5. Interim Demand Review and Phasing of Supply

5.1 Introduction

Irish Water proposes to carry out a detailed review of the Water Demand Projection for the Water Supply Project - Eastern and Midlands Region, when the detailed results of Census 2016 are available later this year. At the time of preparation of this Final Options Appraisal Report, an interim review is presented below, which takes into account the analysis of domestic metering readings from over 825,000 installed meters, as well as the results of more than 15 months operation of the 'Free First Fix' scheme which assists domestic customers to deal with customer-side leakage.

Feedback from the consultation process to date related to water demand is also taken into account in this interim review.

5.2 Interim Water Demand Review

5.2.1 The Project Need Report

5.2.1.1 The Project Need Report Scenario 2 'Most Likely' Demand position, as published in March 2015, is shown in Table 5.1. It estimated domestic consumption on the basis of population projections which were applied to per capita consumption of approximately 125 litres per capita per day, declining marginally to 121 litres per capita per day at 2050.

5.2.1.2 It separately accounted for customer side leakage (CSL), expecting this to decrease from a then estimated 66 litres per property per day, to 25 litres per property per day by 2031.

5.2.1.3 It estimated current Unaccounted for Water (UFW) at 178.1 Mld, which when taken with CSL of 40.8 Mld, totals 218.9 Mld.

5.2.2 Developments in the interim period February 2015 to August 2016

5.2.2.1 The installation of over 825,000 domestic meters nationally and the analysis of metering data, has identified consumption 'per connection' as a basis on which the most reliable directly measured statistical data of domestic water consumption is available. Consumption per connection per day also now includes CSL.

5.2.2.2 Taking the Eastern Region, and a sample size of 386,553 available properties, the average consumption over all properties (including properties not permanently occupied) was 363 litres/ per connection/d in December 2015, with a seasonal range from 389 litres/connection/d (summertime) to 356 litres/connection/d (October 2015). A figure of 365 l/connection/day is therefore adopted as the current domestic consumption rate.

5.2.2.3 Submissions received and discussions with Dublin City Council have clarified that baseline industrial consumption is more reliably estimated at 110.1 Mld rather than the previously estimated 126.5 Mld.

5.2.2.4 Submissions received from Kildare County Council indicate that deployable water supply from Srowland WTP near Athy should be reviewed and reduced, so that overall expected capacity of existing sources, after 2026, is estimated at 650 Mld, marginally down from the previous 658 Mld. Climate change review of the possible erosion of the yield of existing sources has not yet been updated. For water demand projection purposes, it has also been assumed that the maximum treated water capacity available is always available.

5.2.3 Interim Updating assumptions on the PNR position

5.2.3.1 Table 5.2 presents the PNR Scenario 2 'Most Likely' position, adjusted for the above interim developments, and for the assumptions below. The originally projected organic growth profile in non-domestic consumption is added to the adjusted baseline figure in Table 5.1.

5.2.3.2 Irish Water has confirmed that the current best estimate of UFW in the Dublin Water Supply Zone is 204.7 Mld.

5.2.3.3 It is assumed that 'consumption per connection' will trend downwards as occupancy rate does, but early indications from Census 2016 are that the rate of household formation lags behind population growth to a greater extent than anticipated. If occupancy at 2050 reaches 2.2 per residential unit, then 305 l/connection/d is a proportionate figure for 2050.

5.2.3.4 Per-connection consumption is therefore assumed to trend downwards from the current 365 l/connection per day, to 305 l/connection per day at 2050.

5.2.3.5 Irish Water is preparing a Water Conservation Strategy and work is progressing on this. In projecting UFW, it is assumed and noted that Irish Water will commit to a Leakage Targets Policy in work currently in progress (see Section 5.2.4), rather than the Sustainable Economic Level of Leakage (SELL) Base Case. The water demand profiles would be different, and would project a higher production requirement, if the SELL Base Case scenario were followed.

5.2.3.6 In profiling demand in the Benefitting Corridor, Irish Water projected figures have been used, as outlined in the Irish Water Interim Midlands and Greater Dublin Area (GDA) Water Resource Plan in Appendix A, interpolating figures where necessary. Previous estimates were based on individual assessments by Local Authorities which have now been collectively analysed and updated by Irish Water.

5.2.3.7 In accordance with the Water Services Strategic Plan guidelines for large urban settlements (Dublin, Cork, Limerick/Shannon, Galway and Waterford); headroom has been adjusted to 20%. Review of the recent profile of water demand on both domestic consumption and overall has prompted a reduction in peaking factor to 15%. Peaking is not applied to leakage, or to strategic industrial water demand.

Table 5.1: Scenario 2 - 'Most Likely Growth' as published in the PNR (March 2015)

