Autumn 2022

Draft Regional Water Resources Plan - North West

Appendix 7 Study Area G Technical Report

Tionscadal Éireann
Project Ireland
2040

Data Disclaimer:

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

Baseline data included in the draft RWRP-NW has been incorporated from numerous sources including but not limited to National Planning Framework, Central Statistics Office, Regional Spatial and Economic Strategies, Local Authority data sets, Regional Assembly data sets and Irish Water data sets. Data sources will be detailed in the relevant sections of the draft RWRP-NW. 2019 was selected as the base year to align with the planning period (2019-2025) of the NWRP.

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1 Introduction and Background

1 Introduction – Study Area G – Clare

This is the Technical Report for Study Area G which applies the Options Assessment Methodology, as set out in the National Water Resources Plan - Framework Plan (NWRP-FP), the final version of which was reviewed by the authors of this Technical Report Prior to finalisation of this Technical Report. This document should be reviewed in conjunction with Framework Plan and the draft Regional Water Resources Plan – North West (RWRP-NW), which explain key concepts and terminology used throughout the report.

This Study Area includes 9 water resource zone of which 7 are in County Clare and 2 in County Galway. This Technical Report includes:

- The summary of Identified Need in this Study Area including Quality, Quantity, Reliability and Sustainability;
- Options considered within the Study Area;
- The range of approaches to resolve Identified Need;
- Development of an Outline Preferred Approach for the Study Area; and
- The adaptability of our Preferred Approach.

The Preferred Approach for this Study Area feeds into the regional Preferred Approach detailed in the draft RWRP-NW.

1.1 Summary of Our Options Assessment Methodology

In Chapter 8 of the Framework Plan, we described the Option Assessment Methodology that will be used to develop a national programme of proposed solutions for all of our water supplies. The objective of these solutions is to resolve the needs identified through the Supply Demand Balance (SDB), Water Quality, Reliability and Sustainability assessments. These needs will be discussed in further detail in this report. In the draft RWRP-NW, we apply this methodology to the North West Region shown in Figure 1.1.

As outlined in Section 1.9.4 of the Framework Plan, the regional boundaries have been delineated for the purpose of delivering the National Water Resources Plan. As a National Plan, sources outside the delivery region may be considered to meet need within a particular region.

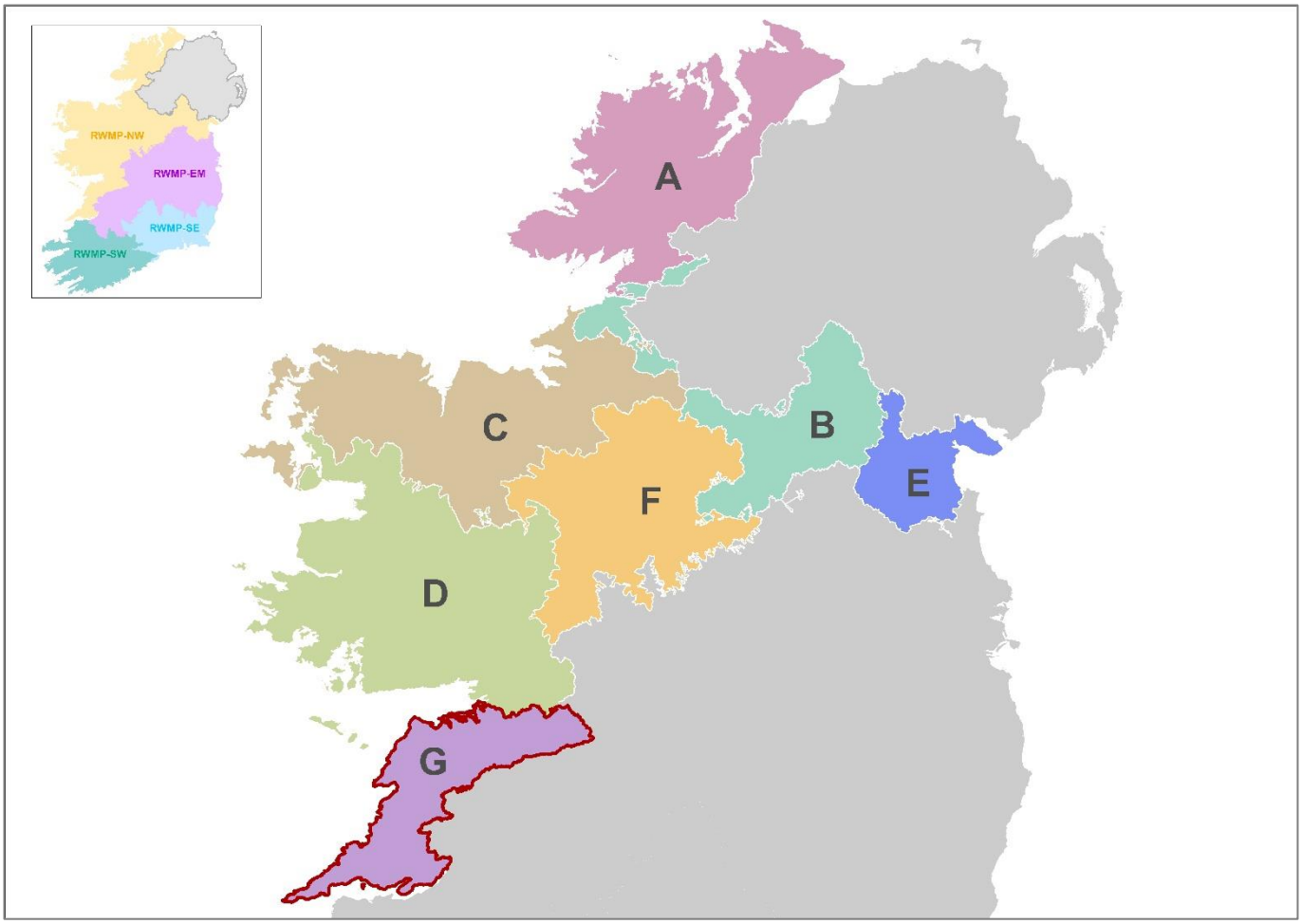


Figure 1.1 Overview of Study Areas within the North West Region.

This Technical Report is for Study Area G (SAG), which consists of 9 individual water resource zones (WRZs). Within this Study Area, the Preferred Approach has been developed following the process shown in Figure 1.2 and as outlined in Section 8.3 of the Framework Plan.

In this document, Option codes are labelled using the following naming convention: SAX-00X

- SAX refers to the Study Area within which the option is located.
- 00X refers to the individual option number.
- Any references to TG1 refers the North West Region (Regional Group 1).

It should be noted that assessments and preferred approaches and solutions at this stage are at a plan level. Environmental impacts and costing of projects are further reviewed at project level. No statutory consent or funding consent is conferred by inclusion in the national plan. Any projects that are progressed following this plan will require individual environmental assessments, including Environmental Impact Assessment and Appropriate Assessment (as required), in support of planning applications (where a project requires planning permission) or in support of licencing applications (for example, for new abstractions). Any such applications will also be subject to public consultation.

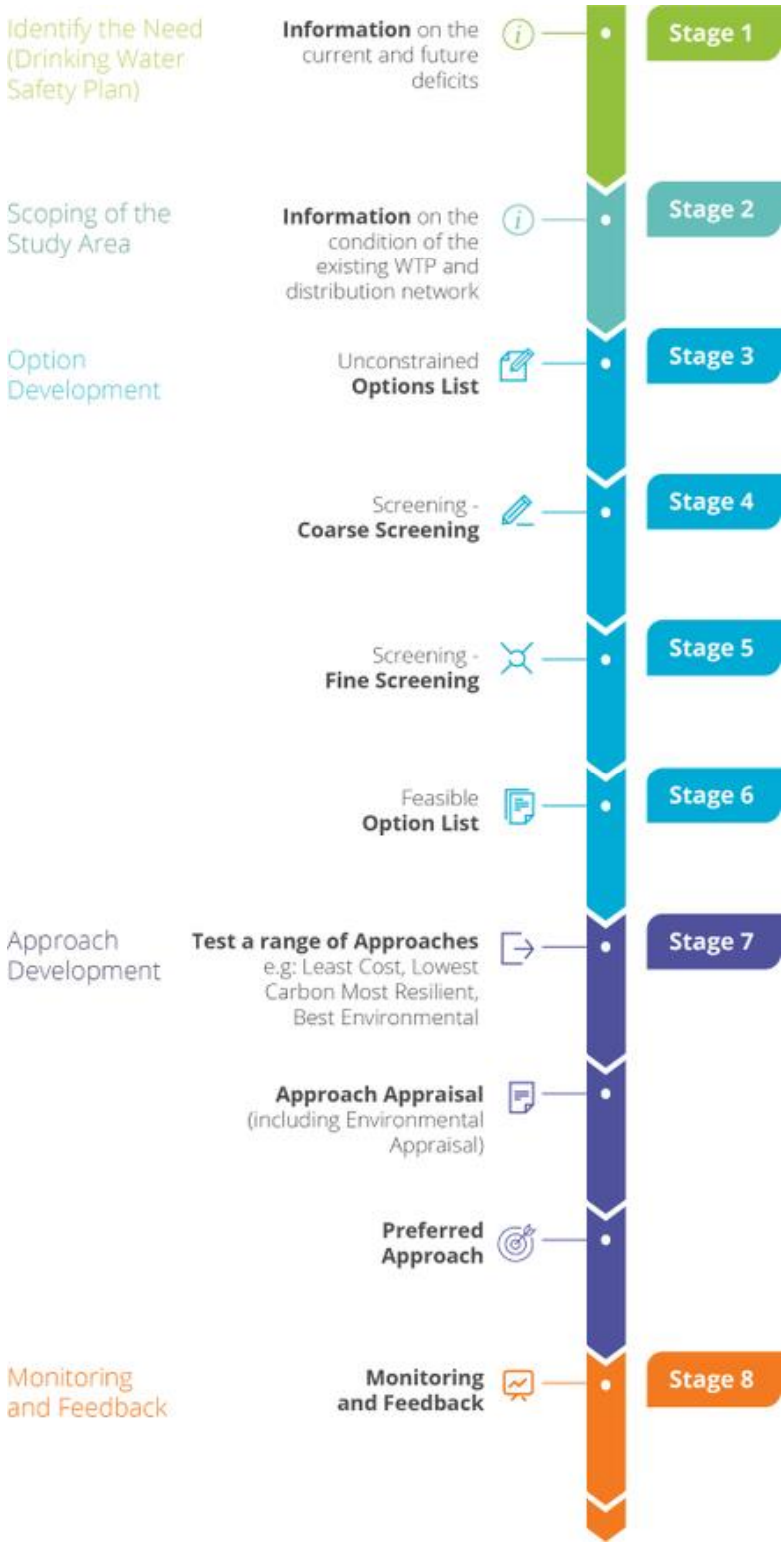


Figure 1.2 Option Assessment Methodology Process

1.2 Introduction to the Study Area

SAG consists of 9 WRZs supplying a population of approximately 29,804 people via approximately 1,454 kilometres of distribution network. The majority of the Study Area is in County Clare, with the northeast boundary in County Galway. West Clare with the towns Kilrush and Kilkee is the high demand area, whilst the town of Ennistymon is another significant demand area within the Study Area. The sources of water supply consist of 6 surface water abstractions and 5 groundwater abstraction sites. The Study Area's water treatment plants (WTPs) and their associated source type are summarised in Figure 1.3. and Table 1.1.

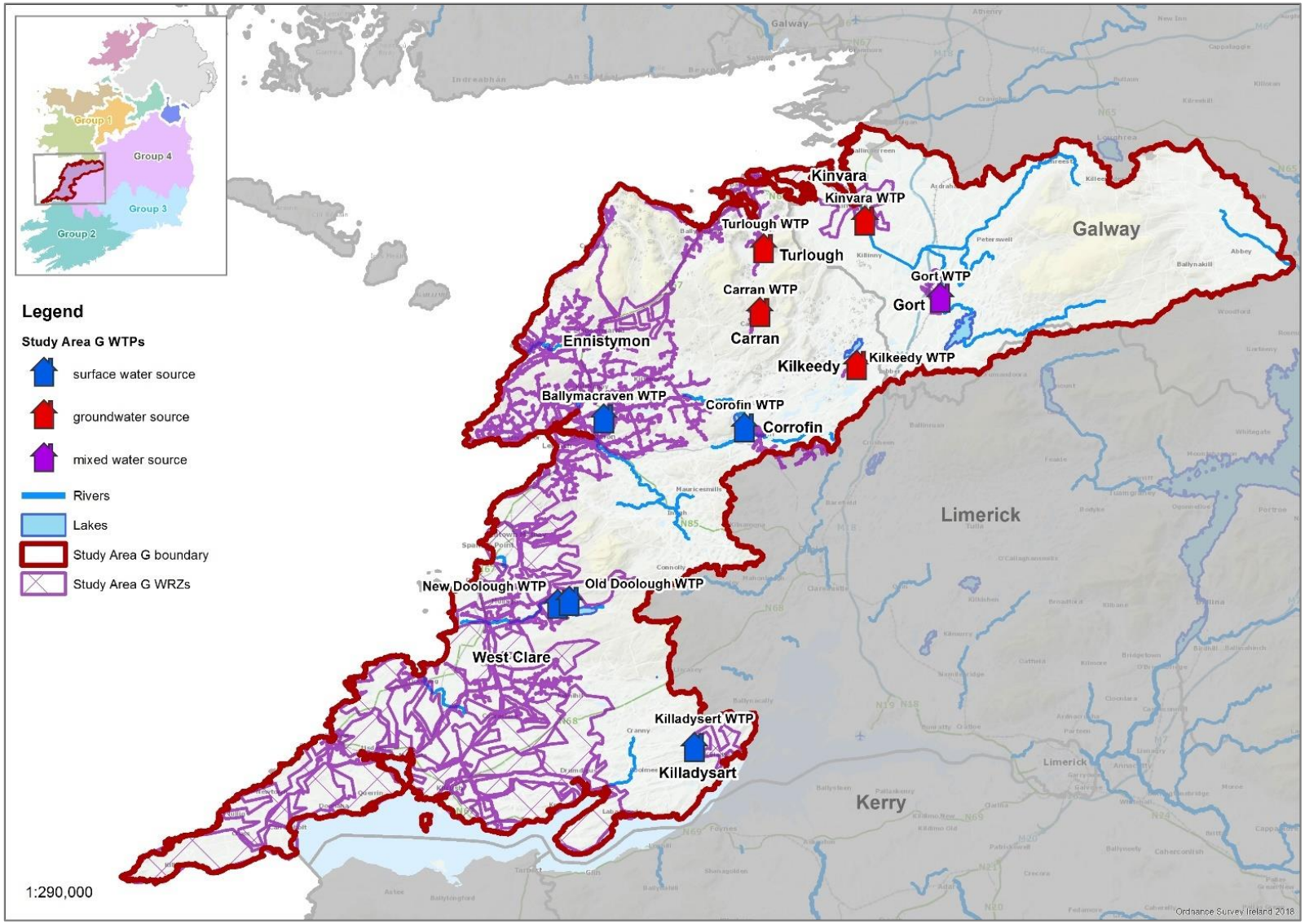


Figure 1.3 SAG Clare Water Supply Study Area

Regarding surface water availability in the Study Area, SAG is split between the Mal Bay catchment (HA 28) in the west, the Shannon Estuary North catchment (HA 27) in the south and central parts, and the Galway Bay South East catchment (HA 29) in the north.

