Appendix H: Options Appraisal Options

This Appendix presents all of the options we considered during the options appraisal process for WRMP19 and also sets out the options that were considered but rejected at different stages off the appraisal process, and the reason for rejection. This Appendix should be read in conjunction with Section 13 of the revised draft WRMP19.

The Appendix contains:

- All options considered, the stage and the reason for rejection:
  The four stages are:
  - **Stage 1**- Unconstrained Options
  - **Stage 2**- Feasible Options
  - **Stage 3**- Initial Options
  - **Stage 4**- Final Constrained Options
- Option description of the Final Constrained Options
- Changes made to the Final Constrained Options list following consultation on the draft WMP19 and production of the revised draft WRMP19 in September 2018

Demand Options

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
C01	Smart metering rollout (all domestic properties) within the Bristol Water supply area.	Customer Demand					Option rejected due to: • The need to review further the costs and benefits in the Bristol Water context through a trial/separate study • May prove cost prohibitive based on a comparison with the traditional metering programme approach Rejection does not preclude the continuing of the "traditional" metering approach and given asset life, does preclude the installation of smart meters at a later date as part of a meter renewal programme if further studies/technology advances demonstrate a cost-beneficial strategy.
C02	Compulsory near-universal metering of domestic customers, i.e., all remaining unmeasured households across the whole company (ARM or smart metering) where practical and economic	Customer Demand					This option was rejected following further consideration of customer acceptability based on the latest information available about customer preferences (set against the cost-benefit expected from the updated supply deficit assessment that was not available at the start of the option appraisal process). The company already has a programme of change of occupier metering and other metering options within the Final Constrained options list to address the expected scale of deficit and so this option is not considered necessary in the short to medium term.
C03	Enhanced water efficiency communications campaign (different messages for different seasons)	Customer Demand				See footnote	All water efficiency options (C03, C04, C07 and C25) have been combined into one new "programme" option which is then divided into sub options, the sub options are C26-01, C26-02, C26-03 and C26-04.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
C04	Education programme on water efficiency on different key stages (primary, secondary, further and higher education)	Customer Demand				See footnote	All water efficiency options (C03, C04, C07 and C25) have been combined into one new "programme" option which is then divided into sub options, the sub options are C26-01, C26-02, C26-03 and C26-04.
C05	Compulsory metering of all domestic customers - all households (new and existing) due to water stressed area status	Customer Demand					Bristol Water is not designated as a water stressed area and supply deficit forecast indicates that it is unlikely to meet the criteria. Most of new properties are already metered and other metering options are included in the Feasible Options lists that are not dependent on Water Stressed Area designation.
C06	Business water use audits and the installation of selective water efficiency measures ranging from 1-3 devices. This could include: waterless urinals, low flush toilets, self-closing taps and low water use taps.	Customer Demand					Water use audits are expected to be provided by the new retail market for business customers rather than Bristol Water as a wholesaler. This is not an option to be promoted by Bristol Water following the opening up of the business water retail market in April 2017.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
C07	Household water efficiency devices installation programme (Partnering or Company led approach, home visit), plus selective water saving devices ranging from 1-5 devices. This could include fitting of showers, low flow shower heads, cistern displacement, low flush toilets, dual flush toilets, timing devices, water butts, flush controllers for urinals, trigger nozzles for hoses, timing devices, fitting people detectors, spray taps and water efficient taps.	Customer Demand				See footnote	All water efficiency options (C03, C04, C07 and C25) have been combined into one new "programme" option which is then divided into sub options, the sub options are C26-01, C26-02, C26-03 and C26-04.
C08	Selective metering of domestic customers based on high consumption e.g. sprinkler use and/or zones of high demand	Customer Demand					Option was assessed as a Constrained Option
C09	Selective metering of domestic customers- Accelerated metering. Install a meter into all households but let the household decide whether to switch from a rateable value to a measured charge. The long term plan is to compulsory switch over billing regime- AMR	Customer Demand					Option is very similar to other metering options but rejected as it carries much greater uncertainty in terms of delivering demand savings. The option allows households to opt out of the metering charge and therefore the benefit may not materialise in the short to medium term of the WRMP19 planning horizon.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
	or Dumb meters.						
C10	Selective metering of domestic customers - Social housing	Customer Demand					The metering of social housing would be undertaken within a number of the other metering options thus there would only be a small benefit from only focusing on social housing, therefore option rejected on the grounds that there are other better metering options.
C11	Selective metering of domestic customers - "the difficult ones"	Customer Demand					Scheme would only be implemented upon universal metering of 90% of Bristol Water's supply network. This option should be reassessed at that point and taking account of the demand position and supply-demand balance prevailing at this juncture.
C12	Enhanced promotion of free meter option to unmeasured households beyond the promotion assumed in baseline demand forecast	Customer Demand					Option was assessed as a Constrained Option
C13	Metering on Change of occupier (all domestic customers) - compulsory- not just encouraging homeowners	Customer Demand					Bristol Water reviewed and confirmed its change of occupier metering policy following the initial fine screening of options and confirmed it is compulsory; therefore this policy is now incorporated into the baseline demand forecast and this option is consequently already assumed to be in place for the future.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