Scenario 2 - 'Most Likely Growth'										
Component		**Element**	**Units**	**2011**	**2021**	**2026**	**2031**	**2041**	**2046**	**2050**
Accounted for Water (AFW)	Domestic Demand	Population	Nr.	1,516,133	1,642,391	1,742,226	1,842,060	2,003,156	2,081,225	2,154,252
		PCC	l/hd/d	125.50	120.40	120.60	120.70	120.90	121.00	121.00
		Domestic Demand	Mld	190.3	197.7	210.1	222.3	242.2	251.8	260.7
	Household (Customer Side) Losses	Occupancy Rate	Nr.	2.64	2.48	2.40	2.32	2.16	2.08	2.00
		Nr of Households	Nr.	618,460	728,480	798,520	873,391	1,020,126	1,100,648	1,184,839
		CSL rate	l/prop/d	66	40	35	25	25	25	25
		CSL	Mld	40.8	29.1	27.9	21.8	25.5	27.5	29.6
	Non-Domestic Demand	Non-Domestic Demand	Mld	126.5	138.3	146.2	154.8	168.7	175.3	181.1
		Strategic Allowance for Major Water Using Industry	Mld	0	34	50	75	100	100	100
	Operational Use	Operation Use Factor[9]	%	1%	1%	1%	1%	1%	1%	1%
		Operational Use Allowance	Mld	3.6	3.7	3.8	4.0	4.4	4.5	4.7
	Accounted for Water (AFW)		Mld	361.2	402.8	438.1	478.0	540.7	559.2	576.1
Unaccounted for Water (UFW) / Distribution Losses		UFW	Mld	178.1	164.8	146.0	140.8	130.0	130.0	130.0
		as % of Average Demand	%	33.0%	29.0%	25.0%	22.8%	19.4%	18.9%	18.4%
		cubic metres per km per day	m^3/km/d	19.42	17.97	15.92	15.35	14.18	14.18	14.18
Average Demand			Mld	539.3	567.6	584.1	618.8	670.7	689.2	706.1
Peak Demand		Peaking Factor	%	20%	20%	20%	20%	20%	20%	20%
		Peaking Allowance	Mld	72.2	73.8	77.6	80.6	88.1	91.8	95.2
Average Day - Peak Week Demand (ADPW)			Mld	611.5	641.4	661.8	699.4	758.9	781.0	801.3
Allowance for Risk and Uncertainty		Headroom & Outage Factor	%	17.5%	17.5%	17.5%	15.0%	15.0%	15.0%	15.0%
		Headroom & Outage Allowance	Mld	63.2	64.5	67.9	60.4	66.1	68.9	71.4
Production Requirement			Mld	**674.7**	**705.9**	**729.7**	**759.8**	**825.0**	**849.9**	**872.7**
		Existing Sources			623	633	658	658	658	658
		Production Deficit			82.9	96.7	101.8	167.0	191.9	214.7
		Benefitting Corridor				90.8	92.5	95.4	97.0	99.1
		Production Requirement				**187.5**	**194.3**	**262.4**	**288.9**	**313.8**

[9] (1% of (Domestic Demand + CSL + Non-Domestic Demand)

Table 5.2: Scenario 2 - 'Most Likely Growth' adapted for' per connection' approach, recalculated UFW, and Benefitting Corridor demand

Scenario 2 - 'Most Likely Growth'									
Component	**Element**	**Units**	**2011**	**2021**	**2026**	**2031**	**2041**	**2046**	**2050**
Accounted for Water (AFW)	Domestic Demand	Population	Nr.	1,516,133	1,642,391	1,742,226	1,842,060	2,003,156	2,081,225	2,154,252
	Household (Customer Side) Losses	Occupancy Rate	Nr.	2.69	2.48	2.37	2.32	2.25	2.20	2.20[10]
		Nr of Households[11]	Nr.	591,798	695,366	771,871	833,690	934,805	993,311	1,028,165
		Consumption per connection[12]	l/prop/d	365	360	350	335	315	310	305
		Domestic Consumption	Mld	216.0	250.3	270.2	279.3	294.5	307.9	313.6
	Non-Domestic Demand	Non-Domestic Demand	Mld	110.1[13]	125.0	135.0	145.0	155.0	160.0	165.0[14]
		Strategic Allowance for Major Water Using Industry	Mld	0	34	50	75	100	100	100
	Operational Use	Operation Use Factor[15]	%	1%	1%	1%	1%	1%	1%	1%
		Operational Use Allowance	Mld	3.3	3.8	4.1	4.2	4.5	4.7	4.8
	Accounted for Water (AFW)		Mld	329.4	413.1	459.2	503.5	554.0	572.6	583.4
Unaccounted for Water (UFW) / Distribution Losses		UFW[16]	Mld	**204.7**[17]	165.9[18]	153.1	145.0	140.8[19]	140.8	140.8
		as % of Average Demand	%	38.3%	28.7%	25.0%	22.4%	20.3%	19.7%	19.4%
		cubic metres per km per day	m^3/km/d	22.32	18.09	16.69	15.81	15.35	15.35	15.35
Average Demand			Mld	534.1	579.0	612.3	648.5	694.8	713.4	724.2
Peak Demand		Peaking Factor	%	15%	15%	15%	15%	15%	15%	15%
		Peaking Allowance	Mld	49.4	56.9	61.4	64.3	68.1	70.9	72.5
Average Day - Peak Week Demand (ADPW)			Mld	583.5	635.8	673.7	712.8	762.9	784.3	796.7
Allowance for Risk and Uncertainty		Headroom & Outage Factor	%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%
		Headroom & Outage Allowance	Mld	65.9	75.8	81.8	85.7	90.8	94.5	96.7
Production Requirement			Mld	**649.4**	**711.7**	**755.5**	**798.5**	**853.6**	**878.8**	**893.4**
	Existing Sources				623	633	650[20]	650	650	650
	Production Deficit				88.7	122.5	148.5	203.6	228.8	243.4
	Benefitting Corridor	**Interpolated from IW data**[21]				26.87	30.6	43.4	51.1	56.0
		Corridor source risk provision				16	16	16	16	16
	Production Requirement					**165.4**	**195.2**	**263.0**	**295.9**	**315.3**

[10] initial Census 2016 indicates occupancy of 2.0 may not be reached
[11] including properties not permanently occupied
[12] Assuming downward trending per connection consumption
[13] Adjusted to align with Table 3.2.8 non-domestic figures
[14] Assuming the 55 Mld organic growth applies
[15] (1% of (Domestic Demand + CSL + Non-Domestic Demand)
[16] Assuming Leakage Targets Policy off UFW 204.7 Mld
[17] IW communication on UFW Jul 2016
[18] 38.8 Mld is the UFW recovered on current work-in-progress at 2021; CSL recovery included in 'per connection' rate
[19] 63.9 Mld is the UFW recovered on current work-in-progress at 2040. CSL recovery is included in 'per connection' rate
[20] Reduction in view of KCC comments on Srowland capacity
[21] Interpolated

5.2.4 Adopting challenging Water Conservation targets for WSP

5.2.4.1 Linked Strategies

Water Conservation is a vital part of the overall strategy to provide safe and secure water supplies in the Eastern & Midlands Region. This has been Irish Water's position from the outset in the Project Need Report (February 2015) and it is reiterated in the appended Interim Midlands and GDA Water Resource Plan.

Public consultation over the past 18 months, has repeatedly emphasised the importance of fixing leaks and of water conservation overall. Demand projections are based on achieving ambitious targets in these areas.

