublin's "true" demand amounts to well under 50% of its supply. By far the biggest element of Dublin's "demand" is, in fact, water that enters the water supply system at Dublin's brand new water treatment plants and then pours through holes in its ancient, damaged pipes straight into the ground.

The extreme proportion of Dublin's average demand that is made up of leakage can be seen in Figure 1, below.

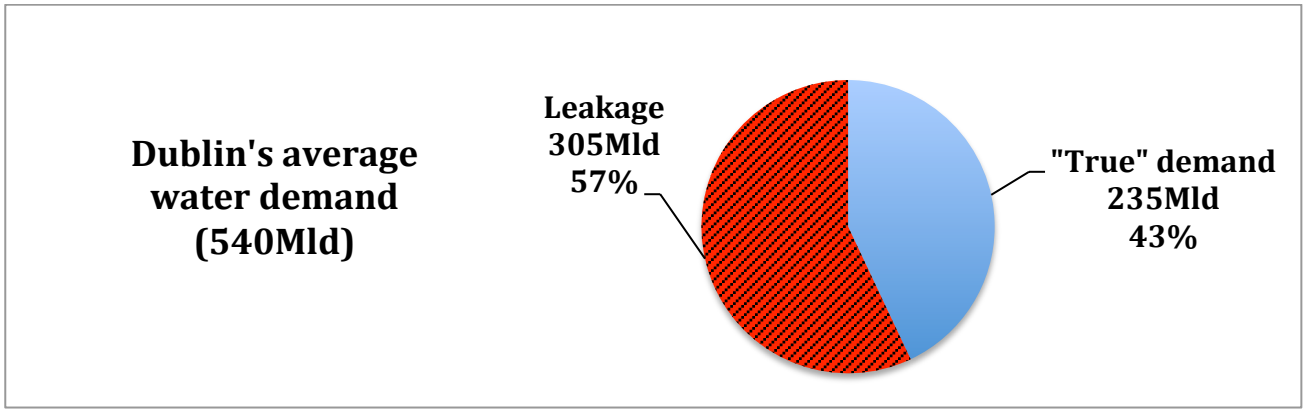


Figure 1

(4) If Dublin had normal levels of leakage it would have an enormous "spare capacity" without having to increase its water supply at all

It is important, in the context of Dublin's extremely high leakage levels, to understand what this concept of "spare capacity" means. Spare capacity is the volume of water available over and above average distribution input (i.e. the amount of water put into the supply system) which equates closely to average demand. It is an absolute figure in Mld, but is also often expressed as a percentage of either (a) *distribution input* or (b) *distribution input minus leakage*.

The question is often asked, in light of the recent major investments and improvements to Dublin's water infrastructure: how much "spare capacity" does Dublin now have? Irish Water's response to that question has been *very inconsistent*, as can be seen in Appendix 3. When Irish Water responds to the question about the level of Dublin's spare capacity it expresses it (with varying degrees of accuracy) as a percentage of total distribution input *including leakage* (see Appendix 3). For Dublin, where an abnormally large proportion of its distribution input is made up of leakage, expressing spare capacity as a percentage of total distribution input *including leakage* naturally results in a much lower "spare capacity" figure than would be the case if Dublin had normal levels of leakage.

It is misleading to compare Dublin's "spare capacity" (expressed as a percentage of total distribution input including leakage) with cities operating with leakage levels that are a fraction of those in Dublin without highlighting the huge disparity in their leakage levels (since this has such a huge bearing on the "spare capacity" calculation). It has been stated that most European capitals have a spare capacity of 10% to 15%: it is vital to note that most of them also operate with leakage levels well below 20% (many of them below 10%). Paris, for example, is often cited as a city operating with a large spare capacity – however it also operates with

leakage levels of around 5%[7]. **If Dublin's leakage rates in 2015 had been 5% then its spare capacity would have been 152%[8]. Even if Dublin's leakage rates in 2015 had been 20% (well above that in comparable European cities with which Dublin competes for inward investment) then Dublin's spare capacity (assuming only its 2015 water supply) would have been 112%[9]. This is absolutely enormous and would give Dublin a commercial edge when competing for inward investment.**

Figure 2 below shows how Dublin's 2015 water supply (623mld, as stated in the Project Need Report) was split between "true" demand, leakage and spare capacity. It can clearly be seen that as leakage is reduced, spare capacity increases.