C14	Treated greywater recycling in new households	Customer Demand					Option rejected following further internal Bristol Water review for the following reasons: • Scheme implementation highly dependent on developer and government support • Significant time delay in the building of new properties and therefore significant demand saving benefits may take decades to achieve • Regulatory controls to prevent water supply cross-contamination still in infancy and further development of specific water quality standards are necessary; Drinking Water Safety risks considered too great until such specific standards are introduced • Risks that the system is removed by householders over time due to operational and maintenance issues • Further research required to develop such solutions in UK and so too much risk for this option to be included in WRMP19
C15	Change of occupier metering (large gardens only)	Customer Demand					Option only focuses on one type of property and therefore expected benefit is low. Option very similar to option C08. Following rejection, Bristol Water subsequently reviewed and confirmed its change of occupier metering policy and confirmed it is compulsory; therefore this policy is now incorporated into the baseline demand forecast and this option is consequently already assumed to be in place for the future for ALL households not just those with large gardens.
C16	Selective metering of commercial properties	Customer Demand					Most commercial properties are already metered and the remaining unmetered properties tend to be low consumption and so demand savings are very small.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
C17	Rising block tariffs for domestic customers - low cost for essential use volume	Customer Demand					Option rejected following further Bristol Water review of its tariff policies: • Difficulties associated with quantifying savings of this tariff and trials / research needed to better understand the likely scale of any demand savings. • Likely to be complex to implement and will require considerable engagement with customers, CCWater and Ofwat. More work is required to further define how such a tariff structure would work in practice and command broad acceptance from customers and regulators. • Would require all domestic customers to be metered to realise appreciable savings - this option can be reviewed once meter penetration increases to >90%. Therefore part of a longer term strategy beyond the WRMP19 planning period.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
C18	Treated greywater recycling as a retrofit option - Treated greywater reuse in existing households	Customer Demand					Option rejected following further Bristol Water internal review for the following reasons: • Number of suitable properties for retrofit is considered to be low (and therefore limited demand savings). • The cost of retrofitting is significant as re-plumbing would be required and further work is needed to explore likely customer response to retrofitting of grey water systems. • Regulatory controls to prevent water supply cross-contamination still in infancy and further development of specific water quality standards are necessary; Drinking Water Safety risks considered too great until such specific standards are introduced. • Risks that the system is removed by householders over time due to operational and maintenance issues • Further research required to develop such solutions in UK in consultation with customers and regulators.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
C19	Seasonal tariffs for domestic customers	Customer Demand					Option rejected following further Bristol Water review of its tariff policies: • Difficulties associated with quantifying savings of this tariff and trials / research needed to better understand the likely scale of any demand savings. • Likely to be complex to implement and will require considerable engagement with customers, CCWater and Ofwat. More work is required to further define how such a tariff structure would work in practice and command broad acceptance from customers and regulators. • Would require all domestic customers to be metered to realise appreciable savings - this option can be reviewed once meter penetration increases to >90%. Therefore part of a longer term strategy beyond the WRMP19 planning period.
C20	Installation of rainwater harvesting in new build households and non-households	Customer Demand					Option was assessed as a Constrained Option
C21	Rainwater harvesting as a retrofit option – households and non-households	Customer Demand					Option rejected following further internal review due to its similarities with Option C20. Option C20 taken forward only.
C22	Introducing spot pricing for selected customers	Customer Demand					Other tariff options are considered more appropriate and more likely to achieve demand reduction in the Bristol Water area as peak day demand is NOT a driver for any supply deficiencies within the water resources plan - this option only addresses peak demand issues.
C23	Selective metering (agricultural troughs)	Customer Demand					Rejected due to the small volumes of water involved and the practicalities of installation of meters. It is considered that many farms have their own water supply and so savings will be small compared to other demand management options.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
C24	White goods subsidy -Subsidy to customers that purchase water efficient appliances	Customer Demand					Option was rejected following further internal Bristol Water review as to the potential demand saving benefits. Most new appliances already promote low water usage and therefore the scheme is not expected to bring significant reductions in demand. Concerns over practicalities of managing the subsidy process with retailers and no way of determining if a customer is replacing a higher consumption appliance or simply replacing a white good that is already at a low consumption.
C25	Household water efficiency programme (Company led, home visit and partnering approach)	Customer Demand				See footnote	All water efficiency options (C03, C04, C07 and C25) have been combined into one new "programme" option which is then divided into sub options, the sub options are C26-01, C26-02, C26-03 and C26-04.
C26-01	Promotion of Water Efficiency to customers- Enhanced water efficiency communications campaign (different messages for different seasons). This option was C03.	Customer Demand					Option was assessed as a Constrained Option
C26-02	Promotion of Water Efficiency to customers- Education programme on water efficiency on different key stages (primary, secondary, further and higher education). This option was C04	Customer Demand					Option was assessed as a Constrained Option