5.2.4.2 Two basic approaches

There are two kinds of conservation strategy being examined in the Water Conservation Strategy Project being implemented by Irish Water, these are work-in-progress at this time and are outlined below. The Sustainable Economic Level of Leakage, or 'SELL', is the level at which the combined cost of water and the cost of leakage management, are minimised. The Water Conservation Strategy being considered by Irish Water includes both a SELL Base Case and a Leakage Targets Policy.

The **SELL Base Case** approach would seek to recover 39 Mld in the six year period to 2021, and then prevent leakage from rising thereafter. It assumes that the Water Supply Project comes on stream at 2025.

The **Leakage Targets Policy,** following the leakage targets set out in the Project Need Report, would recover a greater 63.9 Mld substantively by 2031.

5.2.5 An update on the UFW level

The latest estimate of network UFW in the Dublin Water Supply Area by Irish Water, excluding Customer Side Leakage (CSL) exceeds the published position in the WSP Project Need Report 18 months ago, but the progress made with customer side leakage is better than expected. When the PNR estimate is now adjusted for recent, better '*per connection'* metered data, and in one other area around industrial consumption, a UFW in the network of 204.7 Mld emerges.

In February 2015, UFW in the Dublin Water Supply Area was estimated in the PNR at 178.1 Mld, but CSL was separately estimated at 40.8 Mld, giving a total of 218.9 Mld.

The declared ambition in the PNR of March 2015 was to save 48 Mld off the UFW by 2041, and a further 15.3 Mld was to be cut from CSL, giving a total UFW+CSL saving of 63.4 Mld.

5.2.6 Customer Side Leakage

Irish Water has vigorously tackled the problem of Customer Side Leakage through its *Free First Fix* Scheme (http://www.water.ie/water-supply/first-fix/) and has reported excellent returns on the Scheme to date.

At March 2016, the report to the CER on the Free First Fix Scheme identified 48.5 Mld of savings to date, nationally, 26 Mld of which was achieved in Irish Water's East & Midlands Regions. If we assume that 80% of this was in the Dublin Water Supply Area, then almost 20.7 Mld of growing demand has already been offset by this scheme, and value for money is clear from the report to the CER. This would mean that the CSL recovery projected for 2031 in the PNR has already been achieved.

The future returns from the scheme will diminish since the larger leaks are prioritised and are resolved earliest, but Irish Water will continue to work with customers to help them to conserve water.

5.2.7 Irish Water Initiatives

5.2.7.1 Network Resilience Schemes

Irish Water is pursuing a number of schemes, which are intended to improve the ability to move water around the Dublin Water Supply network. These projects will improve the Deployable Output (DO) (see Section 5.5.2) and bring it closer to the actual Distribution Input. The current schemes are:-

(a) No 1:- Peamount Distribution Area and Network Upgrades
(b) No 2:- Old Kilcullen Pumping Station and Rising Main
(c) No 3:- Peamount Pumping Station and Trunk Main
(d) No 4:- Vartry upgrade

These schemes increase Deployable Output collectively, but they do not appreciably increase source water availability. Heretofore, WSP has subtracted the summed sustainable output of existing sources, with any assumed upgrades, (623 Mld at 2015, 633Mld at 2022 and 658 Mld at 2026) from the gross calculated future requirement.

The current operational experience is that the nominal 623 Mld maximum sustainable output availability up to 2021 is nearer 600 Mld (or less) in practice.

To this extent, these projects increase the likelihood that source capacity can be deployed generally where needed across the network, but they essentially bring the position on the ground towards where WSP demand calculation has already assumed it to be for projecting future demand requirements.

5.2.7.2 The Leakage Targets Policy

The Leakage Targets Policy has been assumed in the interim water demand projections and will give the following profile of UFW:

Table 5.3: Leakage Targets Policy

	2011	2021	2026	2031	2041
UFW (Mld)	**204.7**	165.9	153.5	145.0	140.8
Reduction in period (Mld)		38.8	12.4	8.5	4.2
Cumulative Reduction (Mld)		**38.8**	**51.2**	**59.7**	**63.9**

5.3 Option C (Parteen Basin Reservoir Direct)

Option C sources water from the Parteen Basin (Lower Lake) of the River Shannon system, downstream of Lough Derg. It involves abstraction on the shore of Parteen Basin, at a constant abstraction rate of 330 Mld throughout the year. This is equivalent to 3.82m^3/s over a 24 hour day, but it is expected that the daily volume of water will be flow balanced over 20 hours to avoid peak pumping tariffs.

Water treatment would take place near the abstraction point, and a treated water supply would be pumped to a high level Break Pressure Tank and piped gravitationally onwards to the Midlands and the Eastern Region. This permits the transmission pipeline to provide potable water to communities through a 'benefitting corridor' in the Eastern and Midlands Region.

Integration of this new source into the Dublin Water Supply Network is proposed at a Termination Point Reservoir in close proximity to Irish Water's existing reservoir facility at Peamount.

In addition, the POAR defined a Least Constrained Route Corridor, 2km wide, for this transmission pipeline between the point of abstraction at Parteen Basin and the Termination Point Reservoir in Peamount; traversing a linear distance of approximately 165km.

The Least Constrained Route Corridor for Option C is shown on Figure 5-1.