The Mal Bay catchment consists of several small river sub catchments flowing west into the Atlantic Ocean. The parts of the Shannon Estuary North catchment in the Study Area includes small coastal sub catchments in the south flowing into Shannon Estuary, whilst in the north the River Fergus drains an area underlain with highly karstified limestone geology where the surface water drainage network is either virtually absent (i.e. The Burren) or highly connected to the groundwater system. The areas of the Galway Bay South East catchment within the north of the Study Area includes the Kilchreest River which flows west before crossing onto the limestones near Gort where it follows a pattern of sinking underground and re-emerging before flowing underground through caverns and resurfacing via springs flowing into Galway Bay around Kinvara.

The Study Area has several designated Special Areas of Conservation (SACs), especially in the north, with the largest designation being the East Burren Complex SAC which covers an area across both the Shannon Estuary North and Galway Bay South East catchments.

Around 90% of the total water supplies for the Study Area come from surface water sources, and more specifically a few large lake abstractions. The Doo Lough source is the most significant abstraction source in SAG and has the most strategic importance for the future water supply of the region. Doo Lough is an impounding reservoir on the Annageeragh River within the Mal Bay catchment and feeds both the Old and New Doolough WTPs to supply West Clare WRZ, the largest water resource zone in Study Area. The reservoir has a fish pass and compensation flow constructed as part of the dam, and an existing historical abstraction licence allowing up to 40,000 m^3/day.

Elsewhere in SAG, other surface water abstractions include Lickeen Lake, a natural lake source in the River Inagh sub catchment within the Mal Bay catchment, which supplies Ennistymon WRZ. In the south of the Study Area, the small Gortglass Lough source, within the Shannon Estuary North catchment, supplies Killadysert PWS WRZ. In the centre of the Study Area, the Lough Inchiquin source, a lake on the River Fergus located within the karstified limestone region of the Shannon Estuary North catchment, supplies Corofin PWS WRZ. In the north of the Study Area, the Cannahawna River source, within the Galway Bay South East catchment, partly supplies Gort WRZ in combination with some borehole abstractions.

The predominant aquifer type of the area is made up of poorly productive bedrock (73%), with the remainder (27%) consisting of karstic productive aquifers. There are no major productive fissured or sand and gravel aquifers mapped in SAG. The majority of the large abstractions occur as springs which emerge mainly in the Burren region. This is a large karstified area whereby any rainfall rapidly enters the groundwater conduit system and discharges at any number of internal and external springs in the area.

The landscape of the area reflects the varied underlying geology. The more resistant Old Red Sandstones primarily make up the Slieve Aughty mountains to the northeast of the area, with older, less competent Silurian and Ordovician aged sandstones and siltstones in their cores. The upland area of the west of the county is underlain by the sandstones, siltstones, and shales of Namurian (Upper Carboniferous) age. These areas are classified as poorly productive aquifers and will not offer the same kind of groundwater potential as the limestones.

The karst forms a key regionally important aquifer in some areas, most notably around the Burren, an area covering the limestone uplands of north-western Clare and adjacent lowlands. These younger, softer, and more soluble Carboniferous limestones and shales form part of a larger area which extends from the Ennis area northwards to Gort and the Burren plateau. The Burren can be defined as a temperate glaciokarst landscape, which has been subject to repeated glaciation during the Pleistocene, creating distinctive features such as turloughs, swallow holes, sinking streams, limestone pavement, dry valleys, caves, and large springs. Limestone dissolution during karstification causes groundwater flow to concentrate along

certain pathways/conduits (Rkc type aquifers), making it difficult to locate successful wells. Bare rock and thin subsoils are common across much of the area meaning groundwater is vulnerable to pollution, thus creating difficulties when it comes to water supply and pollution prevention.

Although recharge is high due to high rainfall coupled with low evapotranspiration and shallow/bare rock there is relatively low storage capacity among the limestones. As mentioned, the nature of the Rkc flow coupled with low aquifer storage, makes drilling successful boreholes challenging, despite the large volumes of groundwater flowing through the limestones. This is evidenced by the Ballyvaughan scheme which had 11 boreholes drilled to obtain an adequate yield, with three being contaminated and most giving poor yields. The Burren uplands often result in yield failures for domestic well drilling, while the larger supplies in the lowlands are often serviced by large springs. Springs are the best option for groundwater development, whether by using the overflow, deepening or drilling in the vicinity. However, they usually have a flashy flow regime, with high turbidity and occasionally high iron from surface water flowing off the Namurian rocks.

Overall, 5 groundwater sites are managed by Irish Water in the region, with the majority of the smaller abstractions (< 200 m^3/day) taking place from boreholes sited in the limestones but most likely not intercepting any major water-bearing conduit. The coastal springs at Ballyvaughan and Kinvara serve as discharge points, and with flows reported to be upwards of 12,000 m^3/day, give an idea of the types of volumes being transported throughout the paleokarstic system.

Table 1.1 also provides an overview of the risk of failure against the Quality, Quantity, Reliability, Potential Sustainability criteria. A further breakdown of these scores is provided in Section 2.

Table 1.1 Study Area G

Clare	Total Population	29,804	Total Network Length (km)	1,454	Number of Water Resource Zones	9
Counties in Study Area	Clare, Galway					
Principal Settlements	Kilrush, Gort, Kinvara, Miltown Malbay, Ennistymon, Kilmihill, Kilkee, Lisdoonvarna, Corrofin, Lahinch					
Number of Water Sources	11	Surface Water Sources	6		Groundwater Sources	5

Water Treatment Plant	Source	Population	WTP Capacity (m³/day)	Quality	Quantity	Reliability	Potential Sustainability
Kinvara WTP	1 x Borehole	2,240	1,800	●	○	●	○
Gort WTP	Cannahawna River & 3 x Boreholes	2,840	1,440	●	○	●	○
Turlough WTP	1 x Borehole	415	500	●	●	●	●
Ballymacraven WTP	Lickeen Lake	6,841	4,750	●	●	●	●
Killadysert WTP	Gortglass Lough	1,508	1,500	●	●	○	●
Kilkeedy WTP	1 x Borehole	76	100	●	○	○	○
Carron (Termon Spring) WTP	1 x Borehole	54	139	●	●	●	●
Corrofin WTP	Lough Inchiquin	1,199	720	●	○	○	○
New Doolough WTP	Doo Lough	10,985	16,480	●	○	○	●
Old Doolough WTP	Doo Lough	3,672	5,000	●	○	○	●

Score	Irish Water Asset Standard Assessment	Priority
	Low Risk	Low Priority Asset
	Medium Risk	Priority 2 Asset
	High Risk	Priority 1 Asset

2 Scoping the Study Area

2 Scoping the Study Area

In this chapter we summarise the current and future issues with water supplies in Study Area G, in terms of water quality, quantity, reliability and sustainability.

To identify the issues and corresponding need with the water supplies in this Study Area, and to inform the nature, scale and scope of the solutions that we need to consider to meet them, we have assessed:

- The **water quality** that we can supply;
- The **water quantity** that we can supply;
- The **reliability** of our existing supplies; and
- Additional information that impacts the long-term **sustainability** of our sources or infrastructure.

2.1 Water Quality

We assess the water quality investment needs of our water supplies by assessing the performance of our assets against the barriers set out in Chapter 5 of the Framework Plan. As set out in Chapter 5 of the Framework Plan, Irish Water is developing scientifically robust datasets to assign risk. Irish Water are utilising the well-established 'Failure Mode Effect Analysis' which provides a step-by-step approach for identifying all possible failure modes that can result in a hazardous event. Once identified, we assess risk against the existing controls (Barriers), which we have in place for source protection within our water treatment plants and networks. This Barrier Assessment process highlights where there is a deficit or potential for future deficit in these controls or treatment process elements

The barriers are an internal gauge and the initial desktop assessments of barrier performance for SAG Clare are summarised in Table 2.1.

Table 2.1 Quality: Barrier Scores

Quality: Barrier Scores				
Water Treatment Plants	**Barrier 1: Bacteria & Virus**	**Barrier 2.1: Maintain chlorine Residual in the Network**	**Barrier 3 Protozoa (Crypto) Asset Potential**	**Barrier 6b THM's Leading Indicator**
Kinvara WTP	●	●	●	●
Gort WTP	●	●	●	●
Turlough WTP	●	●	●	●
Ballymacraven WTP	●	●	●	●
Killadysert WTP	●	●	●	●
Kilkeedy WTP	●	●	●	●
Carron (Termon Spring) WTP	●	●	●	●
Corrofin WTP	●	●	●	●

Quality: Barrier Scores				
Water Treatment Plants	**Barrier 1: Bacteria & Virus**	**Barrier 2.1: Maintain chlorine Residual in the Network**	**Barrier 3 Protozoa (Crypto) Asset Potential**	**Barrier 6b THM's Leading Indicator**
New Doolough WTP	●	●	●	●
Old Doolough WTP	●	●	●	●

Score	Irish Water Asset Standard Assessment	Priority
●	Low Risk	Low Priority Asset
●	Medium Risk	Priority 2 Asset
●		
●	High Risk	Priority 1 Asset

The colour coding within the outline assessment indicates the severity of the potential barrier deficit, and the priority in terms of addressing the identified issues. However, it should be noted that the table is not an indicator of non-compliance with the European Union (Drinking Water) Regulations 2014 as amended (Drinking Water Regulations), but an assessment of the asset capability standard compared with the asset standard set out in Section 5.7 of the Framework Plan.

Based on the barrier assessment, 7 of the 10 Water Treatment Plants in the Study Area appear to have significant deficits, particularly in relation to primary disinfection (Barrier 2.1). However, in some cases our desktop assessments can over-estimate risk, particularly when there is little available data on the catchment characteristics of our raw water sources. As our "Source to Tap" Drinking Water Safety Plan (DWSP) assessments are developed for each water supply, the barrier scores for all of our supplies will be updated and become more reliable.

It should be noted that the "quality need" identified through the Barrier Assessment is not an indicator of compliance with the Drinking Water Regulations. It is an assessment of the need to invest in areas of our asset base (human and structural) through resource planning, to ensure that we can address potential risks or emerging risks to our supplies.

At present, there are 3 WRZs within SAG on the Environmental Protection Agency (EPA) Remedial Action List (RAL), Corrofin, Ennistymon, and West Clare.

Irish Water is currently progressing immediate corrective action in advance of the NWRP for a number of supplies within SAG. A national programme to improve disinfection standards (Barrier 1) at water treatment facilities across Ireland was initiated by Irish Water in 2016. Details of the 'in progress' projects to address critical water quality requirements are included in Table 2.2.

Table 2.2 Critical Water Quality Requirements SAG – Clare

Critical Water Quality Requirements	Progress
1. Gort Regional Water Supply Scheme Irish Water has invested over €1.5 million to upgrade the Gort and Spiddal Regional Water Supply Schemes. This investment benefits over 14,000 customers to ensure that both treatment plants can meet demand for treated water in their areas, while also complying with the current drinking water regulations. As part of these works, the processes within the existing plants were assessed and upgraded in order to provide a robust flocculation, coagulation, filtration process and UV disinfection system. These upgrades were necessary to ensure a fit for purpose water supply for the area.	**Complete**
2. Corofin RAL proposed action Irish Water has invested over €2.5 million to fully upgrade the Water Treatment Plant at Corofin to ensure suitable water supply for Corofin and surrounding area. The upgrade comprises a full upgrade of the plant including a new DAF, pressure filters, GAC filter, UVs and sludge treatment works. The works are due for completion in Q2 2022	**Completion in 2022**
3. Ennistymon RAL proposed action An investment of €7m is to be made in Ballymacraven WTP. Ballymacraven currently serves a population of over 12,000 people in Ennistymon and surrounding areas. The upgrade will consist of new flash mixing, two stage flocculation tanks, upgrade to existing clarifiers and construction of a new clarifier, upgrade of primary filtration including new dual-media, backwash infrastructure and run to waste; upgrade of sludge thickening & dewatering assets and new lamella settlement of Used Wash Water; and replacement of ageing site electrics, control system, SCADA and telemetry systems. The project is currently at detailed design stage and is due to commence construction in Q3 '22.	**Commencing in 2022**
4. West Clare New Doolough WTP RAL proposed action An investment of over €7m has been made in New Doolough Water Treatment Plant. New Doolough serves a population of over 11,000 customers and some key industry in West Clare. The upgrade includes the replacement of the existing ageing inlet screen; new flash mixing, 2-stage flocculation tanks and upgrade of clarification with tubular settlers; upgrade of primary filtration including new media, dual-media, run to waste; upgrade to chemical dosing; upgrade of sludge thickening & dewatering assets and new lamella settlement of Used Wash Water; and replacement of ageing site electrics, control system, SCADA and telemetry systems. The project is currently ongoing and is due for completion in Q2 2022.	**Completion in 2022**
5. West Clare Old Doolough WTP RAL proposed action An upgrade is proposed at Old Doolough WTP to address the WQ and sludge management issues. This upgrade is in the optioneering stage and a detailed scope will be developed in 2022.	**Commencing in 2022**
6. Reservoir Cleaning Programme: A major reservoir cleaning programme has been undertaken at 2 sites, which has reduced network water quality issues.	**Complete**
7. Disinfection Programme: In 2016, Irish Water completed a nationwide review of all water treatment plants where disinfection upgrades were required, followed by a programme of works to deliver the required upgrades. To date, the disinfection programme has completed upgrade works at 8 of the 10 WRZs in SAG, based on assessed priority basis.	**Complete**

- Ballymacraven WTP
- Killadysert WTP
- Corrofin WTP
- Kilkeedy WTP
- Carron WTP (Termon Spring)
- New Doolough WTP
- Turlough WTP
- Old Doolough WTP

Any requirements within the remaining 2 supplies will be identified via Drinking Water Safety Plans with solutions developed as part of the NWRP.

In summary, in relation to water quality Irish Water will:

- Continually update Barrier Performance issues in the WRZ which have the potential to impact on drinking water quality in the region;
- Improve these assessments through the development of DWSPs for all of our supplies;
- Address the priority risks identified on the EPA Remedial Action List (noting that steps have already been taken, and are ongoing, to address these risks); and
- All residual need (grey dots) in relation to water quality will be brought through our options assessment process

2.2 Water Quantity – Supply Demand Balance

Irish Water assess the water quantity investment needs of our supplies by developing SDB calculations for each of our water supplies as summarised in Chapter 3, 4 and 6 of the Framework Plan. The calculations are used to assess the amount of water available in our supplies and compare that to the current and forecast demand for water in accordance with Figure 2.1.