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
C26-03	Promotion of Water Efficiency to customers- Household water efficiency devices installation programme (Partnering or Company led approach, home visit), plus selective water saving devices ranging from 1-5 devices . This could include fitting of showers, low flow shower heads, cistern displacement, low flush toilets, dual flush toilets, timing devices, water butts, flush controllers for urinals, trigger nozzles for hoses, timing devices, fitting people detectors, spray taps and water efficient taps. This option was C07.	Customer Demand					Option was assessed as a Constrained Option
C26-04	Promotion of Water Efficiency to customers- Household water efficiency programme (Company led, home visit and partnering approach). This option was C25.	Customer Demand					This option was rejected following further internal review by Bristol Water - the option is very similar to Bristol Water's current work on the water efficiency scheme delivered via the company's Save Water Save Money, where free devices are given out to customers. Savings from this scheme are considered in the baseline, thus additional savings are considered to be very small. There are better demand management options included in the Final Constrained List.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
C27	Targeted water efficiency advice for industrial/commercial customers/public sector customers and recreation facilities	Customer Demand					Following further internal Bristol Water review, this type of water efficiency service is expected to be provided by the new retail market rather than Bristol Water as a wholesaler. Not an option to be promoted by Bristol Water following the opening up of the retail market in April 2017.
C28	Introducing 'interruptible' industrial supplies tariff	Customer Demand					Following further work on the demand forecast and supply-demand balance assessment, it is confirmed that peak day demand is not a driver for any supply-demand balance issues facing Bristol Water which such tariffs are aimed at managing. Option will not address annual average dry weather demand.
C29	Introducing lower charges for major customers with significant water resource storage	Customer Demand					Most customers are very unlikely to have significant onsite water storage which would allow for short term interruptions and therefore the option is not viable. Peak day demand is not a driver for the water resources plan which this option is focussing on.
C30	Water saving devices – Encouraging shallow trap toilets in new built properties	Customer Demand					Better options available with a greater chance of take-up by the developers and consumers - this option is "innovative" and more work would be needed to understand the likely savings and likely level of take-up by developers and customers.
C31	Business water use audits	Customer Demand					Following further internal Bristol Water review, this type of water efficiency service is expected to be provided by the new retail market rather than Bristol Water as a wholesaler. Not an option to be promoted by Bristol Water following the opening up of the retail market in April 2017.
C32	Water saving devices – Encouraging developers to install waterless urinals in new non-household properties	Customer Demand					Rejected following further internal Bristol Water review due to the difficulties associated with quantifying benefits as to the potential uptake - further investigations are needed to ascertain the potential benefits associated with this option.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
C33	Advice and information on leakage detection and fixing techniques (Industrial and Commercial Customers)	Customer Demand					Following further internal Bristol Water review, this type of water efficiency service is expected to be provided by the new retail market rather than Bristol Water as a wholesaler. Not an option to be promoted by Bristol Water following the opening up of the retail market in April 2017.
C34	Targeted water efficiency advice for designers of hot water systems, taps and water using appliances	Customer Demand					Not likely to result in significant water savings. Unable to quantify the benefits with any certainty without further research. Many water devices already achieve low water use so scale of benefit is considered small compared to other demand management options.
C35	Targeted water efficiency advice for purchasers of water using appliances	Customer Demand					No likely to result in significant water savings. Unable to quantify the benefits and trials/research would be needed to better understand the potential benefits but savings likely to be small compared to other demand management options.
C36	Labelling water consumption of appliances	Customer Demand					Option already been explored by Water UK and Waterwise but to date there has been no regulatory commitment to water labelling. Option to be reviewed again at next WRMP cycle to see if regulatory progress has been made.
C37	Appliance exchange programmes	Customer Demand					This option would require "open ended" expenditure commitment from Bristol Water and significant practical challenges in the administration and certification that appliances being replaced are high water usage appliances. In addition, Bristol Water would be responsible for disposing old appliances. Net benefits of water savings are likely to be small compared to other demand management options.
C38	Social landlord audits and benchmarking	Customer Demand					Option rejected as the scheme only focuses on a small percentage of total housing stock and therefore potential demand savings are small. Option C07 focuses on all households and therefore is deemed a more suitable option.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
C39	Water saving devices – Encouraging developers to install composting toilets in new non-household properties	Customer Demand					This option was rejected following further internal Bristol Water review for the following reasons: • Uncertainty in encouraging/incentivising developers to install the composting toilets. • Not a typical construction activity and therefore mechanisms to remove the waste are not in place. • Savings are uncertain • Customer perception issues who may deem un-flushing toilets as unhygienic.
C40	Water saving devices – Retro-fitting of new toilets	Customer Demand					Major disruption to householders with issues around plumbing and access to properties - likely customer resistance to the retrofit and so uptake likely to be very low and therefore demand savings very low as a result.
C41	Working in partnership with builders and/or other partnerships to build very water efficient homes (low water use showers, rainwater harvesting, greywater recycling, and water efficient appliances (if provided). This could be undertaken on a trial basis to inform future policy/WRMP.	Customer Demand					Option rejected following further internal Bristol Water review taking account of the poor track record of success in relation to partnerships with developers. Further work and engagement with developers needed and trials required and so option is not put forward as a Constrained List option for WRMP19.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
C42	Advice and information on leakage detection and fixing techniques (Agriculture)	Customer Demand					Option rejected following further internal Bristol Water review on demand savings as the option is not expected to result in significant savings as many agricultural companies/farms have their own water supplies and agricultural use of public water supply in the Bristol Water area is a low proportion of total demand. Other better demand management options are to be included in the Final Constrained List. (option renamed from C26 to avoid confusion with C26_01, C26_02, C26_03 and C26_04)