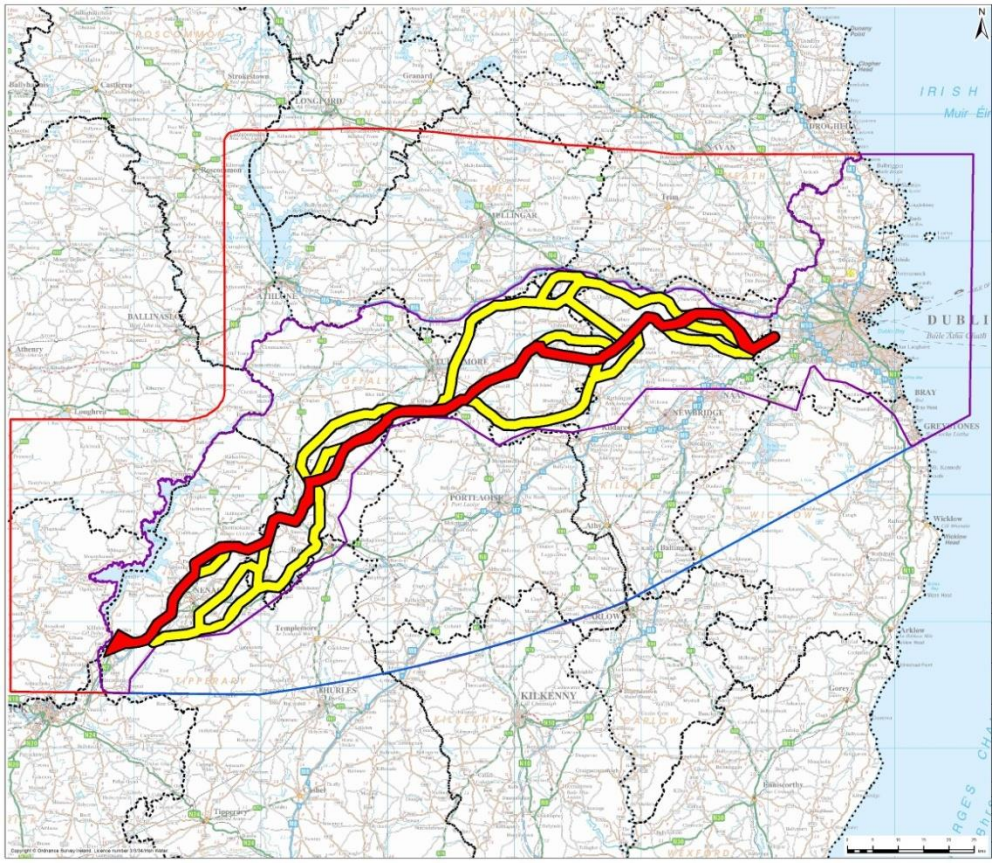

Figure 5-1 Option C Least Constrained Route Corridor (2 Km)

A preliminary review of treatment plant technologies in the POAR proposed a conventional modular stream process, with the sizing and configuration reflective of the expected profile of water demand over time. The presence of alien aquatic species, such as zebra mussels and Asian clams within the raw water source, was also recognised in the design of the raw water abstraction structure, preliminary screening and raw water rising main configuration.

5.3.1 Benefitting Corridor Demand

5.3.1.1 Introduction

At the time of preparation of the Project Need Report (March 2015), a preliminary estimate of the requirements of the Benefitting Corridor was prepared, based on individual county 'need assessments' prepared by Local Authorities, which predated Irish Water's assumption of responsibility for overall National Water Resource Planning. Public Consultation has also emphasized the need to continuously review the public water schemes in the Midlands Benefitting Corridor, and maximise the use of those schemes and sources which offer the best prospects of sustainable abstraction. Therefore, in the interim period since the Project Need Report of March 2015, Irish Water has reviewed the WSP need, based on detailed analysis and risk assessment of 105 existing water supply schemes, based on the 25-year rationalisation objectives of the Water Services Strategic Plan, whilst accounting for necessary upgrade works which have had to proceed in advance of the WSP, due to pressing water quality issues at some locations.

The treated water pipeline would pass through Counties Tipperary, Offaly, Kildare and South Dublin, but the headworks infrastructure and the Termination Point Reservoir connection to the existing Dublin network also permits review of schemes in Counties Clare, Laois, Westmeath, Louth and Wicklow. The Irish Water review of the water supplies in the Benefitting Corridor is appended in Appendix A as the Interim Midlands and GDA Water Resource Plan, it is work-in-progress and it envisages that the 105 existing schemes in the Benefitting Corridor will be consolidated to fewer schemes by the year 2050.

The expected water demand profile for the Benefitting Corridor is composed of two parts, the direct requirement for the excess of projected demand over expected supply from the schemes likely to be retained, and a provision for risk (see Section 5.3.1.2) related to the retained schemes overall.

5.3.1.2 Risk factors

Future abstraction regime:- Ireland, through the Department of Housing, Planning, Community and Local Government, is working to develop an abstraction registration and licencing programme as required by the Water Framework Directive. At present, it is unclear what the requirements of abstraction licencing applied to existing abstractions will be.

Many of the current surface water abstractions were established prior to the introduction of Environmental Impact Assessments or Habitats Directive assessments and retrospective review could determine that the level of proposed abstraction in some instances is not sustainable. A licencing programme with retrospective implications presents an unknown risk to the production capacity of schemes which it is proposed to retain in the Midlands region, particularly for abstractions where there has been no recent upgrade, which would have assessed the environmental impacts.

Particular Risks:- Irish Water has reviewed the larger Water Treatment Plants which it is anticipated will remain at 2050 to establish if any may be at risk due to changing legislation in relation to abstractions, or for other reasons. From these there is a potential that the following abstractions fall into this category:-

- The Portloman WTP (Westmeath), which draws from Lough Owel has a current yield available to Irish Water which is estimated to be 13.6Mld. Because the Royal Canal has been returned to navigability, and under the terms of agreements made in relation to water requirements for the canal, ancillary to the original Water Rights Order in 1985, a prudent provision needs to be made against some potential long term non-availability of this 13.6 Mld.
- Clonsalee WTP (Offaly), the surface water sources from the Clodiagh & Gorragh Rivers, involving 1Mld are considered to be at risk in low flow conditions.
- The Tullamore, Co Offaly groundwater supplies (Arden and Clonsalee WTP's), totalling 3.4 Mld are considered to be at risk.
- Laois is totally dependent on groundwater and may be at risk as a whole. The Portlaoise Water Supply (8.4 Mld), in particular, is known to experience high levels of drawdown following dry conditions, and has been the subject of consultation submissions by Laois Co. Council related to strategic backup support.