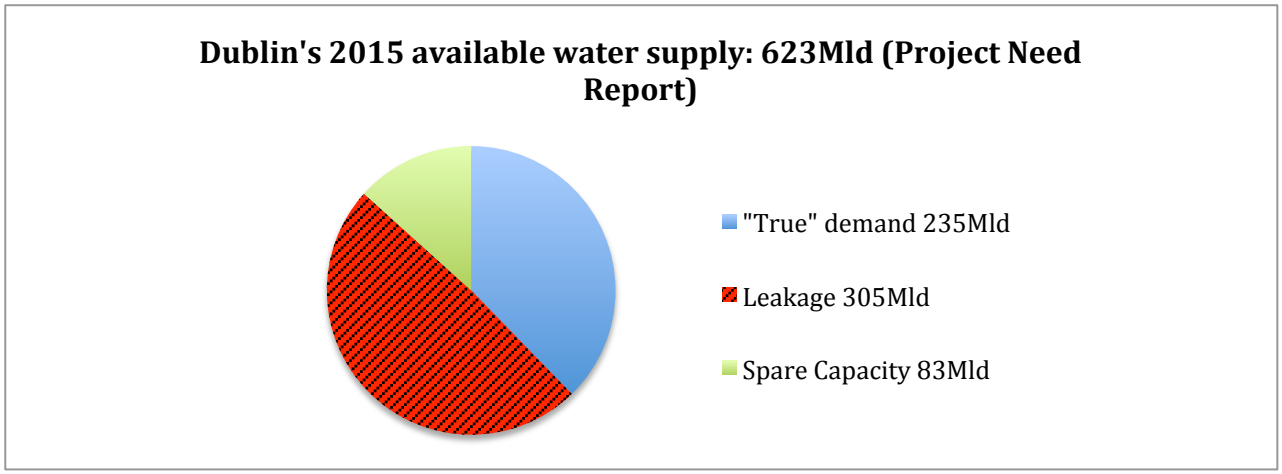


Figure 2

(5) Dublin's recent history of addressing leakage has been inadequate

It has long since been recognised that Dublin's mains are in a disastrous state of disrepair. Dublin City Council stated *over a decade ago*[10]: "*these mains are so ancient that leaving them alone is not an option*".

In 2007 the Dublin Region Watermains Rehabilitation Project began operation with the intention of replacing 250km of Dublin's water mains and recovering at least 20Mld of water within 5 years. However, according to the press releases, **in the following 6 years[11] only 140km of Dublin's mains were actually replaced**. Contrast this with London: when London's leakage levels were *less than half* of Dublin's current leakage levels OFWAT (the UK's independent water regulator) instructed Thames Water (the water supplier for London) to undertake a *wholesale replacement of London's Victorian water mains.* The Chairman of OFWAT said in 2006 "*Thames Water's failure on leakage is unacceptable. Our job as regulator is to protect customers, who have been outraged by Thames' inability to control leakage sufficiently in London*". **In only 4 years[12] 1,868km of London's mains were replaced[13]**. This was an average mains

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7 Presentation "*The remunicipalisation of Paris' water supply service*", Anne le Strat, Deputy Mayor of Paris in charge of water supply, sanitation and the management of Parisian canals; President of Eau de Paris. https://research.ncl.ac.uk/media/sites/researchwebsites/gobacit/Anne%20Le%20Strat.pdf

8 Here is the calculation for this: the Project Need Report stated that in 2015 Dublin's average demand was 540Mld and its supply capacity was 623Mld (this was not in fact its peak supply capacity). The First Fix results (supported by Jerry Grant's statement) show that almost certainly at least 304.7Mld of that average demand was leakage, leaving just 235.3Mld of **"true" demand**. If Dublin's leakage rates had been 5% of average demand then it would have had 12.4Mld of leakage on top of 235Mld of "true" demand, which totals 247.4Mld "average demand". 623Mld (supply) minus 247.4Mld (average demand) equals 375.6Mld of spare capacity which is 152% of the 247.4Mld average demand.