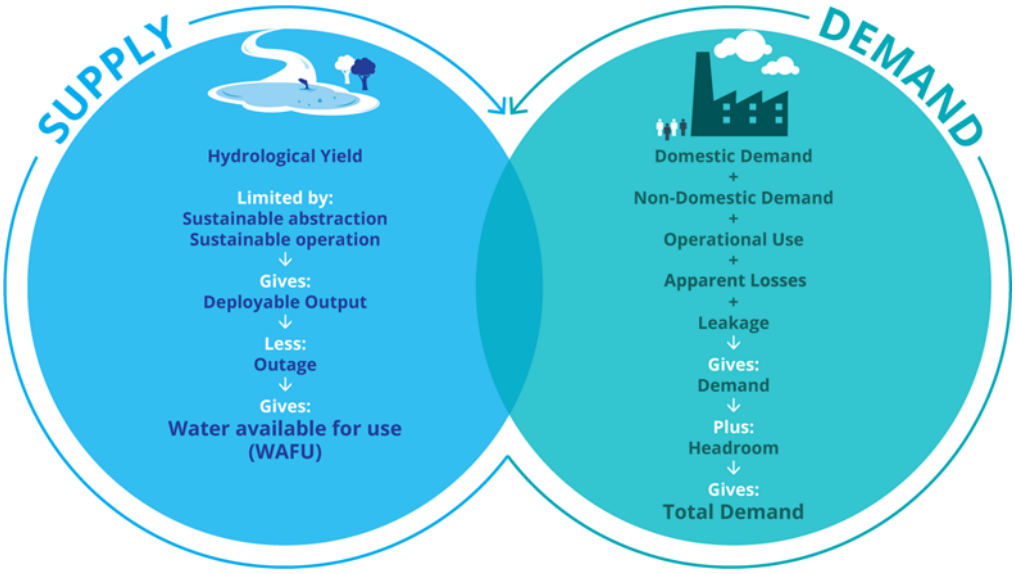


Figure 2.1 Supply Demand Balance

For each of the 9 WRZs in this Study Area, we assessed the baseline SDB and developed 25-year forecasts of supply and demand, in accordance with Figure 2.1.

The SDB assessments were carried out for each of the weather event planning scenarios (Normal Year Annual Average, Dry Year Annual Average, Dry Year Critical Period, Winter Critical Period) which described in Chapter 2 of the Framework Plan. The SDB deficits in SAG manifest in the following ways:

1. **Inappropriate standards and levels of risk for a strategic water supply**: As water supply is essential for public health, regulated water service providers must ensure appropriate standards of water supply which are able to endure drought conditions, peak events, and maintenance of our assets. This requires reserve capacity in our supplies. At present, not all supplies within this Study Area meet the required levels of reserve capacity. However, due to the lack of historical monitoring, particularly in relation to groundwater supplies, some of the deficits may be data driven.
2. **Day to day operations:** At present, 5 out of 9 of the WRZs in SAG have a current deficit and 6 out of 9 have a projected SDB deficit (based on a “do minimum” approach). However, under normal weather and demand conditions, this does not manifest as an interruption to supply for all WRZs. During recent dry periods, particularly the summer of 2018 and 2020 when water conservation orders were implemented, a number of the supplies in SAG were impacted. Several groundwater supplies were impacted along with surface water supplies including West Clare, where tankering to Moveen Reservoir has been required and Gort where sandbagging was required at the River Cannahowna source for a number of months. Tankering has also been required in recent years for the Carron supply.

A summary of the SDB deficit across all 9 WRZs is summarised in Table 2.3. The SDB for each WRZ is included in Appendix L of the Framework Plan.

The water resources zones are detailed in Appendix L of the Framework Plan - Supply Demand Balance Summaries.

Table 2.3 WRZ SDB Dry Year Critical Period Deficits

Water Resource Zone Name	Water Resource Zone code	Population	Maximum Deficit m^3/day					
			2019	2025	2030	2035	2040	2044
Kinvara P.S.	1200SC0023	2,240	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit
Gort	1200SC0016	2,840	-87	-107	-127	-147	-167	-183
Turlough	0300SC0022	415	-93	-99	-104	-109	-114	-118
Ennistymon	0300SC0021	6,841	-4,060	-3,680	-3,633	-3,789	-3,993	-4,157
Killadysert PWS	0300SC0013	1,508	-1,375	-1,376	-1,372	-1,398	-1,431	-1,458
Kilkeedy PWS	0300SC0005	76	No Deficit	No Deficit	No Deficit	0	-1	-1
Carron PWS	0300SC0004	54	-26	-27	-28	-29	-29	-29
Corrofin PWS	0300SC0003	1,199	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit
West Clare	0300SC0001	14,630	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit

As outlined in Chapter 4 of the Framework Plan, the estimated population currently living in each WRZ has been based on the 2016 Census data. Forecasts for future populations have been based on draft growth projections from the National Planning Framework (NPF), and updated information from the Regional Spatial and Economic Strategies (RSES) and Local Authority Planning sections (where available).

The target levels of service in the region were applied in each case, along with the corresponding requirements for reserves, indicating that our supplies are operating with a cumulative SDB deficit of approximately 5,641m^3/day for the Study Area. As a result, while we can continue to supply water, the water supplies in this area may come under pressure, particularly in drought conditions. In addition, there may be ongoing reliability issues.

This situation will further deteriorate over time due to climate change driven reductions in water resources, together with increased demand due to population growth. If we do nothing, the SDB deficit is estimated to increase to approximately 5,946 m^3/day by 2044.

Our ongoing activities to improve the Supply Demand Balance in SAG Clare are prioritised as:

- Ongoing leakage management including active leakage control, pressure management and find and fix activities to meet target levels of Leakage
- Water Conservation measures, including information campaigns and initiatives, and Water Conservation Orders during drought periods

2.3 Water Supply Reliability

The benefits of having sufficient water supplies in terms of quality and quantity are negated if we cannot distribute the water we produce effectively around our networks. We also need sufficient treated water storage to enable us to respond to planned or unplanned outages on our trunk main and distribution networks.

There are a number of problematic distribution and trunk mains throughout SAG. Irish Water & the Local Authority Water Services sections will continue to monitor the performance of all water mains in the network to ensure that the most problematic mains are replaced as required.

During the drought in summer 2018, several raw water sources experienced issues; raw water levels dropped significantly at surface water abstraction at Gort WTP where the river was sandbagged and at groundwater source at Carron WTP (Termon Spring). In these locations service interventions were required in order to ensure supply to customers could be maintained. Ballymacraven WTP and New Doolough WTP were also identified as at risk of potential drought.

During our needs assessment for SAG, Irish Water has identified a number of critical requirements for upgrades to the existing asset base, including storage and trunk main requirements. Progress to date on these projects is summarised in Table 2.4.

Table 2.4 SAG Critical Infrastructure Projects and Need Identification

Critical Requirement	Progress
1. Carran PWS Poor yield during DYCP demands. Tankering required during dry summers. TW drilled in 1980s with potential yield of 1Ml/d. A project is currently progressing to carry out borehole rehabilitation works.	**In Progress**
2. Ballymacraven WTP A project is currently near completion upgrading the existing Ballymacraven WTP to resolve quantity issues along with water quality purposes.	**In Progress**
3. New Doolough WTP A project has recently been completed upgrading the existing New Doolough WTP to resolve quantity issues along with water quality purposes.	**Completed 2022**
4. Distribution Network Repairs and Upgrades: Rolling programme of active leakage control, pressure management, find and fix and network upgrades	**In Progress**

In summary, there are some asset reliability issues across the distribution network within the WRZ. Some critical infrastructural projects, outlined in Table 2.4, to address these issues have been identified and are in progress. In addition to this, a continuous programme of repairs, upgrades and leakage reduction is being progressed as part of Irish Waters National Leakage Reduction Programme across all Study Areas.

2.4 Water Supply Sustainability

The water supplies within the region were developed over time to address the needs of the local populations and to support growth and development. Most of these supplies predate most modern environmental legislation and none of our current abstractions in this area were developed through any formalised abstraction process.

As outlined at Section 3.7.2 of the Framework Plan, the Government is currently developing new legislation dealing with water abstractions. As this legislation is still being developed, we do not have full visibility of the future regulatory regime. We have therefore not progressed through a theoretical licencing process on a site by site basis and cannot reliably include an estimation of sustainable abstraction within the SDB calculations. Instead, we use the hydrological yield, water treatment capacity and bulk transfer limitations in our calculation of DO. This assessment procedure is set out at Appendix C of the Framework Plan, and in line with a precautionary approach.

To understand the potential impact of the Abstraction Legislation on the SAG supplies, we have assessed the potential impacts on our 6 no. surface water abstractions: Cannahawna River (Gort), Lickeen Lake (Ennistymon), Gortglass Lough (Killadysert PWS), Lough Inchiquin (Corrofin PWS), and Doo Lough (West Clare, no.2 abstractions).

Table 2.5 presents the findings of this assessment in order to indicate the potential reductions to abstraction that may be required at our existing surface water supplies and the potential changes to our

SDB. The table presents our current abstraction levels[1], our source hydrological yield[2], the estimated sustainable abstraction[3] amount which the source may be limited to in the future.

Based on this initial assessment, the volumes of water abstracted at Lickeen Lake (Ennistymon), Gortglass Lough (Killadysert PWS), and Doo Lough (West Clare, no.2 abstractions) may not meet sustainability guidelines during dry weather flows. However, under the proposed regulatory regime, this will be adjudicated by the EPA. We have assumed, given the need to maintain supplies, that a transition to new abstraction quantities would likely take place in the medium term.

Table 2.5 shows the West Clare WRZ could have the most significant impact to SDB based on the potential sustainability reductions for the Doo Lough abstraction source. However, it is assumed that under the new regulatory regime the existing historical abstraction licence conditions (up to 40,000 m^3/d) may be preserved, allowing the current abstraction rates to be maintained and additionally for the source to be potentially developed to meet future projected deficits. This assumption is based on the existing licence as well as the source being a critical asset and of strategic importance for the current and future water supplies for the region. Additionally, the impounding reservoir source is classified by the EPA as a heavily modified water body (HMWB), with mitigation measures in place including a fish pass constructed as part of the dam structure, and compensation flow releases required to the downstream in order to comply with WFD objectives.

Table 2.5 Comparison of Current Abstraction, Hydrological Yield and Theoretical Future Abstraction

Source (WRZ)	Current abstraction (m^3/day)	Hydrological yield (m^3/day)	Theoretical future abstraction limit (m^3/day)
Cannahawna River (Gort)	1,320	10,143	3,321
Lickeen Lake (Ennistymon)	4,354	4,851	1,077
Gortglass Lough (Killadysert PWS)	1,375	522	173
Lough Inchiquin (Corrofin PWS)	660	28,571	22,852
Doo Lough, New WTP (West Clare)	4,583	30,986	2,561
Doo Lough, Old WTP (West Clare)	15,107	30,986	2,561

The potential change to the SDB for each WRZ, as a result of these potential reductions in abstraction during Dry Weather Flow are summarised in Table 2.6.

[1] Based on WTP 22hr (DYCP) capacity
[2] Our hydrological yield estimate is the 'safe' yield calculated to be available during a 1 in 50 year drought event. We use this figure in the SDB calculations to determine whether a WRZ is projected to be in deficit or surplus
[3] Our sustainable or 'allowable' abstraction estimate is based on limiting abstraction to 5-15% of the Q95 low flow for river sources or 10% of Q50 inflow for lakes. This is based on our best understanding of how the EPA may enforce future abstraction licencing applying UKTAG guidance.

Table 2.6 Potential Change to SDB Based on Potential Abstraction Reductions

Source (WRZ)	Potential change in SDB[4] (m^3/day)
Cannahawna River (Gort)	None
Lickeen Lake (Ennistymon)	-3,400
Gortglass Lough (Killadysert PWS)	-285
Lough Inchiquin (Corrofin PWS)	None
Doo Lough, New WTP (West Clare)	-13,730
Doo Lough, Old WTP (West Clare)	

The net impact of these potential minimum environmental flow requirements has been assessed using the outline assessment methodology described in Appendix C of the Framework Plan. Groundwater abstractions will need to conform to the proposed new abstraction licencing regime. These abstractions will be assessed in two ways:

- Impacts on the groundwater bodies from which they abstract; and
- Impact of the groundwater abstraction on the base flow in surface waterbodies.

As noted in Section 3.2.2 of the Framework Plan, producing robust desktop assessments of water availability from our existing groundwater abstractions is very difficult. Ideally, yield estimates would be based on a three-dimensional assessment of the geology within the vicinity of the supply, supplemented with long term records on pumping and drawdown of water levels over many years. Irish Water does not have this type of information available for most of our groundwater supplies and while we will aim to complete site-specific studies of groundwater availability, this may take many years.

On an interim basis Irish Water has developed an initial assessment for existing abstractions based on best available information. For more information, please see Appendix C Supply Assessment and Appendix G Regulatory and Licensing Constraints of the NWRP - Framework Plan. Over the coming years, Irish Water will work with the environmental regulator EPA and the Geological Survey of Ireland, to develop desktop and site investigation systems to better understand the sustainability of our groundwater sources. We are not in a position to estimate changes to the groundwater availability until better data is available.

In summary, when considering the requirements of the Water Framework Directive (WFD), some of our schemes may be subject to reductions in abstraction, especially during drought periods. While we have developed a potential understanding of the impact of the legislation, we cannot reliably include an estimation of sustainable abstraction within the SDB calculations.

However, we do use our sustainable abstraction estimations to assess the sensitivity of the Preferred Approach as set out in Chapter 7 of this Technical Report. This assessment determines whether the Preferred Approach is adaptable to change across a range of potential future scenarios and verifies our ability to adapt and increases our resilience to future changes.

When the new Legislation on abstraction of water has been enacted and regulatory assessments completed if an abstraction is confirmed to be affecting a waterbody status the Supply Demand Balance will be updated as outlined in the monitoring and feedback section of the draft RWRP, Section 9.2.2. All

[4] Based on the potential changes to the projected WRZ supply demand balance (SDB) figure for the dry year critical period (DYCP) 2044 future scenario.

future abstractions considered through the Framework Plan options assessment are validated for sustainability, including options to increase abstraction at existing sites.

2.5 Water Resource Zone Needs Summary

Study Area G has issues in relation to quality, quantity, reliability and sustainability which must be addressed as part of the Preferred Approach to future water resources planning, summarised in Table 2.7.

Table 2.7 Summary of Need Quality, Quantity, Reliability, Sustainability

Quality	Upgrades required to water treatment plants
Quantity	Nett leakage reduction 231 m³/day in the region Additional Leakage Targets of 9,156 m³/day to achieve SELL and reduce leakage levels to 21% of demand in WRZs with demand in excess of 1,500 m³/day Interim additional supplies of 5,641m³/day within 10 years Total of 5,946m³/day additional supplies beyond the 10 year horizon
Reliability (In addition to projects in	Continued network upgrades and improvements in the bulk and distribution networks and storage
Sustainability	It is not envisaged that there are sustainability issues with the volumes abstracted at Cannahawna River (Gort), and Lough Inchiquin (Corrofin PWS). Based on this initial assessment, the volumes of water abstracted at Lickeen Lake (Ennistymon), Gortglass Lough (Killadysert PWS), and Doo Lough (West Clare, no.2 abstractions) may not meet sustainability guidelines during dry weather flows. However, under the proposed regulatory regime, this will be adjudicated by the EPA. Over the coming years, Irish Water will work with the environmental regulator EPA and the Geological Survey of Ireland, to develop desktop and site investigation systems to better understand the sustainability of our groundwater sources.

All of these needs will be considered within our options assessment process and in the development of the Preferred Approach.