*Catchment Risks:-*Although most of the water treatment plants likely to be retained will be upgraded to include multiple treatment barriers and to address risks, identified through Irish Waters' Drinking Water Safety Plan risk assessments, catchment risk management is outside the direct control of Irish Water, and there is a real risk that a source contamination event could cause the loss of any one source. In connection with consolidation of smaller Midland water schemes, it is notable, from recent HSE work[22] related to incidence of reported cases of *cryptosporidium* infection, that (referring to HSE regions), the incidence in the Midlands was found to be 15.2 per 100,000 population, whereas the comparable figure in the Eastern region was 1.4 cases per 100,000 population. The quality control benefits of large water treatment plants are evident in these figures.

Climate Change: Climate change assessments are likely over time to reduce the reliable yield of sources, although the degree of reduction is unknown at this stage, the future impact must also be considered.

[22] EPA Research Report 177:- Economic Assessment of the Waterborne, Outbreak of *Cryptosporidium hominis* in Galway, 2007

Group Water Schemes (GWS) and Developer Provided Infrastructure (DPI):- Irish Water is not the managing authority for Group Water Schemes, or for independently operated Developer Provided Infrastructure, however there is a 'taking-in-charge' process by which such infrastructure may transfer to the public water network. It is unclear at this time how many Group Water Schemes and Developer Provided Infrastructure will be taken in charge by Local Authorities or later transferred to Irish Water, but there is a significant number of Group Water Schemes and DPI in a category that may transfer to Irish Water, placing potential additional demand on existing Irish Water abstraction and treatment capacity.

Provision for Risk Factors

The foregoing risk factors have not been included in the detailed water demand projections, and it would not be proportionate to provide for the full exposure in every instance. However, Irish Water believes it is prudent to provide a minimum contingency of 16Mld to deal with unforeseeable abstraction restrictions, contamination events, or demand increases in the Midlands area in particular. This allowance is just under 10% of overall demand in the corridor, and it is proportionate to the exposure at Portlaoise, or Portloman.

5.3.1.3 Overall Benefitting Corridor Demand

The overall demand profile for the Benefitting Corridor is as follows:-

Table 5.4: Benefitting Corridor Water Demand'

	2026	2031	2041	2046	2050
Benefitting Corridor (Mld)	26.87	30.6	43.4	51.1	56.0
Corridor source risk provision (Mld)	16	16	16	16	16
Totals (Mld)	**42.87**	**46.6**	**59.4**	**67.1**	**72**

The profile ranges from 42.9 Mld at 2026 to 72 Mld at 2050, and is reduced compared to the projections made in the Project Need Report of March 2015.

5.3.1.4 Schemes to be retained or consolidated

At the time of writing this Report, the water supply schemes in the Benefitting Corridor that are currently envisaged to be retained or consolidated by 2050 under Irish Water's rationalisation plans are:-

Table 5.5: Schemes to be consolidated or retained

Scheme to be retained or consolidated	Number of WTPs to be retained or consolidated
Clare	**7**
Feakle PWS	1
Flagmount PWS	1
Kilkeedy PWS	1
Killaloe PWS	1
Mountshannon PWS	1
O'Briens Bridge PWS	1
Scarriff PWS	1
Laois	**26**
Abbeyleix 1 PWS	1
Abbeyleix 2 PWS	1
Arles 2 PWS	1

Scheme to be retained or consolidated	Number of WTPs to be retained or consolidated
Ballinakill 1 PWS	1
Ballinakill 2 PWS	1
Ballyroan PWS	1
Borris in Ossory PWS	1
Camross PWS	1
Coolenaugh PWS	1
Durrow 1 PWS	1
Graiguecullen PWS	1
Lough PWS	1
Meelick PWS	1
Mountmellick 1 PWS	1
Mountrath 2 PWS	1
Mountrath 3 PWS	1
Mountrath PWS	1
Portarlington 1 PWS	1
Portarlington 2 PWS	1
Portlaois PWS	1
Rathdowney PWS	1
Reary WTP	1
Rosenallis PWS	1
SE Regional Scheme	1
Swan PWS	1
The Strand PWS	1
Louth	**5**
Collon	1
Drybridge	1
Kilineer	1
Rosehall	1
Staleen	1
Meath	**4**
Danestown	1
East Meath	1
Hollymount	1
Woodview	1
Offaly	**29**
Banagher RWSS PWS	2
Birr PWS	1
Clara/Ferbane PWS	2
Clara/Ferbane RWSS PWS	1
Clonbullogue PWS	1
Coolbawn WTP (New)	1
Coolderry PWS	1
Daingean PWS	1
Dunkerrin PWS	3
Edenderry PWS	2
Geashill PWS	1
Kilcormac PWS	1
Kinnitty PWS	1
Moneygall PWS	1
Mountbolus P.W.S.	1
Rahan - Agall/Hollimshill P.W.S.	1
Rahan - Tully P.W.S.	1
Rhode PWS	1
Shinrone/Brosna PWS	2

Scheme to be retained or consolidated	Number of WTPs to be retained or consolidated
Tullamore PWS	3
Walsh Island PWS	1
Westmeath	**3**
Athlone WSS	1
Ballany High Level Reservoir	1
Frewin Hill High Level Reservoir	1
Wicklow	**31**
Aughrim Annacurra Public Supply	1
Avoca Ballinaclash Public Supply	1
Ballinglen (Preban Bridge)	1
Ballinteskin Public Supply	1
Ballycoog Public Supply	1
Ballymorris 3	1
Ballymorris Public Supply	1
Baltinglass Public Supply	1
Barndarrig Public Supply	1
Dunlavin Public Supply	1
Glenealy Public Supply	1
Grangecon Public Supply	1
Hollywood Donard Public Supply	1
Killyballyowen (Annacurra) Public Supply	1
Killyballyowen (Aughrim) Public Supply	1
Kirikee Public Supply	1
Knockanarrigan Davidstown Public Supply	1
Knoxtershill	1
Lacken Public Supply	1
Laragh Annamoe Public Supply	2
Loughmogue (Dunlavin)	1
Mullans North	1
Rathdangan Public Supply	1
Rathdrum Public Supply	1
Redcross Conary Public Supply	1
Roscath	1
Roundwood Public Supply	1
Stratford Public Supply	1
Valleymount/Ballyknockan Public Supply	1
Wicklow Regional WSS	1
Grand Total	**105**

5.4 Phasing of Supply

The profile of projected treated water production requirement, over time, is summarised below:-

Table 5.6: Treated Water Production Requirement

Element	2026	2031	2041	2046	2050
Treated Water Production Requirement (Mld)	165.4	195.2	263.0	295.9	315.3

'Phasing of Infrastructure' attempts to align the required investment, with the developing position on water requirement, within a system which operates well throughout its working life.