Footnote: These options were revised and incorporated into a wider water efficiency programme option (options C26-01, C26-02, C26-03 and C26-04).

Distribution Options

Following comments made on our draft WRMP19 in relation to leakage reductions and the revisions to our plan made in response to these comments, a number of the options have been removed from the Constrained List as they now feature in our baseline leakage reduction programme and therefore are not available to address the residual baseline supply deficit. The initial ALC leakage reduction options (D21) that were included as options in the draft WRMP along with the pressure management options (D22) are now included in the revised draft WRMP19 as part of our baseline leakage reduction activities to reduce total leakage to 39.33 Ml/d by 2024/25 (rather than to the 43.0 Ml/d baseline position included in the draft plan).For the revised draft WRMP19, Options D21.01, D21.02 and D23 have also been revised to reflect the new baseline starting position on leakage (39.33 Ml/d by 2024/25).

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
D01	Pressure reduction	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D02	Mains infrastructure replacement with communication pipe replacement	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D03	Mains Infrastructure replacement only	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
D04	Trunk Main Expansion/extension	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D05	Distribution Main Expansion/extension	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D06	Targeted Communication Pipe replacement	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D07	Enhanced detection equipment/innovation in detection	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D08	Replacement of customers supply pipes (fully or partial subsidised)	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
D09	Enhanced leak detection efforts in distribution system	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D10	Decreasing the time taken to fixing reported leaks	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D11	Increasing find and fix leakage control activity on communication pipes	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D12	Increasing find and fix leakage control activity on trunk mains and distribution mains	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D13	Deployment of permanent noise loggers	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
D14	Enhanced zonal monitoring (includes noise loggers, district meters, etc.)	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D15	Installation of additional district metered areas	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D16	Mains infrastructure replacement with communication and supply pipe replacement	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D17	Reduced leakage from trunk mains system upstream of DMAs (enhanced leakage detection / trunk mains repairs/replacement)	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D18	Enhanced water consumption metering within DMAs	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
D19	Enhanced repair methods/innovation in repair methods	Distribution					All distribution options have been replaced following the outcome of the SELL modelling which proposes three key "programme options" of Active Leakage Control (D21), Pressure Reduction (D22) and Asset Renewal (D23). These three programme options will be included in the Final Constrained List.
D20	Network reinforcements i.e. expand/extend trunk and distribution network (for managing peak demand and/or new resources)	Distribution					Option rejected as the scheme as it is likely to have very high costs and not justified on water saving alone. The scheme would need to deliver multiple benefits.
D21.1	Active Leakage Control ALC	Distribution					Option was assessed as a Constrained Option but revised to take account of the revised baseline leakage reduction profile (leakage reduced to 39.33 Ml/d by 2024/25) in the revised draft WRMP19