Further details of planned, live and recently completed projects are available on our website see: https://www.water.ie/projects-plans/our-projects/

3

Solution Types Considered in Study Area G

3 Solution Types Considered in Study Area G

In this chapter, we summarise the type of solutions we have considered to address identified need for treated drinking water supply in Study Area G.

Lose Less, **Use Less** and **Supply Smarter** in forming our list of unconstrained options, which are assessed for short, medium and long-term solutions. For SAG as part of our unconstrained options, the following options have been reviewed.

3.1 Leakage Reduction

The Leakage reduction measures across the public water supply considered for SAG are based on what we assess to be both achievable and sustainable and include:

- Ongoing leakage management, including active leakage control, pressure management and Find and Fix activities, to offset Natural Rate of Leakage Rise (NRR); and
- Net leakage reductions targets listed in Table 3.1 have been applied to SDB deficit to move towards achieving the national Sustainable Economic Level of Leakage (SELL) target prioritised based on
    - Supply demand deficit;
    - Existing abstractions with sustainability issues; and
    - Drought impacts.
- Additional leakage targets to achieve SELL and reduce leakage levels to 21% of demand in WRZs with demand in excess of 1,500m^3/day, see Table 3.1.

Table 3.1 SELL Targets for WRZ in SAG

WRZ	Net Leakage Reduction applied to SDB (m^3/day)	Additional leakage Targets to achieve SELL and reduce leakage levels to 21% of demand in WRZs with demand in excess of 1,500m^3/day (m^3/day)	Total Leakage Targets (m^3/day)
West Clare		5,569	5,569
Carron PWS		4	4
Kilkeedy PWS		23	23
Killadysert PWS		432	432
Ennistymon	231	2,918	3,149
Turlough		73	73
Kinvara P.S.		137	137

3.2 Water Conservation

At present, Irish Water is conducting pilot studies in relation to water conservation stewardship in businesses and is actively pursuing Conservation Education Awareness Campaigns and partnerships. During drought conditions in 2018 and 2020, a Water Conservation Order was implemented in order to protect our water supplies and reduce pressure on the natural environment during this period. We will continue to promote 'Water Conservation Activities', collecting and monitoring data over a number of years to assess the benefits. As part of the NWRP – Framework Plan, we have not applied reductions to the SDB deficit for unquantifiable water conservation gains, however as stipulated within the Consultation Report prepared in relation to the NWRP- Framework Plan, IW will progress pilot studies on water conservation measures. Based on the outcomes of these studies, we may include such factors in future iterations of our NWRP. However, we do assume that any gain will offset consumer usage growth factors.

3.3 Supply Smarter

The supply options considered as part of the options development are unconstrained by distance from SAG and include:

- Stand-alone groundwater options, across the region
- Stand-alone surface water options, across the region
- Transfers
- Rationalisations
- Water Treatment Plant Upgrades for water quality purposes
- Advanced Leakage Reductions
- Reservoirs
- Other

4 Option Development SAG

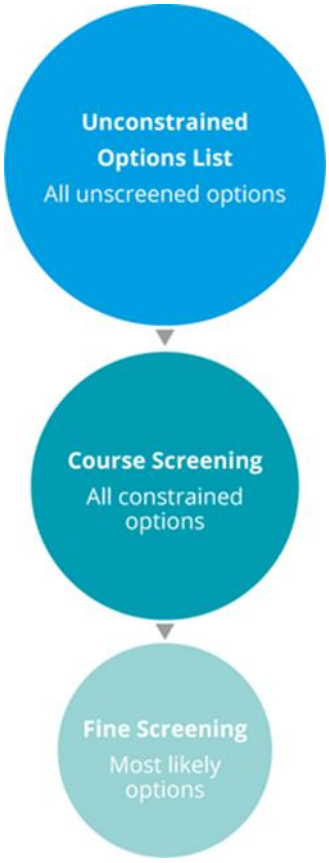
4 Option Development for Study Area G

This chapter describes how our options assessment methodology was applied to produce a Feasible Options list to meet the identified needs.

The purpose of our options assessment process, as outlined in Chapter 8 of the Framework Plan, is to consider the widest practicable range of solutions to resolve identified need within a given area. A suitable screening criterion is then applied to filter out any options that are not feasible, based on sustainability (environmental and social impacts), resilience or deliverability. As sustainability is at the heart of our plan, environmental and social assessment criteria are included at the earliest stages of the screening process. At the outset of the process, some fundamental rules are applied even before screening begins to ensure the protection of the environment. For example, having regard to WFD objectives, Irish Water does not allow for any inter-catchment raw water transfers due to the high risk of transferring invasive non-native species (INNS) between catchments and non-compliance with WFD objectives.

The options assessment screening process involves the following:

- Developing a long list of unconstrained options – the maximum possible list of unscreened options for water supply, not limited by cost or feasibility;
- Coarse Screening – We filter the unconstrained options using a coarse screening assessment where we remove any options that fail to meet desktop assessment criteria under: Resilience, Deliverability and Flexibility or Sustainability (Environmental and Social Impacts); and
- Fine Screening – We filter the remaining options from the coarse screening exercise through a fine screening assessment, which includes 33 detailed questions, related to environmental objectives identified for the SEA (including biodiversity, the water environment and requirements under climate change adaptation) as well as Resilience, Deliverability and Progressibility.



The coarse screening and fine screening questions, and the associated scoring criteria, are included in Chapter 3 and Appendix A of the Study Area Environmental Report.

4.1 Developing a List of Unconstrained Options

At the start of our screening process, we conduct a specialist desktop review of groundwater bodies and surface water catchments. This allows us to understand potential additional availability at existing water abstractions or to identify any potential new water sources within the Study Area; as summarised in Table 4.1.

Table 4.1 Desktop Assessments for Unconstrained Options

Existing and New Ground Water sources	A Hydrogeologist conducts a desktop groundwater availability assessment of all potential aquifers and aquitards within, and within a reasonable distance of, the study area.
Existing and New Surface Water sources and Conjunctive Use Options	A Hydrologist carries out a desktop surface water availability assessment of all potential catchments and waterbodies within, and within a reasonable distance of, the study area.
Water Treatment upgrades, Desalination, Rationalisation and Effluent Reuse Options	An Engineer reviews any potential increases in capacity at existing water treatment sites and any potential conjunctive use or effluent reuse options.

Based on these desktop assessments, Irish Water developed an initial list of unconstrained options for new supplies and increases and upgrades to existing supplies and assets. An unconstrained options review workshop was then held with our Local Authority Partners to identify any additional unconstrained options that may be available based on local knowledge. A total list of unconstrained options was then compiled.

For SAG, 80 Unconstrained Options were identified to address need. These unconstrained options were not limited by cost, distance from the area or feasibility. These options are summarised in Table 4.2 and shown spatially in Figure 4.1.

Table 4.2 SAG Unconstrained Options

No. of Options	Option Type
23	Groundwater
19	Surface Water
17	Transfers
15	Rationalisation
1	Advanced Leakage Reduction
2	Upgrade WTP (WQ only)
1	Reservoirs
2	Other

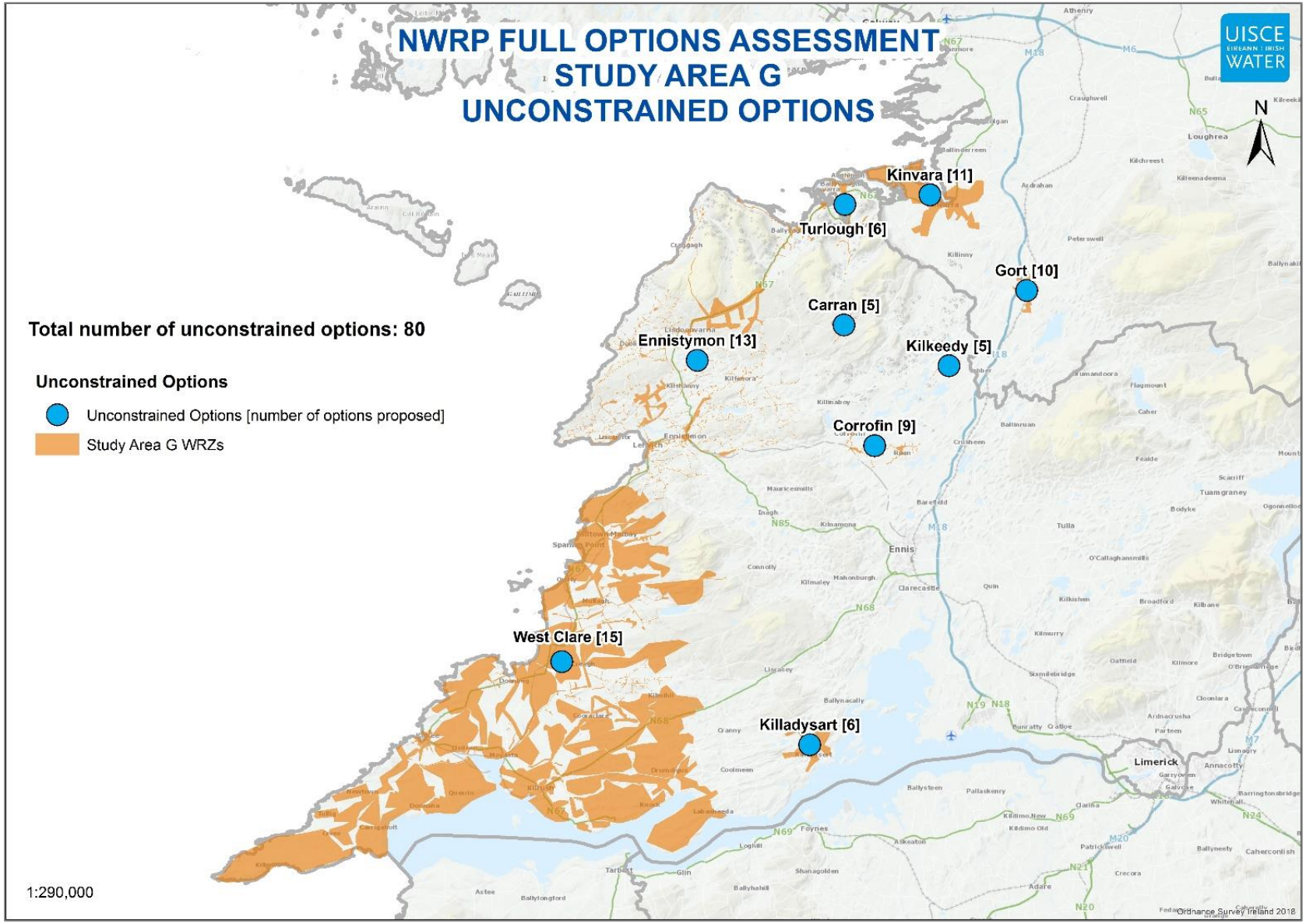


Figure 4.1 SAG Unconstrained Options

The 80 options were filtered through our screening process to eliminate those with potentially unviable environmental impacts or feasibility issues. This process is summarised below.

4.2 Coarse Screening

The 80 identified Unconstrained Options were assessed through Coarse Screening against the criteria of:

- Resilience;
- Deliverability and Flexibility; and
- Sustainability (Environmental and Social Impacts).

The Course Screening process is summarised in Chapter 8 of the Framework Plan. The coarse screening assessments were conducted by a specialist team, including Engineers, Hydrologists and, Hydrogeologists, Ecologists, and Environmental Scientists.

44 Unconstrained Options were rejected at this stage as they were found to be unviable in relation to one or more assessment criteria. Details of these options and the justification for their rejection are outlined in the rejection summary, Annex B of this report. The rejection summary records the criteria against which the rejected options were assessed as having a 'red' score for the purposes of the coarse screening exercise (as explained in more detail in Chapter 8 of the framework plan), and accordingly were not brought forward at the coarse screening phase. The box below provides an example of a rejection justification for an option considered for a Killadysert PWS WRZ in study area G.

Example Rejected Option

Option SAG-08

Interconnect Killadysart PWS and Lissycasey GWS and supply partial deficit from Liscasey GWS (network upgrades required)

Rejection Reason

No scope to increase from Lough Acrow based on allowable abstraction (10% Q50) estimate. Very small lake source (c/a <1km2).

The remaining 36 options were progressed to further assessment through the Fine Screening process. The rejected options are summarised in Annex A of this technical report. Annex A records the criteria against which the rejected options were assessed as having a "red" score for the purposes of the coarse screening exercise (as explained in more detail in Chapter 8 of the Framework Plan), and accordingly were not brought forward at the coarse screening stage. The options remaining after Coarse Screening are summarised by type in Table 4.3.

Table 4.3 SAG Remaining Options after Course Screening

No. of Options	Option Type
13	Groundwater
10	Surface Water
4	Transfers
8	Rationalisation
1	Upgrade WTP (WQ only)

4.3 Fine Screening

The 36 remaining options were subject to a more detailed multi-criteria assessment (MCA) at the Fine Screening Stage using desktop assessments of performance against 33 specified questions relating to Sustainability (Environmental and Social Impacts), Resilience, Deliverability and Progressibility. These questions are set out in Appendix N of the Framework Plan. The assessment for each option was based on an objective assessment with uniform scoring criteria, based on best publicly available datasets.

At Fine Screening stage, no further options were rejected, with the remaining 36 options considered to be feasible and brought forward to desktop outline design and costing. These are summarised in Table and shown spatially in Figure 4.2.