In developing phasing proposals, it is necessary to consider not only the growing volumetric water requirement, but also the other elements of 'need', the diversification of risk with the existing sources, and the requirement to bring resilience and headroom to the overall system. It is also necessary to geographically distribute this headroom, by operating existing sources, and particularly Ballymore Eustace and Leixlip at not more than 85% of full output, so that routine maintenance of treatment streams can take place, without impacting output.

5.4.1 Issues to be considered in Phasing the Water Supply Project

The Intake, Raw Water Pumping Station and twin Raw Water Rising Mains would be constructed for the full raw water abstraction of 330 Mld, because these either include dual elements, one of which must have the facility to be taken out of service for maintenance, or it involves civil engineering construction near the source waterbody, where phased construction would not be practical. Pumping plant within the Raw Water Pumping Station would be phased, with space within the station provided to add pumpsets with increasing demand.

Many pipeline configurations and options have been considered, including single pipe, dual pipes, and phased dual pipes. Options which involve a gravitational supply from a high level Break Pressure Tank near the Tipperary/Offaly border, as well as combined gravitational / booster pumping have also been considered.

If a Phase 1 configuration were curtailed strictly to 160 Mld, which is of the order of 50% of the long term requirement at 2050, and which might be considered with a phased dual pipe, it would only match projected demand at the mid 2020's and it would not cover both demand at that level, and resilience support if supply elsewhere is disrupted. Neither would it cover a system needing to be operated at above average flows over a short period, to refill storage drawn down in an emergency, particularly in Dublin.

It should be recalled that risk to existing major sources was discussed in the Project Need Report (February 2015), and this continues to be a major factor in project need and in considerations of phasing. The experience of a large UK water utility, in Summer 2015, where one million customers were affected by a cryptosporidium outbreak at a major water treatment plant, despite the presence of strong barriers to this microorganism in its treatment process, is a reminder of the need to properly plan for potential outage at sources. Due to its location in the catchment and its proximity to highly populated areas, with a large waste water treatment plant upstream, the Leixlip WTP is considered by Irish Water to be vulnerable to pollution events, and this is an influencing factor in WSP phasing recommendations. With any phasing of a dual pipe, the second pipe would have to be laid alongside a live operating main. The required permanent wayleave for a position where twin configuration is planned would need to be wider than 20m, to accommodate a separation of 7m-10m between the pipes. Construction of a second pipeline adjacent to a live Phase 1 pipeline carries risks, particularly if thrust blocks are required with the initial pipe.

It could not be assumed with certainty that the same wayleave could be used for the second of a twin pipeline in a completely separate Planning Application.

Farming organisations in public consultation have warned against double disruption within a short time period, for dual pipe construction, where it can take land several years to recover full productivity. Attempting to manage demand risk by phasing twin pipelines carries a significant disruption risk if demand growth is faster than expected and the effective life of Phase 1 is overestimated.

A greater than anticipated, or earlier than expected erosion of safe yield on the existing sources in the Dublin WSA and Midlands, with climate change, would also disrupt the effectiveness of a Phase 1, if sized inflexibly in the region of 160 Mld.

Irish Water considers as optimum, a single pipeline configuration with a diameter of the order of 1700mm diameter in the rising pressure section from the Water Treatment Plant to the Break Pressure Tank, and of the order of 2000mm diameter pipeline from there to the Termination Point Reservoir at Peamount.

The proposed single pipeline would be sized to deliver the full demand, but it would have an element of phasing in its design, being sized to operate gravitationally for flows up to 245 Mld, with later booster pumping being employed to deliver the balance up to 315.3 Mld by 2050.

5.4.2 Phase 1 of 240 Mld delivering in a full sized 315 Mld pipeline.

A Phasing proposal of 240 Mld would comprise 3 No 80 Mld treated water streams, in covered building units. This would provide capacity for a start-up flow of the order of 160 Mld, and a resilience margin of 80 Mld to support and de-risk existing sources in the Midlands and Eastern Region, and to provide a working margin for large diameter arterial main maintenance works.

Water would be delivered through a single pipeline sized for the ultimate 315.3 Mld, but operating initially at 165.4 Mld, and capable of delivering 240 Mld on a gravity mode of operation from the Break Pressure Tank, and finally at 315.3 Mld , with boosting, by 2050.

5.5 "Do Minimum" Position

5.5.1 Introduction

It is necessary, in order to place the Water Supply Project in its proper strategic context, to compare the water supply position with WSP in place, compared to that which would have to be pursued in the absence of the new source.

The WSP is a planned and phased response to a carefully estimated unfolding position; the other 'Do Minimum' position is an intensification of current efforts to recover more water.

It is recognised that there are clear qualitative differences in these opposite positions: one provides additional water to meet growing demand, meeting modern water utility standards of service and resilience, the other expends increasing effort to stretch the existing resources, accepting the escalating attendant risks to increasingly compromised standards of service (e.g. outages). These are very different water supply positions. Ultimately the water just will not be available from ever more intensive burdens placed upon existing sources and options for water recovery from leakage management and water conservation. That ultimately means water rationing.

Long before that point, even when water is mostly, if unreliably, available at the tap, there will still be an escalating risk-of-outage environment around that. That kind of risk environment forces hard choices on customers and businesses which depend upon reliable water supplies; unacceptable frequency of substandard service is a factor in the strategic planning function of any water-using enterprise. Businesses and Industry monitor risks on all their inputs, including water, and investment decisions are informed by such risk appraisals.