9 If Dublin's leakage rates had been 20% of average demand then it would have had 59Mld of leakage on top of 235Mld of "true" demand, which totals 294Mld "average demand". 623Mld (supply) minus 294Mld (average demand) equals 329Mld of spare capacity which is 112% of the 294Mld average demand.

10 On 15 December 2006 http://www.watermainsrehab.com/index.php?page=press-releases

11 From 2007 up to mid-2013.

12 From 2005/06 to 2009/10.

13 Thames Water Mains Replacement Programme Independent Review, Findings and Recommendations Report (02 July 2010).

replacement of **467km per year in London** versus **23km per year in Dublin** where the leakage problem was far more extreme. **London, with leakage levels of less than half those in Dublin, replaced its mains at a rate 2,000% faster than that in Dublin.**

Irish Water has confirmed that over the past ten years only around EUR100million has been spent on addressing leaks. This is an average of only EUR 10million per year which is a shockingly low figure given the scale of the problem - it equates to **an annual spend on addressing leaks of only 0.8% of the projected EUR1.2billion cost of the Shannon project.**

(6) Irish Water's existing leakage targets, as contained in its analysis for the Shannon project, are extremely under-ambitious, especially given the scale of the problem

Irish Water states that it has incorporated "*ambitious*" leakage targets into its projections. This is very difficult to support:

(a) On customer side leakage:

Irish Water's target on customer side leakage, as set out in the Project Need Report, was to recover a total of **19Mld** over the course of **39 years**. **This was so under-ambitious that it was achieved within a year** of operation of the First Fix scheme. Indeed, in just 18 months of operation First Fix (a scheme which only targets a specific element of customer side leakage: only *major* leaks - not the hundreds of thousands of minor ones - and only in homes with a functioning water meter) had already recovered over **31Mld** in Dublin[14]. This recovery of 31Mld was despite (1) a very low rate of customer responses to letters notifying the customer of a major leak (only 39% of customers had even responded to that letter), and (2) only 23% of *known* major leaks having been repaired. **Despite the very low response/repair rate, in only 18 months Irish Water's "ambitious" 39-year customer side leakage target had been *achieved 1.6 times over* through the First Fix scheme alone.** What is more, recovering water through the First Fix scheme has ***cost less than a third of the amount being cited in Irish Water's analysis for the Shannon project***[15].

The First Fix results make clear that the *total* level of Dublin's customer side leakage (*including* small leaks and leaks in homes without a functioning water meter – i.e. leaks falling outside the scope of the First Fix scheme) in 2011 (which was the base year for Irish Water's analysis) can *not* have been **40.8Mld** (as Irish Water assumed) but rather must almost certainly have been at least **100Mld**[16]. This has various implications for the rest of the base-year data and Irish Water's analysis including that, in meeting its 2050 customer side leakage target of 29.6Mld, **Irish Water will recover an additional 59.2Mld of water over and above that assumed in the Project Need Report**.

The First Fix results establish that far more water can be recovered through addressing leakage than Irish Water has assumed, far more quickly and for far less money. The implications of the First Fix results were *not* correctly accounted for in the November 2016 Final Options Appraisal Report, despite Irish Water's statements to the contrary.

(b) On distribution side leakage:

Irish Water's absolute distribution side leakage targets (in million litres per day) as set out in the Project Need Report (March 2015) and as updated in the Final Options Appraisal Report (November 2016) were:

	2011	**2021**	**2026**	**2031**	**2041**	**2046**	**2050**
Project Need Report 2015	178.1	164.8	146.0	140.8	130.0	130.0	130.0
Final Options Appraisal Report 2016	204.7	165.9	153.1	145.0	140.8	140.8	140.8

[14] Irish Water First Fix Leak Repair Scheme for Domestic Water Customers, Quarterly Report Q2 2016 – see also the Kennedy Response for analysis.
[15] As at the Q3 2016 report – see also the Kennedy Response for analysis..
[16] See the Kennedy Response for the full analysis on this figure.