Table 4.4 SAG Remaining Options after Fine Screening (Feasible Options)

No. of Options	Option Type
13	Groundwater
10	Surface Water
4	Transfers
8	Rationalisation
1	Upgrade WTP (WQ upgrade)

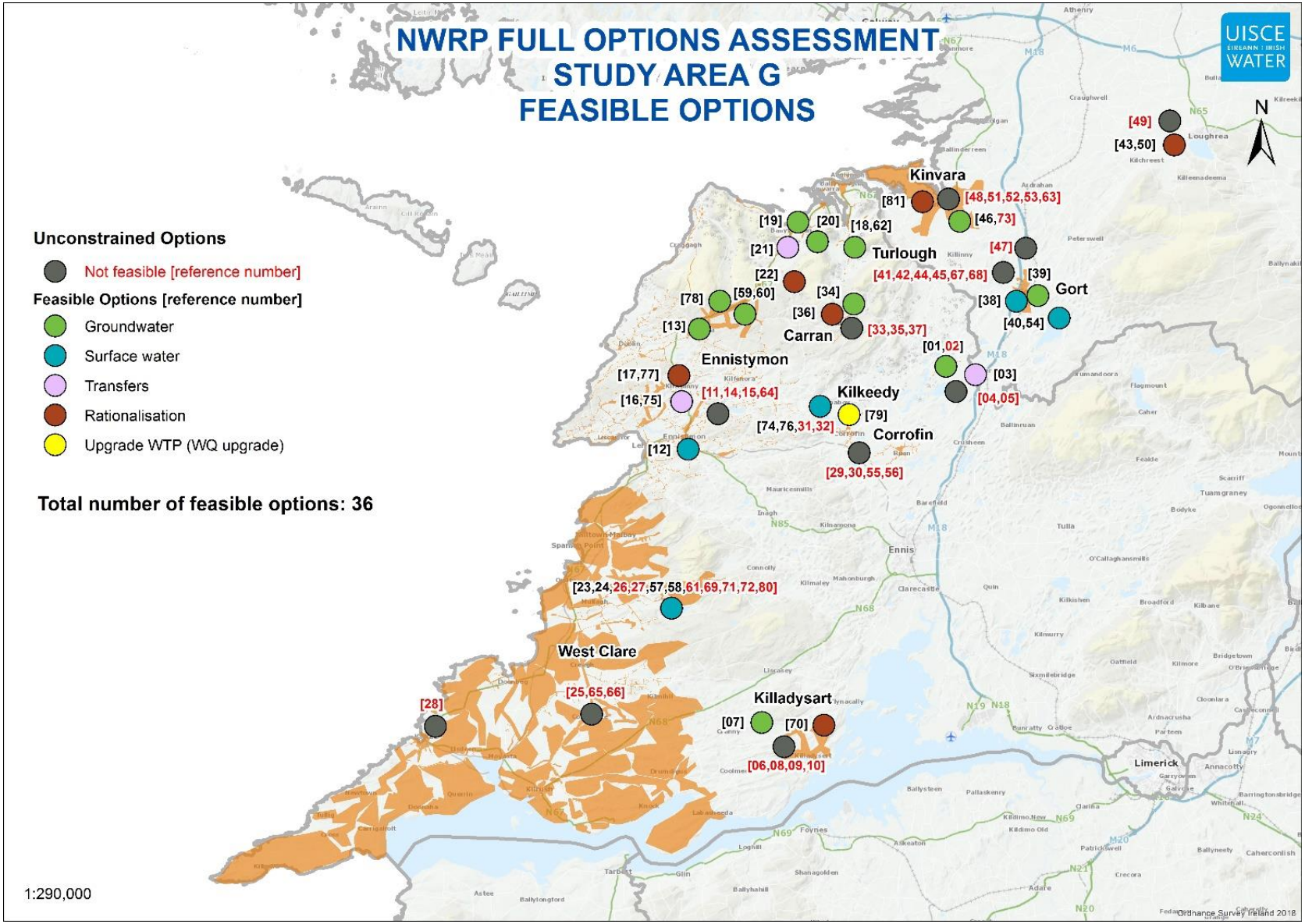


Figure 4.1 SAG Spatial Overview of the Feasible Options

4.4 Options Assessment Summary

The SDB deficit in the region ranges between 5,641 m^3/day in 2019 during normal conditions, to a maximum of 5,946 m^3/day in 2044 during dry conditions. During the options assessment stage, a total of 80 unconstrained options were assessed. Of these, 44 options were screened out for the reasons summarised in Table 4.5 and recorded in Annex B.

Table 4.5 Rejected Options Summary

No. of Options	Reason for Rejection
19	Resilience, Deliverability & Flexibility, Sustainability
6	Deliverability & Flexibility
19	Other

The remaining 36 feasible options, are categorised into options that resolve the need for one WRZ only "WRZ options" and options that resolved the need for more than one WRZ "Study Area options". Table 4.6 provides an overview of the number of WRZ options and Study Area options for the WRZs in Study Area G. From this table it can be noted that there are 18 WRZ Options and 18 options which can be merged to form 9 Study Area Options.

A summary of the number of options and whether they are WRZ or SA options is contained in Table 4.6.

Table 4.6 SAG Feasible Options Summary

Water Resource Zone Name	Option Type	
	WRZ Option	SA Grouped Option
Carran PWS	1	1
Corrofin PWS	1	2
Ennistymon	3	6
Gort	4	1
Kilkeedy PWS	2	0
Killadysert PWS	1	1
Kinvara	2	1
Turlough	3	3
West Clare	1	3

5 Approach Development

5 Approach Development

This chapter describes how we tested different combinations of the Feasible Options to develop a Preferred Approach to meet the needs we identified for the WRZ in Study Area G.

5.1 Approach Development

5.1.1 Introduction to Approach Development

The purpose of the NWRP is to examine all potential options that could be used to resolve issues within the water resource zone (unconstrained options) and then to eliminate those that are not feasible or that have identifiable environmental issues at a desktop level (options assessment screening). Of the remaining feasible options Irish Water's next step is to assess a number of approaches to resolve need across the Study Area. An approach is a way of configuring an option or options to meet the deficit focused on a particular outcome. For example, a "Least Carbon" approach would be the option or combination of options that would involve the least embodied and operational carbon load over the lifetime of the option. As part of the NWRP, Irish Water considers six approaches, as summarised in Table 5.1.

These six approaches have been outlined at Section 8.3.7 of the Framework Plan, and were consulted on as part of the SEA Scoping consultation conducted between 9th November 2017 and 22nd December 2017. These approaches have been specifically chosen to ensure that the NWRP aligns with all the relevant Government Policies outlined in Table 5.1.

Table 5.1 The Six Approaches

Approaches Tested	Description	Policy Driver
Least Cost	Lowest Net Present Value (NPV) cost in terms of Capital, Operational, Environmental and Social and Carbon Costs.	Public Spending Code
Best Appropriate Assessment (AA)	Lowest score against the European Sites (Biodiversity) sub-criteria question: Score = 0 equates to no likely significant effects (LSEs). If, in our opinion, these 0 scoring options meet the deficit/ plan objectives, they are automatically picked as the Preferred Approach. Score = -1 or -2 equates to LSEs that can be addressed with general/standard mitigation measures. Score = -3 equates to LSEs that may be harder to mitigate or require significant project level assessment.	Habitats Directive
Quickest Delivery	Based on an estimate of the time taken to bring an option into operation (including typical	Statutory Obligations under the Water Supply

Approaches Tested	Description	Policy Driver
	feasibility, consent, construction and commissioning durations) as identified at Fine Screening This is particularly relevant where an option might be required to address an urgent Public Health issue.	Act and Drinking Water Regulations
Best Environmental	This is the option or combination of options with the highest total score across the 19 No. SEA MCA sub-criteria questions	SEA Directive and Water Framework Directive
Most Resilient	This is the option or combination of options with the highest total score against the resilience criteria.	National Adaptation Framework and Climate Action Plan
Lowest Carbon	This is the option or combination of options with the lowest embodied and operational carbon cost.	Climate Action Plan

We then compare the options identified as the best performing within each of the six approach criteria (Least Cost, Best AA, Lowest Carbon etc.) against each other as outlined in Figure 5.1 to come up with a Preferred Approach that meets the objectives of the Framework Plan and aligns with all relevant Government Policy.

STEP 0 Best AA	If there is an option that meets the Objectives of the Plan, and is assessed as having no potential impact on a European Site (based on desktop assessment), it is automatically adopted as the Preferred Approach
STEP 1 Least Cost	Compare Least Cost against **best AA** Approach, and consider again at Step 6
STEP 2 Quickest Delivery	Compare Least Cost against Quickest Delivery Approach and develop Modified Approach if appropriate
STEP 3 Best Environmental	Compare Least Cost or Modified Approach against Best Environmental, and modify approach **if appropriate**
STEP 4 Most Resilient	Compare Least Cost or Modified Approach against Most Resilient
STEP 5 Least Carbon	Compare Least Cost or Modified Approach against **Lowest** Carbon
STEP 6 Approach Comparison	Compare output from Steps 1 to 5 against: • SEA required outcomes • Sectoral Adaptation Outcomes • **Best AA outcomes** • Public Expenditure Code Outcomes
STEP 7 Preferred Approach	Select Preferred Approach based on steps 0 to 6

Figure 5.1 Figure of the 7 step assessment process

This methodology which is further detailed in Chapter 7 of the draft RWRP - NW follows a process to develop the Preferred Approach for a Study Area across three stages;

- **Stage 1** – We assess the water resource zones individually to develop an initial Preferred Approach, the **WRZ Preferred Approach** for all of the supplies in the Study Area
- **Stage 2** – We assess whether there are any larger options that might resolve deficits across multiple WRZs within a Study Area. We then develop combinations of these options (SA Combinations).
- **Stage 3** – We assess the SA Combinations and the WRZ Level approach in order to determine the best performing combination. This is known as the Preferred Approach at SA Level.

At each stage of assessment as detailed above, we carry out an assessment of the cumulative and in-combination effects of the Preferred Approach as detailed in the SEA Environmental Report for the RWRP-NW and the Environmental Review for this Study Area.

Within the Regional Plan, we will examine the Preferred Approach at a third spatial level across all of the Study Areas in the North West Region and will make any required changes in order to develop a Preferred Approach across the entire Region.

Further details on these three stages are provided in Chapter 7 of the draft RWRP -NW. Section 5.2 provides an overview of the application of this process to SAG.

5.2 Preferred Approach Development Process for Study Area G

5.2.1 Stage 1 – WRZ Level Approach

As outlined in Section 4.4 of this technical report there are 36 feasible options. 18 of these options are WRZ Options while 18 options are merged to form 9 Study Area Options. Table 5.2 outlines the 18 WRZ options for SAG, providing option reference numbers and detailing the WRZs they provide a solution to. These solutions are presented as "Options" for the purposes of this plan; however, will be subject to their own regulatory, timing and budgetary constraints.

Table 5.2 SAG Feasible Options

Water Resource Zone Name	Feasible Options SAG	
	Option Code	Option Description
Carran PWS	SAG-034	Increase abstraction at Carran spring (Burren groundwater body - karstic bedrock) and upgrade Carran WTP.
Corrofin PWS	SAG-079	No deficit - upgrade WTP.
Ennistymon	SAG-012	New SW abstraction from River Inagh to partly supply deficit, upgrade existing WTP/new WTP.
Ennistymon	SAG-013	New GW from St Brendan's Well and/or Oughtdarra Spring and new WTP to partly supply deficit. Possibly combine with increasing abstraction from Killeany Spring and/or Ballyvaughan.
Ennistymon	SAG-078	Increase existing GW abstraction from Killeany Spring to meet partial deficit.
Gort	SAG-038	Increase SW abstraction from existing River Cannahowna source - river engineering.
Gort	SAG-039	Increase existing GW abstraction from boreholes (poorly productive bedrock - Caherglassaun Turlough groundwater body).
Gort	SAG-040	New SW abstraction from Lough Cutra and new WTP. Abandon existing river abstraction d/s of lake.
Gort	SAG-043	Rationalise Gort WRZ to Galway WRZ via Loughrea WRZ (new source required).
Kilkeedy PWS	SAG-001	Increase abstraction at Kilkeedy BH (Lough Mannagh Turlough groundwater body - karstic bedrock) and upgrade Kilkeedy WTP to supply deficit.
Kilkeedy PWS	SAG-003	Interconnect Kilkeedy PWS and Tubber GWS to supply deficit from Tubber GWS (approx. distance 3km, new watermains and network upgrades required).
Killadysart PWS	SAG-007	New GW abstraction to partly meet supply and new WTP.
Kinvara	SAG-046	Increase existing GW abstraction from Kinvara Well (karstic bedrock - Kinvara-Gort groundwater body) - saline intrusion.
Kinvara	SAG-050	Rationalise Kinvara WRZ to Lough Corrib WRZ (Galway City, Tuam, Loughrea) in SA-D to supply full demand.
Turlough	SAG-018	Increase GW abstraction from Turlough BH (Ballyvaughan Uplands groundwater body - karstic bedrock) and upgrade Turlough WTP.
Turlough	SAG-019	New GW abstraction from Ballyvaughan PWS.
Turlough	SAG-020	New abstraction from Akers spring in Ballyvaughan to supply deficit.
West Clare	SAG-024	Increase abstraction from Doo Lough and upgrade existing New Doolough WTP. Rationalise Old Doolough WTP.

The WRZ options are then assessed against the six approach types, outlined in Table 5.1 and the result of this process is provided in Table 5.3.

Table 5.3 SAG Alignment of WRZ Options with Approach Categories

Water Resource Zone Name	Feasible Options SAF		Approach					
	Option Code	Option Description	Least Cost	Quickest Delivery	Best AA	Best SEA	Lowest Carbon	Most Resilient
Carran PWS	SAG-034	Increase abstraction at Carran spring (Burren groundwater body - karstic bedrock) and upgrade Carran WTP.	✓	✓	✓	✓	✓	✓
Corrofin PWS	SAG-079	No deficit - upgrade WTP.	✓	✓	✓	✓	✓	✓
Ennistymon	SAG-012	New SW abstraction from River Inagh to partly supply deficit, upgrade existing WTP/new WTP.	✓	✓	✓	-	✓	✓
Ennistymon	SAG-013	New GW from St Brendan's Well and/or Oughtdarra Spring and new WTP to partly supply deficit. Possibly combine with increasing abstraction from Killeany Spring and/or Ballyvaughan.	✓	✓	✓	-	✓	✓
Ennistymon	SAG-078	Increase existing GW abstraction from Killeany Spring to meet partial deficit.	-	-	✓	-	-	-
Gort	SAG-038	Increase SW abstraction from existing River Cannahowna source - river engineering.	-	-	-	✓	-	-
Gort	SAG-039	Increase existing GW abstraction from boreholes (poorly productive bedrock - Caherglassaun Turlough groundwater body).	✓	-	✓	-	✓	-
Gort	SAG-040	New SW abstraction from Lough Cutra and new WTP. Abandon existing river abstraction d/s of lake.	-	-	-	-	-	✓
Gort	SAG-043	Rationalise Gort WRZ to Galway WRZ via Loughrea WRZ (new source required).	-	✓	-	-	-	✓
Kilkeedy PWS	SAG-001	Increase abstraction at Kilkeedy BH (Lough Mannagh Turlough groundwater body - karstic bedrock) and upgrade Kilkeedy WTP to supply deficit.	✓	-	✓	✓	✓	✓
Kilkeedy PWS	SAG-003	Interconnect Kilkeedy PWS and Tubber GWS to supply deficit from Tubber GWS (approx. distance 3km, new watermains and network upgrades required).	-	✓	✓	-	-	✓
Killadysart PWS	SAG-007	New GW abstraction to partly meet supply and new WTP.	✓	✓	✓	✓	✓	✓
Kinvara	SAG-046	Increase existing GW abstraction from Kinvara Well (karstic bedrock - Kinvara-Gort groundwater body) - saline intrusion.	✓	-	✓	-	-	-

Kinvara	SAG-050	Rationalise Kinvara WRZ to Lough Corrib WRZ (Galway City, Tuam, Loughrea) in SA-D to supply full demand.	-	✓	-	✓	✓	✓
Turlough	SAG-018	Increase GW abstraction from Turlough BH (Ballyvaughan Uplands groundwater body - karstic bedrock) and upgrade Turlough WTP.	✓	-	✓	✓	✓	✓
Turlough	SAG-019	New GW abstraction from Ballyvaughan PWS.	-	✓	✓	-	-	✓
Turlough	SAG-020	New abstraction from Akers spring in Ballyvaughan to supply deficit .	-	-	-	-	-	-
West Clare	SAG-024	Increase abstraction from Doo Lough and upgrade existing New Doolough WTP. Rationalise Old Doolough WTP.	✓	✓	✓	✓	✓	✓

The 7 Step Process outlined in Figure 5.1 was then applied to each WRZ in SAG, in order to develop a WRZ level approach. A summary of the outcome of this assessment at WRZ level (i.e. WRZ options only) is shown in Table 5.4

The findings of the Preferred Approach Development for SAG at WRZ level, include the following:

- In terms of Best AA, no WRZ option scores a 0 in relation to potential impact on a designated European Site;
- The Best AA and the Best Environmental (overall SEA score) approach is identified as the Preferred Approach for 6 of the 9 WRZs;
- 2 WRZ options have a -3 AA score against the European Site (Biodiversity) question. A -3 Score against biodiversity indicates that while likely significant effects may be harder to mitigate, it is understood at plan level that mitigation would be achievable, however further project level assessments are required to confirm this;

Preferred Approaches at WRZ level are outlined in Table 5.4.