The escalating risk environment also erodes the flexibility around all operations which attempt to underpin water supply, and it frustrates any planned approach to asset management. All of that impairs the ability of Irish Water to function as a level-of-service driven efficient utility, as would be expected with power supply, gas or telecommunications utilities.

5.5.2 Deployable Water

There is a difference between potential Deployable Output, if water can be moved efficiently around the system, compared to 'Current Deployable Output', where 'pinch-points' in the network prevent full deployment of water.

Potential Deployable Output around 623 Mld currently, is not *actually* deployable, all year round, throughout the network, above 560-600 Mld. Irish Water is addressing this issue, the foregoing sections already reference four network 'resilience projects' which will improve this position, but it is again emphasized that they do not bring any extra water to the system, they rather ensure that existing water treated at several sources, can be made truly available wherever it is needed in the network.

By subtracting 650 Mld, from the calculated overall demand, to define the required additional water, the WSP already assumes full availability of that water; it already assumes the effectiveness of the 'resilience projects'.

5.5.3 Intensification of recovery of leakage

The WSP already assumes UFW recovery of 63.9 Mld in the Dublin Water Supply Area by the year 2041 which is just over 20% of projected average demand in that year.

Under a 'Do Minimum' approach of intensified and accelerated effort to recover more leakage, the implications of striving to recover a further 15 Mld by 2021, and a further 15 Mld again by 2026, have been examined.

In the first instance, it is extremely doubtful if the available resources and the watermain rehabilitation industry could service such an intensified effort over this time scale. Based on established water recovery productivity in Dublin city, it would take rehabilitation of an additional 593 km of water mains to recover the initial additional 15 Mld, and a further 693 km of rehabilitated mains to yield the next 15 Mld. Costs to recover the first 15 Mld of the intensified yield are estimated at €111m, with the next 15 Mld costing €210m, yielding a potential 30 Mld in total for an outlay of €321m. The social costs in terms of disruption with an intensified effort on this scale would also be very substantial.

An intensified effort to recover an extra 30 Mld leakage recovery at 2026, on top of the 51.2 Mld already included in the WSP demand position at 2026, would bring UFW in ten years to below 20%, a leakage recovery performance that few UK water companies or utilities of similar scale have managed to reach. In the UK, it took more than 20 years of sustained investment in water conservation and mains replacement/rehabilitation to get UFW down to between 20% and 25%.

In summary, the WSP already has ambitious leakage recovery targets assumed in its water demand calculation, and intensified effort under a 'Do Minimum' approach will rapidly approach diminishing returns at escalating social and monetary cost.

5.5.4 Beyond 'Do Minimum'

The Preliminary Options Appraisal Report has already considered the position with more intensive use of existing water supplies on the Liffey, and of groundwater development, and the position in relation to these is reviewed below.

5.5.4.1 Intensified development of surface waters

Over 84% of Dublin's' water treatment capacity is now dependent upon the River Liffey, over 40% of the mean annual flow from the catchment is used in water supply, and diversification of the water supply sources serving the city is an important part of 'resilience planning' in order to manage risks such as climate change impacts on existing sources and existing water supply source pollution.

The maximum sustainable availability of raw water from the River Liffey is 533 Mld, based on average annual abstraction in 1975/76 drought conditions which was the most extreme drought on the Liffey in historic drought analysis from more than 50 years of record. The Water Treatment Plants at Ballymore Eustace and Leixlip are already developed to treat water at this maximum sustainable yield level. Options to expand that yield were described in the Preliminary Options Appraisal Report, but are not sustainable. The potential impact of climate change on this yield must also be planned for, as must the obligations for river management for effective flood control and the requirements of the Water Framework Directive (e.g. raising of water quality status requirements).

The sustainable raw water yield of the existing sources, and particularly the Liffey, has been determined based on average demand over the year. A seasonal variation in water demand profile in a prolonged drought is an additional burden on impounded raw water storage and must be provided for.

It has not been assumed, in considering raw water requirements, that the 'peak week' is an isolated anomaly of a week's duration in an otherwise average profile over the year. In a drought situation, demand above average, (but below the peak week level) is likely to persist over a prolonged period of weeks or months. Raw water volume is required to support prolonged demand at above average conditions.

The Pollaphuca reservoir is finite in raw water volume, the available volume has been closely studied for reliable yield, and with considerations on safe management of the reservoir for flood attenuation, it is possible that the upper normal operating water level may be reduced, impacting the yield of the existing Liffey source.

A treatment plant may have an installed treatment capacity, summed over all its modules, which on first consideration appears higher than the source yield. An ability to treat the required flow at any treatment plant even with some modules out of service is important for day-to-day operation, where for example a treatment stream must be taken out of service for maintenance, or a reservoir must be refilled as quickly as possible after an outage, but it must be clearly understood that while treatment plants might have an ability to produce more during a peak week, or for a short time to support an outage in a plant elsewhere, they cannot operate over sustained periods in excess of the reliable yield of the source, without risking failure of the water supply. The overall position must also allow for prolonged operation at elevated seasonal demand in dry weather.

Other river catchments nearer Dublin, such as the Boyne, and Barrow are already significantly developed for water supply. Abstraction at Roughgrange from the Boyne already supplies Drogheda and East Meath, and the new Treatment Plant at Srowland near Athy in Co. Kildare is designed to abstract at the sustainable limit of low flow on the River Barrow at that location.

The Vartry Reservoir and the Ballyboden sources are all operating at or near their sustainable yields.

5.5.4.2 Groundwater

Groundwater throughout a region of 80km in radius centred on Dublin was assessed in 2008. This work was reviewed in the Options Working Paper (http://www.watersupplyproject.ie/wp-content/uploads/2015/05/150525WSP1_AppendixBSource_A011.pdf) and it was concluded that groundwater on its own would not be able to supply the projected demand, and the best use of the limited resource would be in a supplementary capacity.