The target reduction in the *absolute volume of leakage* was 27% in 39 years in the PNR which increased to a target reduction of **31% in 39 years** in the FOAR, due to a retrospective increase in the base-year level of customer side leakage[17]. This target is ***very un-ambitious*** when compared with recent reductions in leakage achieved in the UK (which Irish Water cites for comparison in its analysis) and in the EU (as referred to in the recent 2015 EU Reference Document "*Good Practices on Leakage Management*"). For example, as set out in detail in Appendix 4:

- London's leakage was reduced by **30% in only 6 years**
- Scotland's leakage was reduced by **55% in only 10 years**
- Lisbon's (Portugal's capital city) leakage was reduced by **64% in only 8 years**
- Leakage in the Reggio Emilia province in Italy was reduced by **50% in 8 years**
- Malta's leakage was reduced by **over 83% in under 20 years.**

The leakage reductions in the UK are even more significant given the fact that **they were starting from a base level of leakage (as a percentage of demand) *significantly* below that in Dublin**. The law of diminishing returns suggests that **leakage recovery in Dublin should be significantly easier given the very high base** from which it is starting – indeed Irish Water itself stated "*It should be noted that finding and repairing leaks is very expensive with ever lower leakage reductions being achieved (for the same expenditure) over time as the situation improves*". **On this basis, recovery of water through addressing leaks in Dublin should be cheaper and easier than has been the case in the recent efforts in the UK.**

(7) Implications for Dubliners of having ancient, corroding water pipes and 57% leakage

The **ancient, damaged state of Dublin's water pipes** and its **57% leakage levels** are unacceptable on many levels. Dublin also has has **low pressure** in its water supply system which has many implications.

(a) Irish Water has stated that one of the risks with having such damaged water pipes combined with very low water pressure at times is "contaminated groundwater" flowing *into* the pipes carrying water to Dubliners' taps - Irish Water itself states "this is a public health risk"[18]

The most obvious potential contaminant is **raw sewage** from sewage pipes that are also leaking badly[19]. Irish Water mitigates this risk by adding **high levels of chlorine** to the water.

Pumping an ever increasing volume of expensive treated water from Dublin's brand new water treatment plants into one end of the supply system to offset the fact that most of it leaks straight into the ground fails to address a key issue: **the consumer (both domestic and industrial) demands not only a guaranteed *quantity* of water but also (and perhaps more importantly) a guaranteed *quality* of water**.

No matter how much water is put into one end of Dublin's water supply system, unless and until its damaged and leaking pipes are repaired Irish Water will not be able to guarantee the quality of the water that it delivers.

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[17] The 2015 Project Need Report targeted that 2050 distribution side leakage would be reduced to 130.0Mld which is **27%** below the 178.1Mld 2011 level assumed in the PNR. The 2016 Final Options Appraisal Report retrospectively increased the base year (2011) distribution side leakage level (from 178.1Mld to 204.7Mld) and targeted that, by 2050, distribution side leakage would only have been reduced to 140.8Mld (this is 10.8Mld higher than the target set in the 2015 PNR). Despite the fact that the absolute level of the 2050 target in the 2016 FOAR is *less ambitious* than that set in the 2015 PNR, the targeted reduction in the absolute volume of leakage between 2011 and 2050 is higher (a 31% reduction in leakage) due to the retrospective increase in the base year 2011 leakage level.

18 See page 45 of the Final Options Appraisal Report: "*in a system which suffers extensive leakage at joints, bringing the internal pressure down to low levels when flows are cut off during rationing, risks contaminated groundwater entering the mains, and this is a public health risk, which requires boosted chlorination to mitigate it*."

[19] Irish Water stated in its latest Business Plan published on 7 October 2015 "*many of our sewers are in very poor condition, with high leakage into and from sewers due to lack of funding for maintenance and repair for decades*".

(b) Overhauling Dublin's water pipes is inconvenient but inevitable.

A water supply system with pipes that are so old and damaged that they have 57% leakage levels (even at low pressure) is **unsustainable - they will only get worse with each cold winter and the passage of time**. **Irish Water's current targets will not bring Dublin's water pipes anywhere close to being acceptable for a thriving city encouraging inward investment.** There is no question that **a very significant amount of money will need to be spent overhauling Dublin's water pipe network in the coming decades**. Naturally, the work required to replace water pipes is very inconvenient. However if London (with its far bigger population, economy and far greater urban complexities) deemed this a necessary evil at leakage levels less than *half* those of Dublin then it is extremely difficult to justify not doing so in Dublin.