Table 5.4 SAG WRZ Approach Options

Water Resource Zone Name	Feasible Options SAG Clare		Zero AA	Approach						Preferred Approach
	Option Code	Option Description		Least Cost	Quickest Delivery	Best AA	Best SEA	Lowest Carbon	Most Resilient	
Carran PWS	SAG-034	Increase abstraction at Carran spring (Burren groundwater body - karstic bedrock) and upgrade Carran WTP.	-	✓	✓	✓	✓	✓	✓	✓
Corrofin PWS	SAG-079	No deficit - upgrade WTP.	-	✓	✓	✓	✓	✓	✓	✓
Ennistymon	SAG-012	New SW abstraction from River Inagh to partly supply deficit, upgrade existing WTP/new WTP.	-	✓	✓	✓	-	✓	✓	✓
Ennistymon	SAG-013	New GW from St Brendan's Well and/or Oughtdarra Spring and new WTP to partly supply deficit. Possibly combine with increasing abstraction from Killeany Spring and/or Ballyvaughan.	-	✓	✓	✓	-	✓	✓	✓
Gort	SAG-039	Increase existing GW abstraction from boreholes (poorly productive bedrock - Caherglassaun Turlough groundwater body).	-	✓	-	✓	-	✓	-	✓
Kilkeedy PWS	SAG-001	Increase abstraction at Kilkeedy BH (Lough Mannagh Turlough groundwater body - karstic bedrock) and upgrade Kilkeedy WTP to supply deficit.	-	✓	-	✓	✓	✓	✓	✓
Killadysart PWS	SAG-007	New GW abstraction to partly meet supply and new WTP.	-	✓	✓	✓	✓	✓	✓	✓
Kinvara	SAG-046	Increase existing GW abstraction from Kinvara Well (karstic bedrock - Kinvara-Gort groundwater body) - saline intrusion.	-	✓	-	✓	-	-	-	✓

Turlough	SAG-018	Increase GW abstraction from Turlough BH (Ballyvaughan Uplands groundwater body - karstic bedrock) and upgrade Turlough WTP.	-	✓	-	✓	✓	✓	✓	✓
West Clare	SAG-024	Increase abstraction from Doo Lough and upgrade existing New Doolough WTP. Rationalise Old Doolough WTP.	-	✓	✓	✓	✓	✓	✓	✓

5.2.2 Stage 2 - Preferred Approach Development at the Study Area Level

The Second Stage of our Approach Development Process involves identifying the Study Area options that can address Need in more than one WRZ within the Study Area, and then develop various combinations which contain elements of the different options. These are called SA Combinations SA Combinations will consist of a number of different projects or options; however, looking at a wider, more holistic, spatial scale benefits the plan level assessment in considering what options might work across multiple WRZ's.

For each Study Area, one of the SA Combinations will always be the WRZ Level Approach. The WRZ Level Approach is the combination of all of the individual the Preferred Approaches at WRZ level for the entire Study Area. Table 5.5 below provides a summary of the 9 Study Area options.

Table 5.5 SAG Grouped options

Feasible Options SAG Clare			
Water Resource Zone Name	**Option Code**	**Option Description**	**SA Grouped Option**
Ennistymon West Clare	SAG-501	Interconnect Ennistymon and West Clare (distance TBC, new watermains and network upgrades required) for increased resilience and supply part of the deficit from West Clare (New Doolough WTP) to Ennistymon WRZ. Increase abstraction from Doo Lough and upgrade existing New Doolough WTP. Rationalise Old Doolough WTP.	Group 1
Ennistymon West Clare	SAG-502	Rationalise Ennistymon to New Doolough WTP (West Clare WRZ) and abandon existing WTP. Increase abstraction from Doo Lough and upgrade existing New Doolough WTP. Rationalise Old Doolough WTP.	Group 2
Turlough Ennistymon	SAG-503	Interconnect Turlough and Ennistymon WRZs for increased resilience and to supply deficit. New GW from St Brendan's Well and/or Oughtdarra Spring and new WTP to partly supply deficit. Possibly combine with increasing abstraction from Killeany Spring and/or Ballyvaughan PWS.	Group 3
Turlough Ennistymon	SAG-504	Rationalise Turlough to Ennistymon WRZ to supply deficit and abandon existing WTP. New GW from St Brendan's Well and/or Oughtdarra Spring and new WTP to partly supply deficit. Possibly combine with increasing abstraction from Killeany Spring and/or Ballyvaughan PWS.	Group 4
Carran PWS Turlough	SAG-506	Rationalise Carran WRZ to Turlough WRZ to supply deficit. Increase GW abstraction from Turlough BH (Ballyvaughan Uplands groundwater body - karstic bedrock) and upgrade Turlough WTP.	Group 6
West Clare Killadysart PWS	SAG-513	Increase abstraction from Doo Lough and upgrade existing New Doolough WTP. Rationalise Old Doolough WTP. Rationalise Killadysart PWS WRZ to West Clare Old Doolough WTP	Group 13

Feasible Options SAG Clare			
Water Resource Zone Name	**Option Code**	**Option Description**	**SA Grouped Option**
Corrofin PWS Ennistymon	SAG-514	Increase existing SW abstraction and upgrade existing WTP. Interconnect Ennistymon to Corrofin and supply deficit from increased abstraction from Lough Inchiquin (Corrofin WTP upgrade).	Group 14
Corrofin PWS Ennistymon	SAG-515	Increase existing SW abstraction and upgrade existing WTP. Rationalise Ennistymon to Corrofin and supply deficit from increased abstraction from Lough Inchiquin (Corrofin WTP upgrade).	Group 15
Gort Kinvara	SAG-516	New SW abstraction from Lough Cutra and new WTP to supply Gort, Kinvara and nearby GWSs. Abandoning Gort and Kinvara existing sources. Rationalise Kinvara to Gort WRZ new Lough Cutra WTP.	Group 16

The 9 Study Area options result in 9 SA Combinations including WRZ level Approach. The 9 SA Combinations in terms of the types of options within each combination are summarised in Table 5.6 below.

Table 5.6 SAG Combinations

Key	WRZ Approach Option	○	SA Grouped Option	□

WRZ	WRZ Approach Options	SA Combination 1 (SA Grouped Option 1 and 6)	SA Combination 2 (SA Grouped Option 2 and 6)	SA Combination 3 (SA Grouped Option 6 and 13)	SA Combination 4 (SA Grouped Option 6 and 14)	SA Combination 5 (SA Grouped Option 6 and 15)	SA Combination 6 (SA Grouped Option 6, 13 and 14)	SA Combination 7 (SA Grouped Option 6, 13 and 15)	SA Combination 8 (SA Grouped Option 1, 6 and 13)
Carran PWS	○	□	□	□	□	□	□	□	□
Corrofin PWS	○	○	○	○	□	□	□	□	○
Ennistymon	○	□	□	○	□	□	□	□	□
Gort	○	○	○	○	○	○	○	○	○
Kilkeedy PWS	○	○	○	○	○	○	○	○	○
Killadysart PWS	○	○	○	□	○	○	□	□	□
Kinvara	○	○	○	○	○	○	○	○	○
Turlough	○	□	□	□	□	□	□	□	□
West Clare	○	□	□	□	○	○	□	□	□

5.2.3 Stage 3 – Preferred Approach at Study Area Level

As part of stage three, we compare the WRZ Level Approach and the SA Combinations to determine the Preferred Approach that provides the best outcome for the Study Area.

We use the EBSD tool to rank the combinations against the assessment criteria and we then compare the best performing SA Combinations under each of the six approach types, using the 7 step process set out in Fig 5.1, to establish the Preferred Approach at Study Area level. The results of this process are provided in Table 5.7.

Table 5.6 SAG Summary of SA Combination of Performance against Approach Type

Ranked order (best to worst)	Best														Worst

WRZ	WRZ Approach Options	SA Combination 1 (SA Grouped Option 1 and 6)	SA Combination 2 (SA Grouped Option 2 and 6)	SA Combination 3 (SA Grouped Option 3 and 13)	SA Combination 4 (SA Grouped Option 6 and 14)	SA Combination 5 (SA Grouped Option 6 and 15)	SA Combination 6 (SA Grouped Option 6, 13 and 14)	SA Combination 7 (SA Grouped Option 6, 13 and 15)	SA Combination 8 (SA Grouped Option 1, 6 and 13)
Least Cost									Best
Quickest Delivery									Best
Best AA *no. of -3 scores against biodiversity	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores
Lowest Carbon								Best	
Most Resilient							Best		
Best Environmental							Best		

The SA combination in Table 5.6 is assessed to determine the approach categories as summarised in Table 5.7

Table 5.7 Best Combinations

Approach Categories	Best Performing Combination
Least Cost (LCo)	SA Combination 8
Best Environmental (BE)	SA Combination 6
Quickest Delivery (QD)	SA Combination 8
Most Resilient (MR)	SA Combination 6
Lowest Carbon (LC)	SA Combination 7
Best AA (BA)	SA Combination 4*

*Note: Combination 4 has the least -2 AA impacts

The MCA assessment included the following assessment criteria:

- Resilience;
- Deliverability and Flexibility;
- Progressibility; and
- Sustainability (Environmental and Social Impacts).

The NPV Costs are based on four criteria:

- Capital Costs – the cost to construct the option, including all overheads, consent and land acquisition costs;
- Operational Costs – the whole life cost to operate the option, including operators, chemical requirements and energy requirements including pumping;
- Carbon Costs – the whole life embodied and operational Carbon costs of the option; and
- Environmental and Social – the whole life Environmental and Social cost of the option covering climate regulation, traffic disruption and food production (carbon emissions are covered separately in the bullet point above).

The wider range of costs used in the estimation of the NPV aligns our Plan with any future Project Level Cost Benefit Analysis, in accordance with the Public Spending Code.

In terms of NPV Cost, SA Combination 8 has the lowest NPV Cost, as shown in Figure 5.2 with the lowest total costs (CAPEX and OPEX) over the solutions lifetime.

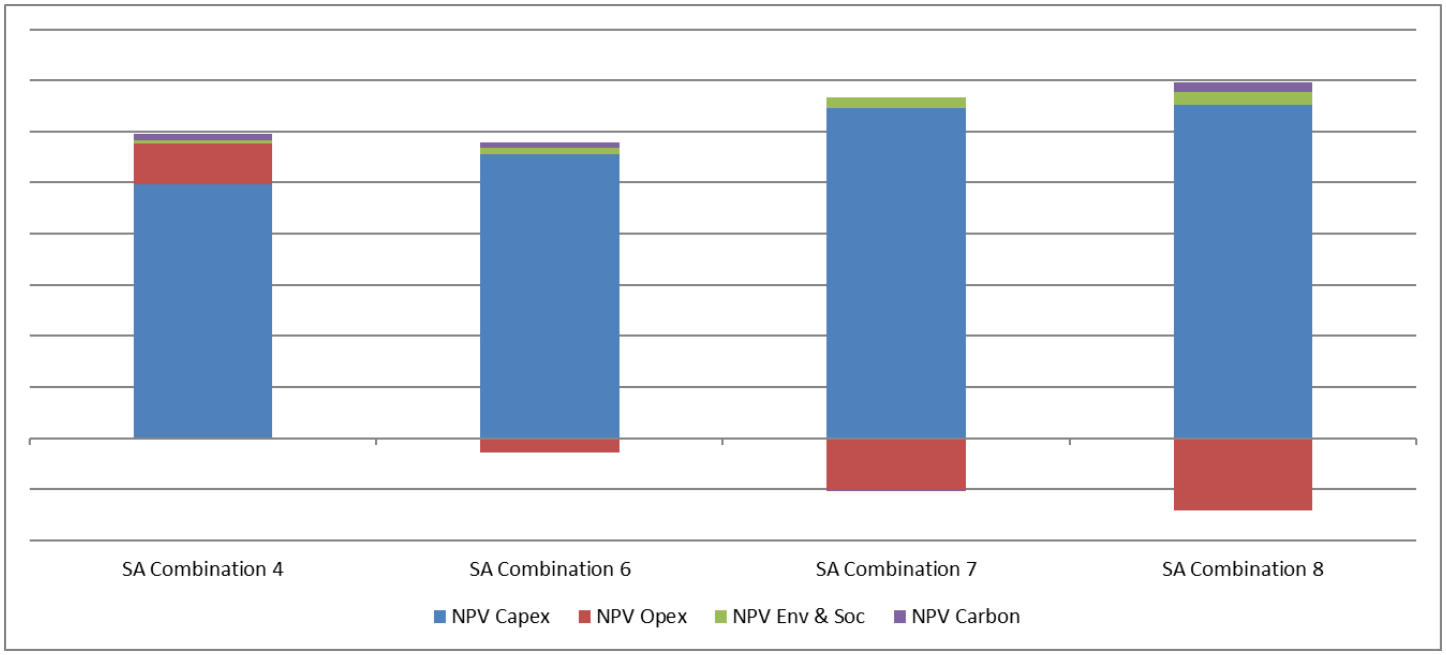


Figure 5.2 NPV Costs for WRZ and SA approaches

In accordance with the Options Methodology, these approaches are then compared against each other using the 7-Step process in Figure 5.1 to generate the best value combination of options at the Study Area level. The best value combination of options at the Study Area level results in the SA Preferred Approach. The outputs from the assessment were as follows:

- Step 1 – We compared the Least Cost Approach against the Best AA approach. There was no -3 AA impact against the Least Cost Approach, and it scores closely against the Best AA category. The Least Cost approach was therefore retained at this stage.
- Step 2 – We compared the Quickest Delivery Approach against the Least Cost Approach. The Quickest Delivery Approach is also the Least Cost Approach and it was therefore retained as Preferred Approach at this stage.
- Step 3 - We compared the Least Cost and Quickest Delivery Approach against the Best Environmental Approach. While the Best Environmental Approach scored better than the Least Cost Approach against the environmental, carbon cost and resilience criteria, the difference was not significant. The Best Environmental Approach involves the provision of a new pipeline through rock over a long distance and therefore there is a degree of uncertainty associated with the project timeline and costs associated with the Best Environmental Approach. in terms of deliverability. The Least Cost and Quickest Delivery Approach was therefore retained at this stage.
- Step 4 – We compared the Least Cost and Quickest Delivery Approach against the Most Resilient Approach. The Most Resilient Approach is also the Best Environmental Approach. The 2 Combinations score closely in terms of resilience so progressing the Most Resilient Approach would not result in material benefits. The Least Cost and Quickest Delivery Approach was therefore retained at this stage.