Since 2008, the definition of 'available groundwater resource' in the Groundwater Regulations (2010) introduces a complex linkage with the Water Framework Directive, when it says:-

> *"available groundwater resource…….means the long term annual average recharge of the body of groundwater less the long term annual rate of flow required to achieve the ecological quality objectives for associated surface waters specified under Article 4 of Directive 2000/60/EC to avoid any significant diminution in the ecological status of such waters and to avoid any significant damage to associated terrestrial ecosystems".*

The Curragh aquifer, for example, is one of the larger groundwater bodies in Leinster, but is also a source of water for the Pollardstown Fen, an internationally important ecological habitat. Groundwater also indirectly feeds the Grand Canal system through the Milltown Feeder. The Kildare wellfields, developed over the past decade under the Kildare Water Strategy, and Bog of the Ring are operating at their assessed sustainable yields which emerged from an appraisal of all groundwater resources in Co. Kildare

Groundwater test drillings were carried out at multiple locations in the Fingal/Meath border area, and extending into South Louth. Thirteen test areas were examined, at Rath and Curragha near Dunboyne, at Rathfeigh and Duleek, in the River Nanny valley towards Mosney and Donnycarney, in the southern environs of Drogheda at Donore, Staleen, Kiltrough and Bryanstown, and at Ballymakenny in south Louth. It is notable that yield estimation, based on two years' research and more than 60 boreholes drilled in an area of 675 sq. km in extent,

north of Bog of the Ring, was estimated to have a sustainable yield, which would not risk Water Framework Directive quantitative objectives on surface waters, of just 22 Mld. Compared with the originally predicted yield estimates of 33-41 Mld, this is an indication that true availability of the groundwater resource in that region calls for a much more conservative approach.

Eleven groundwater bodies within 80 km of Dublin currently enjoy 'Good' status under the WFD. Five of them are classified as 'at risk of not achieving good status' in future, (including the existing Bog of the Ring abstraction, part of the source capacity for the Dublin Water Supply Area) and two more are 'possibly at risk' of not achieving good status. The estimated potential regional resource of 115 Mld over an area of the order of 10,000 sq.km, is not adequate to meet both projected demand and resilience rapid response requirements. It would have to be located, tested & proven not to involve significant impact on terrestrial ecosystems dependent upon groundwater, and it would have to be sustainably developed as well fields, where water rights can be obtained and water quality protected by extensive land use restrictions.

Mine dewatering was previously investigated and is complicated by large cones of groundwater depression extending tens of square kilometres, by prolonged discharge of pumped groundwater into surface water systems, which have come into environmental equilibrium with the imported flows. The pumped water has become part of established flow in adjacent surface water systems, and some serve to improve background quality in receiving waters. Mining facilities are engaged under licence with extensive decommissioning and aftercare obligations and Irish Water must take such factors into account. Such options are best developed for auxiliary or local supply.

The 2008 conclusion that groundwater has a potential role as a proven, sustainable supplementary source, capable of augmenting alongside a primary supply from an alternative source, is correct and it places groundwater in its proper context, in time, in scale, and in planning risk.

5.5.5 Operating conditions under "Do Minimum"

5.5.5.1 Risk of rationing under tightening supply

The yield of water through intensified leakage recovery would struggle to match water demand from the early 2020's, and increased risk of rationing would then prevail. In discussing a drift towards rationing, the first point to understand is that to maintain customer service to match expectation, it is always necessary to meet the maximum daily demand in each area of the network, not just the overall average daily demand. Where industries such as brewing have a seasonal peak demand it must also be met. The distinction between trunk mains (which should move water in bulk) and distribution mains (which deliver water to connected customers) has become blurred in the city over decades, which makes operating a pressure management and rationing strategy difficult.

The first step in demand management is to 'trim' network pressures, or generally reduce them to the lowest tolerable operational levels. This creates difficulty where many 2-3 storey buildings and apartment blocks, which should have booster pumps on their internal systems, do not have. They lose the ability to fill high level storage tanks, so that some customers lose supply. One hospital has a water supply which is directly mains fed, so that reduction in mains water pressure immediately impacts healthcare service there.

With deeper night time pressure reductions, and with night time rationing, this affects any business or industry operating evenings or shift work. It also means that attic storage tanks which have been drawn down after mains supply is curtailed during the night, will all seek to simultaneously refill when pressure returns the following day. This will significantly distort flow patterns from late morning to late afternoon.

When night rationing is introduced, in sections of the city on rotation, teams of operatives must manually operate isolating valves, each evening, and again the following morning. The change in pressure from 'no flow' to 'resumed high flow' itself leads to additional bursts, and water quality is impaired as sediments in mains are mobilized by the flow surges. Prolonged night rationing leads to a customer coping response through irregular water storage, and when associated with increased burst frequency in older mains, is ultimately self-defeating.

More importantly, 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.

5.5.6 Summary overview

The 'Do Minimum' position involves a very expensive intensification of an already ambitious leakage recovery effort, with diminishing returns and extensive socio-economic impacts, on a tight programme, towards leakage levels not achieved by others in the UK in comparable conditions, despite investment in a regulated environment over several decades.

Where existing abstractions have already been incrementally increased over decades to the reliable yield of the water bodies from which they draw, then intensification of these abstractions can only take place against increasing risk of failure in drought conditions. Multiple dispersed development of wellfields, to develop groundwater resources, has attendant legal, planning and sustainability risks.

Where the requirement is to bring resilience to the expanded water supply system, and to diversify risks associated with it, taking the existing sources and new source operating together, then neither the 'Do Minimum' nor the available courses of action beyond it, address this aspect of need at all.

5.6 Conclusions

5.5.1 Interim review of water demand indicates that treated water demand at 2026 will be 165.4 Mld, rising to 315.3 Mld at 2050.

5.5.2 This projection already includes an assumed leakage recovery of 63.9 Mld by 2041.

5.5.3 A 'Do Minimum' intensification of UFW recovery to yield a further 30 Mld within a decade, would require rehabilitation of more than 1,286km of additional mains and would cost an estimated additional €321m in addition to the significant social cost of disruption that would be caused by such works.

5.5.4 The recommended Phase 1 project would provide 245 Mld of treated water, in a three-module treatment plant, with space for a fourth module for the total projected treated water requirement of 318.5 Mld. Raw water abstraction may exceed these figures, due to water used in the treatment process, and the abstraction of 330 Mld identified in the POAR is confirmed.