Spending EUR1.2billion on the Shannon project is an extremely expensive sticking plaster when major surgery will be required down the line in any event - the *sooner* Dublin's water pipes are replaced/repaired the *fewer* people will be inconvenienced if Irish Water's projections of population and economic growth are correct.

(c) If Dublin had normal levels of water pressure then its 57% leakage rate would be even higher.

A 57% leakage rate in a system with *such low pressure* is astonishing since the *rate* of flow of water out of the holes is relatively low.

Ironically, unless accurate pressure-management is adopted, replacing or repairing one section of pipes leaves more water in the supply system than would otherwise be the case and so increases the pressure with the knock-on effect of *increasing* leakage through the holes in the remaining sections of pipes because water flows out of those holes *at an even higher rate*.

A significant proportion of Dublin's mains will need to be replaced for Dublin's supply system to be in a more normalised position.

(8) The need for diversification in Dublin

Although Dublin has no mathematical "need" for a new raw water source, commentators agree that the key to security of supply for a water supply system lies in diversity of *types* of raw water sources. Academic research cited in Irish Water's reports concludes "*the key to maintaining water reliability is a diverse portfolio of water supply sources*"[20]. Paris' water supplier also states: "*the key strength of the water supply [in Paris] is the diversity of its sources. Equal amounts of water come from underground and river sources. This mixed supply enables efficient management of unexpected incidents like accidental pollution or pipe damage and Eau de Paris [Paris' water supplier] can mobilize different water resources alternatively depending on the situation*"[21].

Dublin currently has almost *no* diversification of its raw water sources: it is supplied *almost exclusively by surface water sources* and the Shannon option would be *yet another surface water source*.

(9) Evidence shows that if water companies have high leakage rates then their consumers conserve less water

In its November 2016 report on the performance of water companies in England and Wales, the Consumer Council for Water stated "*leakage is a key concern for customers and can have a big impact on customers' motivation to save water, as well as their perception of water companies… If customers do not see progress on this issue, they are more likely to ignore company campaigns on water efficiency"*. The 2015 EU Reference Document on Good Practices on Leakage Management concluded similarly: "*customers are far less likely to conserve water if their provider maintains high leakage levels*".

[20] "*Total Regional Economic Losses from Water Supply Disruptions to the Los Angeles County Economy*", Rose et al, 2012.

[21] "Water in Paris. A public service" http://www.eaudeparis.fr/uploads/tx_edpevents/Brochure_institutionnelle_ENG_2013.pdf

Leakage in Paris has been reduced consistently over the past 25 years (down to a leakage level of around 5%) – and Paris has seen an accompanying reduction in its "true" demand (i.e. the actual consumption by its domestic and business consumers): "*like many urban metropolises, Paris has seen its water consumption decrease by nearly 30% in the last twenty-five years. This good news for water conservation can be explained by changes in the Parisian business fabric (service industries require less water), the efforts from the business community to reduce its consumption and also the efforts from private citizens to better control their domestic usage. This consumption decrease continues at an average rate of 2% per year*"[22].

If Irish Water is to incentivise its domestic and business consumers to reduce their water consumption then it must lead by example.

Conclusion

Perhaps Dubliners should be presented with two alternatives - either:

(1) accept traffic disruption in rotating areas of Dublin for the coming years while Irish Water aggressively replaces pipes - this will be expensive but will (a) address Dublin's water volume, quality and pressure issues, (b) make Dublin a viable investment proposition for incoming investors who need confidence in not only the *volume* of water available but also the *quality* of that water, and (c) eliminate the need to spend EUR724 per household on the Shannon project, or

(2) accept that they will continue to drink potentially contaminated water being delivered through ancient and corroding water pipes, and spend a huge amount of money "kicking the ball down the road" by piping water from the Shannon, just to *delay* the expense and disruption that will have to take place at some point in any event to address the unacceptable state of Dublin's water supply network.

Is the solution of shipping huge volumes of extra water into a system with such high leakage rates simply a shirking of responsibility?