Step 5 - We compared the Least Cost and Quickest Delivery Approach against the Lowest Carbon Approach. The carbon costs associated with the Lowest Carbon Approach are significantly better than the Least Cost and Quickest Delivery Approach, but these costs are small in absolute terms across all the Combinations. The Least Cost and Quickest Delivery Approach was therefore retained at this stage.

- Step 6 – A final assessment of the Least Cost and Quickest Delivery Approach was completed against the Lowest Carbon, Best AA, Best Environmental and Most Resilient Approaches. The Least Cost and Quickest Delivery does not perform significantly worse than any of the other approaches within these categories, and offers the best outcome in terms of deliverability and cost. The Least Cost and Quickest Delivery Approach was therefore retained at this stage.

- Step 7 – The Least Cost and Quickest Delivery Approach was therefore selected as the Preferred Approach.

5.3 Study Area Preferred Approach Summary

On the basis of this initial assessment at Plan level, Combination 8 represents the Preferred Approach for Study Area G, which consists of the options listed in Table 5.9.

Table 5.9 Preferred Approach for SAG

WRZ Name	Preferred Approach Option Description SA Combination – Combination 8
Carran PWS Turlough	SAG-506: Rationalise Carran WRZ to Turlough WRZ to supply deficit. Increase GW abstraction from Turlough BH (Ballyvaughan Uplands groundwater body - karstic bedrock) and upgrade Turlough WTP.
Corrofin PWS	SAG-079: No deficit - upgrade WTP.
Ennistymon West Clare	SAG-501: Interconnect Ennistymon and West Clare (distance TBC, new watermains and network upgrades required) for increased resilience and supply part of the deficit from West Clare (New Doolough WTP) to Ennistymon WRZ. Increase abstraction from Doo Lough and upgrade existing New Doolough WTP. Rationalise Old Doolough WTP.
Gort	SAG-039: Increase existing GW abstraction from boreholes (poorly productive bedrock - Caherglassaun Turlough groundwater body).
Kilkeedy PWS	SAG-001: Increase abstraction at Kilkeedy BH (Lough Mannagh Turlough groundwater body - karstic bedrock) and upgrade Kilkeedy WTP to supply deficit.
Killadysart PWS	SAG-513: Increase abstraction from Doo Lough and upgrade existing New Doolough WTP. Rationalise Old Doolough WTP. Rationalise Killadysart PWS WRZ to West Clare Old Doolough WTP.
Kinvara	SAG-046: New GW abstraction at existing site and upgrade Kinvara WTP. Rationalise existing GW abstraction (karstic bedrock - Kinvara-Gort groundwater body) - saline intrusion.

The Preferred Approach (SA approach Combination 8) is shown schematically in Figure 5.3.

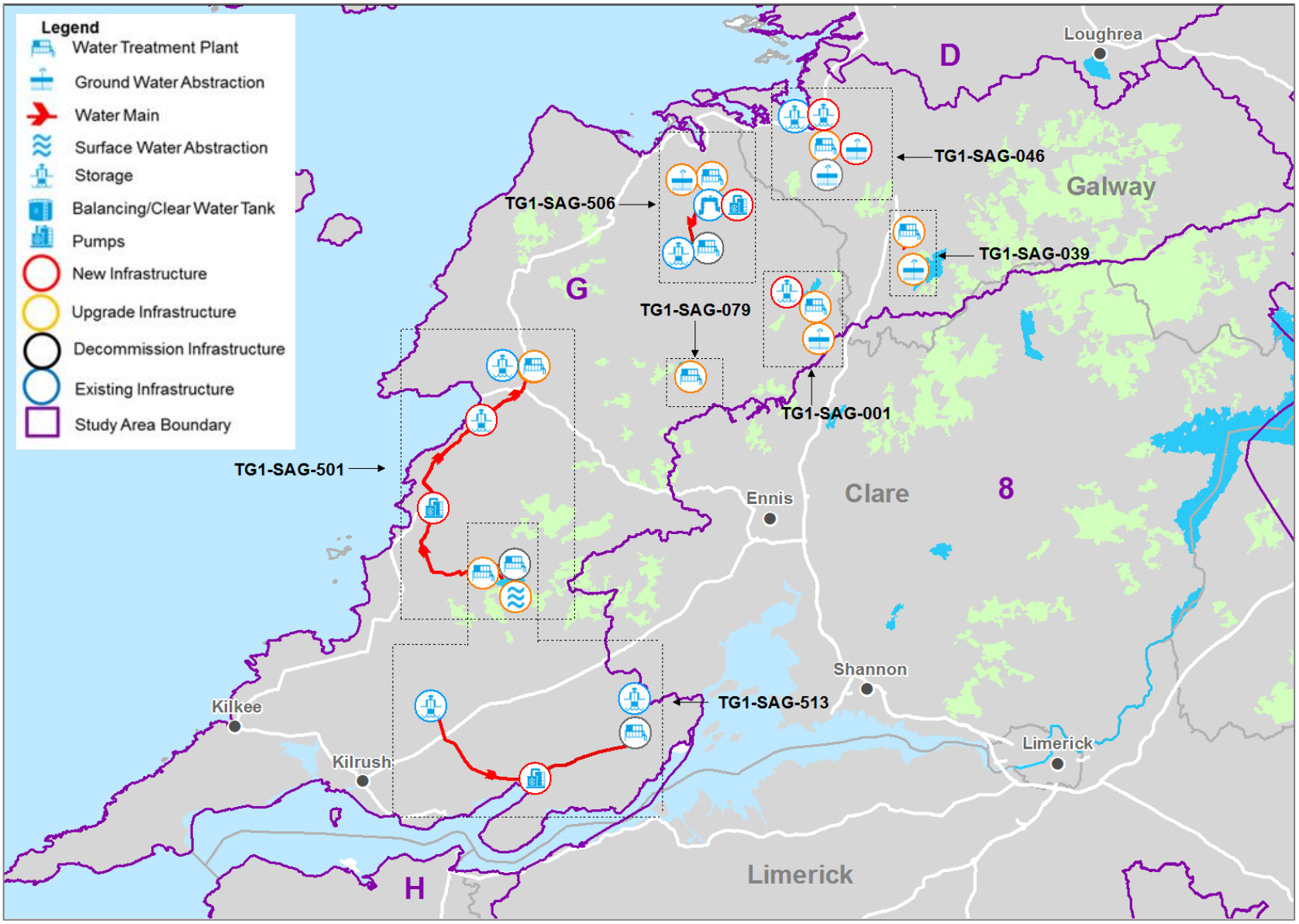


Figure 5.3 SAG Preferred Approach

The Preferred Approach for SAG Clare also includes for demand side (**Lose Less** and **Use Less**) measures, including.

- Ongoing leakage management including active leakage control, pressure management and find and fix activities to offset Natural Rate of Leakage Rise (NRR)
- Continuation of IW household and business water conservation campaigns, initiatives and education programmes
- The option to implement legally enforceable Water Conservation Orders in drought periods in order to protect the environment and our public water supplies

Before we adopt this approach at Plan level for SAG, we must give consideration to the following:

- **Interim Solutions**: Based on the scale of need identified across all 539 WRZs, it is likely that it may take 5-10 investment cycles before we address all issues with the existing water supplies. Therefore, small localised options may be required on an interim basis to secure priority need in existing supplies until the SA Preferred Approach can be delivered; and
- **Sensitivity Analysis**: When planning for water supplies over a medium to long term horizon, we must give consideration to adaptability of our plan to change across a range of future scenarios (for example, what if changes to technology allow us to reduce leakage beyond SELL, even in small WRZs or what if we are unable to secure a licence in the medium term to abstract the quantity water currently allowed for at a given location).

6 Preferred Plan Constraints – Interim Solutions

6 Preferred Plan Constraints – Interim Solutions

As outlined in more detail in Section 8.3.7.6 of the Framework Plan, the NWRP provides for an “interim solution” approach, which allows shorter term interventions to be identified and prioritised, when needed. The Preferred Approach for each WRZ, Study Area and Region will be delivered on a phased basis subject to budget and regulatory constraints. It will take many investment cycles to deliver the Preferred Approach across all WRZs, therefore, Irish Water must have a means to continue delivering safe, secure and reliable water supplies (on a short to medium term basis) while we deliver our Preferred Approach.

On this basis, interim, short term capital maintenance solutions have been identified for all WTPs and will be utilised when needed. These solutions will allow IW time to deliver the Preferred Approach, while at the same time, maintaining a sustainable water supply. These interim solutions are generally smaller in scale and rely on making best use of already existing infrastructure.

Examples of general interim measures for different water sources include the following:

- For groundwater sites, where the Preferred Approach requires that the existing WTP is to be maintained, the interim solution would typically provide for refurbishment of the existing or development of new boreholes and borehole pumps, and an upgrade of the treatment process in line with proposed growth predictions. This may require a staged upgrade of the WTP. For example, the interim solution would typically include an upgrade of the WTP to provide supply to existing customers with consideration given to a further required expansion of the WTP at a later date.
- For surface water sites, where the Preferred Approach requires that the existing WTP is to be maintained, the interim option would typically involve the upgrade of the existing WTP in line with proposed growth predictions. As for groundwater sites this may require a staged upgrade of the WTP where the interim solution would typically include an upgrade of the WTP to provide supply to existing customers with consideration given to a further required expansion of the WTP at a later date.
- For groundwater and surface water sites where the Preferred Approach involves the decommissioning of the WTP by providing supply to the customers from another WTP within the WRZ or from another WRZ/Study Area/Region, the interim solution would involve the advancement of the rationalisation of the WTP, by provision of part supply or full supply if possible. If rationalisation is not feasible at that point in time due to dependencies on Study Area or Regional options, containerised WTP upgrade solutions would be considered for the WTP. This involves the provision of a package WTP within a containerised unit. These package plants can be modified for use on other sites in the future therefore are considered “no regrets” infrastructure investment.

A decision to progress any interim solution will be based on urgent or priority need to address water quality risk or supply reliability e.g., RAL or drought issues or critical need for example. The Regional Plan does not confer funding availability for any project and any interim measures will be subject to budget availability, relevant environmental assessment and other required consents in the normal way.

These solutions, in most cases, will only be used to allow time to deliver the longer-term solution. The interim solutions are determined in line with the Preferred Approach and as such, they are considered “no regrets” infrastructure investment.

Table 6.1 SAG Interim Options

WTP Name	Interim Option
Ballymacraven WTP	Upgrade WTP to IW Standards
Killadysert WTP	Upgrade WTP to IW Standards – Potential site for a containerised solution
Corofin WTP	Upgrade WTP to IW Standards
Old Doolough WTP	Upgrade WTP to IW Standards – Potential site for a containerised solution
Carron WTP (Termon Spring)	Refurb existing Spring, and upgrade WTP to IW Standards – Potential site for a containerised solution
Kilkeedy WTP	Refurb existing Borehole, upgrade WTP to IW Standards
New Doolough WTP	Upgrade WTP to IW Standards
Turlough WTP	Refurb existing Borehole, and upgrade WTP to IW Standards
Gort WTP	Refurb existing Boreholes, and upgrade WTP to IW Standards
Kinvara WTP	Refurb existing Borehole, and upgrade WTP to IW Standards

7 Preferred Approach – Sensitivity Analysis

7 Preferred Approach – Sensitivity Analysis

Our supply demand forecast, and water quality barrier deficit assessments have been developed using the application of best practice methods within the data available. We have identified areas where we will focus improvements in data to improve the certainty of our forecasts. However, all long-term forecasts are subject to uncertainty. We have explored the sensitivity of our supply and demand forecasts to some of the key factors which influence them through a range of scenarios. This enables us to test the sensitivity of the Preferred Approach to changes in need, in order to ensure that our decision making is robust and that the approach is adaptable. We describe the factors which have been considered in Chapter 8 of the Framework Plan. In summary we test our Preferred Approach against the following questions:

1) What if the deployable output across our supplies is reduced based on sustainability limits within the new legislation on abstraction resulting in a larger supply demand balance deficit?
2) What if climate change impacts on our existing supplies are greater than anticipated?
3) What if our forecasts are too great and expected demand growth does not materialise resulting in a smaller supply demand balance deficit?
4) What if we are able to reduce leakage below SELL within the timeframe of the plan resulting in lower Needs?

A summary of the adaptability criteria and analysis we have undertaken for SAG is shown in Table 7.1.

Table 7.1 Sensitivity Analysis for SAG

Uncertainty	Likelihood	Increase/Decrease in Deficit	Impact on Preferred Approach
Sustainability	Moderate/High (as our current abstractions are large compared to the water bodies from which they abstract)	+21,000 m^3/day	**The impact of sustainability reductions would reduce the volumes that can be abstracted from our existing sources therefore increasing the supply demand balance deficit**. There are some surface water sources in SAG that would be impacted from sustainability reductions. However, our preferred approach is designed to relieve pressure on these sources by supplementing from more resilient sources. Regarding the Doo Lough source supplying West Clare WRZ, it is assumed that the existing abstraction licence conditions can be maintained, allowing for the source to be developed to therefore relieve pressure on the Lickeen Lake and Gortglass Lough sources. Groundwater sustainability is more difficult to assess at desktop level, however, as the abstractions in SAG are small in scale they do not appear to be problematic. Based on this scenario, the Preferred Approach remains the optimal solution.

Uncertainty	Likelihood	Increase/Decrease in Deficit	Impact on Preferred Approach
Climate Change	High (international climate change targets have not been met)	+600 m^3/day	**Higher climate change scenarios would impact our existing supplies and result in decreased water availability at certain times of year.** Although the likelihood of this scenario is high based on climate change adaptation to date, potential impacts may be mitigated against by optimizing our operations on a more environmentally sustainable basis across the range of supplies. Based on this scenario, the Preferred Approach remains the optimal solution.
Demand Growth	Low/Moderate (growth has been based on policy)	-5,946 m^3/day	**The impact of lower than expected growth would reduce the supply demand balance deficit and the overall need requirement.** The supply demand balance deficit is spread across 9 individual water resource zones and is driven by quality as well as quantity issues. In this rural area, growth is relatively low. Based on this scenario, the Preferred Approach remains the optimal solution.
Leakage Targets	Low (Irish Water is focused on sustainability and aggressive leakage reduction)	231 m^3/day	**The impact of lower than expected leakage savings would increase the supply demand balance deficit and the overall need requirement.** As Irish Water is committed to achieving leakage reductions, the likely scenario would be an extension in the period of time taken to achieve leakage targets as opposed to accepting lower targets. Based on this scenario, the Preferred Approach remains the optimal solution.
	Moderate/High (Irish Water is focused on sustainability and aggressive leakage reduction)	9,156 m^3/day	**Increased leakage savings beyond SELL would reduce the supply demand balance deficit and the overall need requirement.** The need drivers in SAG Clare are across all 9 water resource zones and are driven by quality as well as availability issues. Therefore, the Preferred Approach is required, even accounting for increased leakage savings. Based on this scenario, the Preferred Approach remains as the optimal solution.

In reality, a combination of these scenarios may occur together. For example, growth in demand might be lower if we achieve greater leakage reductions. However, if this coincided with a reduction in permitted abstraction volume under the abstraction licensing regime, the reduction in demand may offset some or all of the loss in supply availability due to abstraction sustainability reductions.