22 "Water in Paris. A public service" http://www.eaudeparis.fr/uploads/tx_edpevents/Brochure_institutionnelle_ENG_2013.pdf

Appendix 1

Component	**2050 Projections as per the 2015 Project Need Report (Mld)**	**2050 projections adjusted for (1) corrected non-domestic demand data, and (2) corrected base-year customer side leakage levels**
Domestic demand	260.7	260.7
Non domestic demand	181.1	238.2
Adjustment for strategic industrial allowance	100.0	0 (Indecon's analysis incorporated th is into the 238.2)
Customer side leakage	29.6	29.6
Additional water to be recovered through addressing CSL assuming Irish Water's current CSL target of 29.6Mld but using a corrected base-year level of 100Mld (not 40.8Mld, which the First Fix results have shown to be wrong)	0	(59.2)
Supply side leakage	130.0	130
Operational water	4.7	4.7
Average demand	**706.1**	**604.0**
Average demand minus leakage and100Mld strategic allowance	476.1 (the PNR failed to deduct CSL from this figure despite stating that it had done so)	344.4
Peaking allowance (20%) - not applied to leakage or to the strategic allowance as stated in the PNR	95.2	68.9
Headroom and outage (15%) - not applied to leakage or the strategic allowance as stated in the PNR	71.4	51.7
Production requirement (average demand plus peaking, headroom and outage)	**872.7**	**724.**6
Less existing sources ***not* accounting for** the additional brand new capacity at BE and Leixlip over their licensed limits	(658.0)	(668)
Water deficit/surplus	**215 DEFICIT**	**57 DEFICIT**
Alternative: Less existing sources ***accounting for*** the additional capacity at BE and Leixlip over their licensed limits		(790)
Alternative water deficit/surplus		**65 *SURPLUS***

Appendix 2

Below is fuller detail on the points identified in section (1): Irish Water's messaging on Dublin's leakage levels and on its leakage targets are inaccurate

(a) Irish Water's statement implies that Dublin's current *total* leakage is 33% - this is false.

Leakage is split into (i) distribution side leakage (also known as unaccounted for water, UFW) and (ii) customer side leakage. 33% is the amount of water that Irish Water *used to think* was being lost on the *distribution side* of the network *alone* (it *does not include any customer side leakage*). What is more, this 33% level for distribution side leakage is now known by Irish Water to be **incorrect.**

Distribution side leakage: Base year (2011) distribution side leakage was thought, at the time of the 2015 Project Need Report, to be 178.1Mld which equated to 33% of the average demand (539.3Mld). The November 2016 Final Options Appraisal Report increased the assumed base year distribution side leakage to 204.7Mld which equated to **38%** of the (also restated) base year average demand of 534.1Mld. **So, according to Irish Water's November 2016 data, Dublin had 38% distribution side leakage.**

Customer side leakage: The Project Need Report had assumed that base-year customer side leakage was 40.8Mld out of 539.3Mld average demand, equating to **8%** customer side leakage. However the Q2 2016 report on Irish Water's First Fix scheme (the "*First Fix results*") establish that base year customer side leakage can *not* have been 40.8Mld but rather must almost certainly have been *at least 100Mld*, meaning that base year **customer side leakage was almost certainly at least 19%** of average demand[23].

Dublin's total base-year leakage was therefore 38% (distribution side leakage) plus almost certainly at least 19% (customer side leakage) amounting to a TOTAL leakage that was almost certainly at least 57% of all of the water that entered the distribution system. **57% leakage is very different to 33% leakage**.

The 2016 FOAR (which updated the original analysis contained in the Project Need Report) took account of this increased leakage level for *distribution side leakage* but *failed* to take account of the increased leakage level for *customer side leakage*.

(b) Irish Water's assumptions on the cost of recovering water through addressing customer side leakage have already been shown to be hugely over-estimated.

Irish Water has stated repeatedly (including *since* the First Fix results established the contrary) that recovering water through fixing customer side leakage costs **EUR 0.75million** per 1Mld. In fact, at the time of the Q3 2016 report it had cost an average of **EUR 243,000** per 1Mld recovered. So **fixing customer side leaks through the First Fix scheme has cost less than a third of the amount being cited by Irish Water.** Irish Water's analysis also suggests very high costs of recovering distribution side leakage (the FOAR cited EUR 7million-8million per 1Mld of recovery; the FAQ page of the Water Supply Project website cites an even higher estimate of EUR 8million-9million). Given that its assumed cost of recovering customer side leakage has already been proven to have been ***more than three times over-stated***, and that Irish Water has stated itself that its estimates are based on experience in Dublin over the past decade (i.e. *before* the introduction of meters) it is hard to have any confidence that Irish Waters assumed costs of recovering distribution side leakage are not also hugely over-estimated. Recovering water through addressing leaks *post* the introduction of meters is far easier and cheaper than before - indeed Irish Water itself stated in its latest Business Plan "*the domestic metering programme is key to identifying network leaks".*

[23] See the Kennedy Response for full details of this.