Based on the adaptability assessment, the Interim and Preferred Approaches perform as follows:

- Interim Approach – As the purpose of the Interim Approach is to allow for emergency works for priority Quality and Quantity issues, the solutions will have a limited design life (usually less than 10 years). They allow time to assess the Preferred Approach and improve adaptability within our Plan
- Preferred Approach – As the Supplies in SAG Clare are relatively small, and as conservative limits have been applied to the supply availability assessments, the Preferred Approach is adaptable to a range of future outlooks in relation to sustainability and climate change. The demand growth in the area is small, and the Supply Demand Deficits are primarily driven by reliability. As Water Treatment Plants are modular, capacity will be delivered on a phased basis, allowing for adaptation across a range of futures. Our Preferred Approach is therefore Adaptable.

In summary, our sensitivity assessment of the Interim and Preferred Approaches demonstrates that they are both highly adaptable to a broad range of futures, and therefore represent ‘no regrets’ infrastructure.

8 Summary of Study Area G

8 Summary of Study Area G

Delivery of the Preferred Approach will secure all of the supplies in the area in terms of Quality, Quantity, Sustainability and Resilience

The Preferred Approach for SAG (summarised in Table 5.8 and Figure 5.3) consists of local WRZs solutions for Kilkeedy PWS, Corrofin PWS, Gort and Kinvara WRZs in the Study Area, primarily driven by the small scale of the supplies and difficulties in transporting small volumes of water over long distances.

Proposed solutions for Killadysart PWS, Ennistymon, Turlough, West Clare and Carran PWS WRZs involve constructing connections across one or more supplies. The preferred approach for Killadysart PWS involves rationalising the scheme to West Clare and increasing abstraction from the existing Doo Lough abstraction. The preferred approach for West Clare and Ennistymon looks at increasing abstraction from the existing Doo Lough abstraction, interconnecting the 2 schemes and interconnecting Old Doo Lough WTP and New Doo Lough WTP. Finally, the preferred approach for Turlough and Carran PWS involves increasing GW abstraction from Turlough BH and rationalising Carran PWS to Turlough.

Delivery of the Preferred Approach will secure all of the supplies in the area in terms of Quality, Quantity, Sustainability and Resilience.The Preferred Approach for SAG Clare/Galway also includes for demand side (**Lose Less** and **Use Less**) measures, including.

- Ongoing leakage management including active leakage control, pressure management and find and fix activities to offset Natural Rate of Leakage Rise (NRR)
- Nett leakage reduction in Ennistymon Water Resource Zone, amounting to 231 m^3 per day (applied to SDB Deficit) to move towards achieving the National SELL Target by 2034
- Continuation of IW household and business water conservation campaigns, initiatives and education programmes
- The option to implement legally enforceable Water Conservation Orders in drought periods in order to protect the environment and our public water supplies

As part of our Preferred Approach we have also identified a range of interim solutions for SAG, as summarised in Table 6.1. The measures will only be progressed in the event of critical need to allow time for delivery of the required Preferred Approach solutions in the Study Area.

Annex A- Study Area G Water Treatment Plants

WTP Asset Name	Local Plant Names
Kinvara WTP	Kinvara WTP
Gort WTP	Gort WTP
Turlough WTP	Turlough WTP
New Doolough WTP	New Doolough WTP
Kilkeedy WTP	Kilkeedy WTP
Carron WTP (Termon Spring)	Carron WTP (Termon Spring)
Old Doolough WTP	Old Doolough WTP
Corrofin WTP	Corrofin WTP
Killadysert WTP	Killadysert WTP
Ballymacraven WTP	Ballymacraven WTP

Annex B – Study Area G Rejection Register Summary

Annex B Study Area G Rejection Register Summary

Study Area G - CS Rejection

Option Reference	Option Description	Rejection Reasoning	Resilience	Deliverability & Flexibility	Sustainability
TG1-SAG-02	New GW abstraction from Ennis groundwater body (karstic bedrock) and new WTP	Increasing abstraction from existing boreholes is feasible and unlikely that new boreholes will need to be developed. Therefore, this option does not meet the requirements of the Deliverability criterion.		●	
TG1-SAG-04	Reduce Leakage at Kilkeedy PWS to remove deficit	This option refers to a "Tactical Option" as planned works are underway across all our WRZs as part of the National Leakage Reduction Programme. However, it is unlikely to meet the full deficit on its own. IW is committed to Leakage reduction and targets are included in SDB. As leakage reduction targets will progress in conjunction with other supply options, this option was screened out of the Preferred Approach development phase at coarse screening.	This option is a tactical option and is unlikely to meet the full deficit. This will likely be implemented along with a new supply option		
TG1-SAG-05	Tanker water when required	Tankering is not a robust, resilient, long-term solution for any WRZ within the region and for this reason, is not taken forward to fine screening.	This option is a tactical option and is unlikely to meet the full deficit. This will likely be implemented along with a new supply option		
TG1-SAG-06	Increase SW abstraction from Gortglass Lough and upgrade Killadysert WTP	Abstracting the volume of water required to make this a feasible option is considered likely to result in the waterbody not achieving WFD objectives. Therefore this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAG-08	Interconnect Killadysart PWS and Lissycasey GWS and supply partial deficit from Liscasey GWS (network upgrades required)	Abstracting the volume of water required to make this a feasible option is considered likely to result in the waterbody not achieving WFD objectives. Therefore this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●

Option Reference	Option Description	Rejection Reasoning	Resilience	Deliverability & Flexibility	Sustainability
TG1-SAG-09	Interconnect Killadysart and West Clare (New Doolough WTP) for increased resilience and supply deficit	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAG-10	Rationalise Killadysart WRZ to West Clare New Doolough WTP, abandon exisitng WTP	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAG-11	Increase SW abstraction from Lickeen Lake and upgrade existing Ballymacraven WTP to partly supply deficit	Abstracting the volume of water required to make this a feasible option is considered likely to result in the waterbody not achieving WFD objectives. Therefore this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAG-14	Bring back to production abandoned GW sources	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAG-15	Interconnect Ennistymon and Kilmaley/Inagh GWS and supply part of the deficit from Kilmaley/Inagh GWS (approx. distance 1km, new watermains and network upgrades required)	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAG-25	New GW abstraction and new WTP to supply deficit	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●

Option Reference	Option Description	Rejection Reasoning	Resilience	Deliverability & Flexibility	Sustainability
TG1-SAG-26	Interconnect West Clare WRZs (improve network connectivity) and supply deficit	This option is currently undergoing design to rationalise Old Doolough to New Doolough, and will therefore, be considered as part of all designs for West Clare WRZ. Therefore, the option did not progress to fine screening.	Project ongoing to rationalise Old Doolough to New Doolough and will be considered in all designs for West Clare WRZ		
TG1-SAG-27	Rationalise Old Doolough WTP to New Doolough WTP	This option is currently undergoing design to rationalise Old Doolough to New Doolough, and will therefore, be considered as part of all designs for West Clare WRZ. Therefore, the option did not progress to fine screening.	Project ongoing to rationalise Old Doolough to New Doolough and will be considered in all designs for West Clare WRZ		
TG1-SAG-28	Recommission abandoned SW source - Kilkee Impoundment	Abstracting the volume of water required to make this a feasible option is considered likely to result in the waterbody not achieving WFD objectives. Therefore this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAG-29	Rationalise Corrofin to Ennis (approx. distance 10km, new watermains and network upgrades required) for improved resilience, not in deficit	The option requires a significant length pipeline for a relatively small demand. Transferring small quantities of water over long distances can affect the quality of the water. Therefore, it was considered not feasible at coarse screening stage due to age of water and possible sedimentation issues and not taken forward to fine screening.		●	
TG1-SAG-30	Interconnect Corrofin PWS and Killinaboy GWS and supply from Killinaboy GWS to remove Corrofin from RAL (new watermains required)	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, the WRZ is no longer in deficit. Therefore, no new supply option is required.	WRZ is no longer in deficit		
TG1-SAG-31	Increase existing SW abstraction and upgrade existing WTP	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, the WRZ is no longer in deficit. Therefore, no new supply option is required.	WRZ is no longer in deficit		

Option Reference	Option Description	Rejection Reasoning	Resilience	Deliverability & Flexibility	Sustainability
TG1-SAG-32	New GW abstraction from Ennis groundwater body (karstic bedrock) to remove Corrofin from RAL	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, the WRZ is no longer in deficit. Therefore, no new supply option is required.	WRZ is no longer in deficit		
TG1-SAG-33	Tanker water when required	Tankering is not a robust, resilient, long term solution for any WRZ within the region and for this reason, is not taken forward to fine screening.	This option is a tactical option and is unlikely to meet the full deficit. This will likely be implemented along with a new supply option		
TG1-SAG-35	New GW abstraction at Carran (Burren groundwater body - karstic bedrock) and new WTP at exisitng reservoir site	It is likely that refurbishment of the WTP will address the need for this WRZ so option is not taken forward to the fine screening stage based on deliverability. WTP upgrade is assessed as part of a different feasible option.		●	
TG1-SAG-37	New GW abstraction at Carran (Burren groundwater body - karstic bedrock) and new WTP (exisitng TW - bring it to PW)	It is likely that refurbishment of the WTP will address the need for this WRZ so option is not taken forward to the fine screening stage based on deliverability. WTP upgrade is assessed as part of a different feasible option.		●	
TG1-SAG-41	Interconnect Gort and Coole GWS and supply deficit from Coole GWS	This is not a sustainable long-term source to supply Gort. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAG-42	Rationalise Gort WRZ to Kinvara WRZ to supply deficit	Saline intrusion is a problem so new supply required in order to address this issue. Therefore, this option did not meet the requirements of the deliverability criterion.		●	
TG1-SAG-44	Rationalise Gort WRZ to Kinvara WRZ (new source required)	The desktop assessments undertaken indicate that there will be issues regarding salinity and sitting new wells will be difficult. As a result, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●

Option Reference	Option Description	Rejection Reasoning	Resilience	Deliverability & Flexibility	Sustainability
TG1-SAG-47	New GW abstraction/wellfield to supply deficit (karstic bedrock - Kinvara-Gort groundwater body)	The desktop assessments undertaken indicate that sitting new wells in this area will pose a challenge. There is no guarantee of yield associated with this option. As a result, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAG-48	New SW abstraction from River Kilchreest and new WTP	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, the WRZ is no longer in deficit. Therefore, no new supply option is required.	WRZ is no longer in deficit		
TG1-SAG-49	Inteconnect Kinvara WRZ to Lough Corrib WRZ (Galway City, Tuam, Loughrea) in SA-D to supply deficit	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, the WRZ is no longer in deficit. Therefore, no new supply option is required.	WRZ is no longer in deficit		
TG1-SAG-51	Interconnect Kinvara and Lydacan GWS and supply deficit from Lydacan GWS	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, the WRZ is no longer in deficit. Therefore, no new supply option is required.	WRZ is no longer in deficit		
TG1-SAG-52	Raw water storage to tackle salinity issue - could be place beside reservoir site	New raw water storage could be a viable solution dependant on length of time of salinity problems. More information required to assess, but for now assumed that duration of salinity issues occurs over a 3 month period and for this reason, it has been screened out based on deliverability.		●	
TG1-SAG-53	Rationalise Kinvara to Ennistymon	Abstracting the volume of water required to make this a feasible option is considered likely to result in the waterbody not achieving WFD objectives. Therefore this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●

Option Reference	Option Description	Rejection Reasoning	Resilience	Deliverability & Flexibility	Sustainability
TG1-SAG-55	Interconnect Corrofin PWS and Ranaghan GWS and supply from Ranaghan GWS to remove Corrofin from RAL (new watermains required)	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, the WRZ is no longer in deficit. Therefore, no new supply option is required.	WRZ is no longer in deficit		
TG1-SAG-56	Interconnect Corrofin PWS and Toonagh/Dysart GWS and supply from Toonagh/Dysart GWS to remove Corrofin from RAL (new watermains required)	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, the WRZ is no longer in deficit. Therefore, no new supply option is required.	WRZ is no longer in deficit		
TG1-SAG-61	Not in deficit - Supply spare capacity to West Clare (New Doolough WTP)	This option is currently undergoing design to rationalise Old Doolough to New Doolough, and will therefore, be considered as part of all designs for West Clare WRZ. Therefore, the option did not progress to fine screening.	Project ongoing to rationalise Old Doolough to New Doolough and will be considered in all designs for West Clare WRZ		
TG1-SAG-63	New SW abstraction from River Kilchreest and new WTP	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, the WRZ is no longer in deficit. Therefore, no new supply option is required.	WRZ is no longer in deficit		
TG1-SAG-64	Increase SW abstraction from Lickeen Lake and upgrade existing Ballymacraven WTP to partly supply deficit	Abstracting the volume of water required to make this a feasible option is considered likely to result in the waterbody not achieving WFD objectives. Therefore this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAG-65	New GW abstraction and new WTP to supply deficit- location TBC	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●

Option Reference	Option Description	Rejection Reasoning	Resilience	Deliverability & Flexibility	Sustainability
TG1-SAG-66	New GW abstraction and new WTP to supply deficit- location TBC	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAG-67	Interconnect Gort and Seehan GWS and supply deficit from Seehan GWS	Abstracting the volume of water required to make this a feasible option is considered likely to result in the waterbody not achieving WFD objectives. Therefore this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAG-68	Interconnect Gort and Roo GWS and supply deficit from Roo GWS	Abstracting the volume of water required to make this a feasible option is considered likely to result in the waterbody not achieving WFD objectives. Therefore this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAG-69	Increase SW abstraction from Doo Lough and upgrade existing New Doolough WTP	This option is currently undergoing design to rationalise Old Doolough to New Doolough, and will therefore, be considered as part of all designs for West Clare WRZ. Therefore, the option did not progress to fine screening.	Project ongoing to rationalise Old Doolough to New Doolough and will be considered in all designs for West Clare WRZ		
TG1-SAG-71	Interconnect West Clare Old Doolough WTP and West Clare New Doolough	This option is currently undergoing design to rationalise Old Doolough to New Doolough, and will therefore, be considered as part of all designs for West Clare WRZ. Therefore, the option did not progress to fine screening.	Project ongoing to rationalise Old Doolough to New Doolough and will be considered in all designs for West Clare WRZ		
TG1-SAG-72	Rationalise West Clare Old Doolough WTP to West Clare New Doolough WTP	This option is currently undergoing design to rationalise Old Doolough to New Doolough, and will therefore, be considered as part of all designs for West Clare WRZ. Therefore, the option did not progress to fine screening.	Project ongoing to rationalise Old Doolough to New Doolough and will be considered in all designs for West Clare WRZ		
TG1-SAG-73	Increase existing GW abstraction from Kinvara Well (karstic bedrock - Kinvara-Gort groundwater body) - saline intrusion	The desktop assessments undertaken indicate that there will be issues regarding salinity and sitting new wells will be difficult. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●

Option Reference	Option Description	Rejection Reasoning	Resilience	Deliverability & Flexibility	Sustainability
TG1-SAG-80	No deficit - upgrade Old Doolough WTP	This option is currently undergoing design to rationalise Old Doolough to New Doolough, and will therefore, be considered as part of all designs for West Clare WRZ. Therefore, the option did not progress to fine screening.	Project ongoing to rationalise Old Doolough to New Doolough and will be considered in all designs for West Clare WRZ		