(c) Comparing its 20% "target" to leakage levels in the UK is highly misleading.

Leakage in the UK is reported on the basis of **"total leakage"** i.e. distribution side leakage *plus "supply pipe losses from consumers' pipes"*[24]. By contrast, Irish Water's 20% "target" figure was a reference to target ***distribution side leakage*** **only** (it included *no customer side leakage*).

What is more, this 20% "target" was the targeted *absolute* volume of distribution side leakage *expressed as a percentage of the predicted 2050 average demand* (which figure is highly uncertain and is already known to have been *overstated* due to Irish Water's accidental use of the wrong data on non-domestic demand). Naturally, when expressing leakage as a percentage of predicted demand, the *bigger* that predicted demand figure is then the *smaller* leakage appears as a percentage of it. When that predicted demand figure is extremely *uncertain* (as is the case here) and is *already known to be overstated* (as is the case here) then expressing a predicted figure for leakage as a percentage of that predicted demand is *valueless*. The only measure of Irish Water's target leakage reduction that is *not* impacted by the uncertainty of predicted data 33 years into the future is a measure of the targeted absolute reduction of the volume of water being lost through leaks, i.e. *comparing the absolute volume of water being lost from the system today with the absolute volume of water that Irish Water target will be lost from the system in 2050* (as per the analysis in section 6(b) above and Appendix 4). On this measure, Irish Water's targets are extremely under-ambitious when compared with leakage reduction achievements in the UK and elsewhere.

(d) The statement that "*it would take three times as long as the Water Supply Project to achieve these savings*" is baseless.

The length of time that it will take to recover water for Dublin through addressing leakage is *driven by the resources and focus that Irish Water commits to its leakage strategy*. Jerry Grant stated on 15 February 2017 "*We must replace **2,000km** of old cast iron pipes in the city. If we were to do this over ten years we would paralyse the city. It would be like having the Luas works continuously for **ten years***". However, **London replaced 1,868km of mains (almost the full amount that Jerry Grant referred to) in only 4 years** after its leakage levels, at l*ess than half* of Dublin's current leakage levels, were deemed by OFWAT to be unacceptable[25]. The Victorian mains replacement in London focused on replacing mains in one DMA at a time – in this manner disruption is limited as much as possible to discrete, rotating areas.

(e) The statement "*would recover less than one fifth of the projected water needs*" is incorrect even using Irish Water's analysis data (which is now known to be incorrect)[26].

What is more the First Fix results now show that water recovery from addressing customer side leakage, assuming nothing more than Irish Water's existing 2031 target of 21.8Mld but starting from a corrected base of 100Mld, would be **78.2Mld**. Combining this with Irish Water's existing distribution side leakage recovery target (63.9Mld) totals **142.1Mld recovery through addressing leakage** which equates to ***249%*** **of Dublin's projected 2050 deficit of 57Mld** as per Appendix 1 (which itself is adjusted for *only two* of the many errors that the Kennedy Analysis has identified – once more errors are corrected the deficit become a surplus – see the Kennedy Analysis).

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24 "*In England and Wales, leakage is treated water lost from the distribution system. It includes water lost from the companies' distribution networks and supply pipe losses from consumers' pipes.*" (Source: OFWAT)

25 Thames Water Mains Replacement Programme Independent Review, Findings and Recommendations Report (02 July 2010).

26 Irish Water targets a distribution side leakage recovery of 63.9Mld and a customer side leakage recovery of 19Mld in 2031 reducing to 11.2Mld in 2050 which totals a leakage recovery of either **82.9Mld or 75.1Mld** depending which year's customer side leakage target one uses. Dublin's projected 2015 water deficit as per the Project Need Report was only **215Mld**. The "total" production requirement for Dublin plus "benefit corridor" was (a) **313.8Mld** as per the Project Need Report or (b) **315.3Mld** as per the FOAR with its new concept of a benefit corridor, but to compare leakage recovered in Dublin *alone* with the water needs of the entire "benefit corridor" without taking account of leakage recovery within that "benefit corridor" would be highly inappropriate. Even if one *does* use these deficit/production requirement figures including the benefit corridor (each of which is now known to be incorrect due to the error on non-domestic demand), **even the lowest leakage-recovery figure of 75.1Mld is greater than one fifth of any of these deficit/production figures used in Irish Water's analysis.**

Appendix 3

Irish Water's response to the question of the extent of Dublin's spare capacity since the recent significant investment in its water infrastructure/increase in its treatment capacity is inconsistent:

(1) The Project Need Report (**March 2015**) stated that 2015 average demand was 540Mld and 2015 supply was 623Mld (note: this was *not* the full peak capacity) which equated to **spare capacity of 83Mld.** 83Mld expressed as a percentage of 2015 distribution input/average demand (540Mld) amounts to **over 15% spare capacity**[27].

(2) Four months later, a **10 July 2015** press release cited Jerry Grant as follows: "*Currently in Dublin, water supply is operating with* ***spare capacity of around 10%***".

(3) Irish Water's business plan published three months later in **October 2015** stated: "there is ***less than 2%*** *spare drinking water capacity in Dublin".*

(4) Seven months later Minister Simon Coveney stated in a Dail debate on **24 May 2016**: "*I wish to remind Members of the condition of the public water system when the previous Government decided to establish a single national utility.... The capital city, Dublin, which should have had a spare water capacity of 10% to 15% like most European capitals, had a spare capacity of just 1% to 4%.... Since Irish Water became the national water utility in January 2014, it has made significant progress in addressing some of the problems...* ***Dublin's spare water capacity has increased from 1%-4% to 10%*** *which is a welcome move towards the 15% target of Irish Water."*

(5) Nine months later, on **15 February 2017**, Jerry Grant told a Joint Committee meeting that Dublin's spare capacity is ***"about 8%"*** He did not mention that Dublin's water supply **will increase by a *further* 6% (**from 623Mld (2015) to 658Mld (2026)) once ongoing/planned projects are completed.

27 Being 83Mld (the spare water available over average demand of 540Mld) expressed as a percentage of the average distribution input/average demand, amounting to 15.4%.

Appendix 4

Recent reductions in leakage achieved in the UK:

(1) Thames Water, the provider for **London** (a city with huge urban complexities), reduced London's absolute volume of leakage by **30% in only 6 years** (between 2004 and 2010 it reduced leakage from 946Mld to 670Mld – a reduction of 276Mld) in response to targets set by OFWAT[28].

(2) Scottish Water reduced **Scotland's** absolute volume of leakage by **55% in only 10 years** (from 1104Mld in 2005/06 to 500Mld in 2015/16 - a reduction of 604Mld) once the Water Industry Commission for Scotland began setting targets for leakage recovery[29].

Recent reductions in leakage achieved in the EU:

The EU Reference Document "*Good Practices on Leakage Management*" (2015) referenced case studies of water operations in 16 European cities/regions/countries. Even within these case studies one can observe far greater achievements on leakage reduction than Irish Water's "ambitious" leakage targets. One example is **Lisbon (Portugal's capital city) which reduced its leakage levels by 64% in only 8 years** through a major commitment to addressing its leakage levels including the segmentation of its distribution network into DMAs (district metered areas) and monitoring of the pressure and flow within those DMAs every 15 minutes, combined with the use of "Water Optimisation for Network Efficiency" computer software which armed the dedicated leakage detection team with detailed information about leaks and estimated recoverable losses ahead of their leak detection efforts. Other examples in the EU reference document were Iren Emilia, operator for **Reggio Emilia province in Italy, which achieved a 50% reduction in leakage in 8 years** and **Malta, where leakage was reduced by over 83% in under 20 years**.

[28] Thames Water Mains Replacement Programme Independent Review, Findings and Recommendations Report (02 July 2010).

[29] Water Industry Commission for Scotland Investment Report 2007-2008, and Water Industry Commission for Scotland report "Scottish Water Performance 2015-2016".