D21.2	Active Leakage Control ALC	Distribution					Option was assessed as a Constrained Option but revised to take account of the revised baseline leakage reduction profile (leakage reduced to 39.33 Ml/d by 2024/25) in the revised draft WRMP19
D22	Pressure Management	Distribution					Option was assessed as a Constrained Option in the draft plan but was removed for the revised draft plan as it has been included as part of the baseline leakage reduction programme.
D23	Asset Renewal	Distribution					Option was assessed as a Constrained Option

*Footnote: At Stage 4, three “programme” distribution options were developed (Options D21 to D23) following completion of the Sustainable Economic Level of Leakage (SELL) modelling and assessment which amalgamated several individual options.

Production Options

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
P01_01	Increase performance of existing sources (e.g. P01-02R) to increase deployable output to near licensed volume	Production					Option was assessed as a Constrained Option
P01_02	Increase performance of existing sources (P01-01R) to increase deployable output to near licensed volume	Production					Option was assessed as a Constrained Option
P02	Management of water quality (Metaldehyde) of the Gloucester and Sharpness Canal	Production					The water has occasional drinking water quality failures but this does not at present affect deployable output so addressing the risk will not provide a benefit to deployable output at present.
P03	Sustainable abstraction from sources which feed into the Gloucester and Sharpness Canal	Production					Sources at times have high nitrate levels but the risk is managed via flushing/dilution with extra River Severn water. Addressing this issue is unlikely to provide additional deployable output benefits.
P04	Catchment Management for all abstraction sources at risk of high nitrates.	Production					Many groundwater sources have falling nitrate concentrations within the supply area, therefore measures to address nitrates are not likely to result in additional deployable output benefits.
P05	Catchment Management for three groundwater sites (P01-01R, P05R and P01-02R) to manage the outage risk from high turbidity.	Production					There is uncertainty regarding how effective this option would be in reducing outage (turbidity may be related to groundwater). Requires further assessment to determine the cause of the high turbidity and limited deployable output benefit due to intermittent nature of the turbidity issues.
P06	Catchment Management of the Mendip Lakes (Chew, Blagdon and Cheddar) to manage outage risk from algal blooms	Production					Option was assessed as a Constrained Option

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
P07	Catchment Management for Cheddar Reservoir to prevent further deterioration of water quality	Production					Option has been combined into one single integrated option (P06) as catchment management is currently undertaken by the Mendip Lakes Partnership
P08	P08R WTW (increased production)	Production					Option was assessed as a Constrained Option
P09	P09R WTW (increased production)	Production					The scheme has many dependences and the increase in deployable output is constrained by the raw water quality. Therefore there is uncertainty as to whether this option is viable. Option expected to be very expensive for a small increase in yield (expected to be 6 Ml/d).
P10	P10R WTW (increased production)	Production					Option was assessed as a Constrained Option
P11	P11R WTW (increased production)	Production					Scheme only brings a small increase to overall supply and therefore not likely to be cost-beneficial. These sources are not always available for abstraction, reducing the resilience benefit of the scheme.
P12	P01-02R WTW (increased production)	Production					Scheme only expected to increase deployable by ~1 Ml/d. There is uncertainty as to whether the scheme will operate well under high rainfall conditions and therefore lower certainty associated with the yield benefit.
P13	P13R WTW (increased production)	Production					Option rejected due to: • Issues surrounding the sustainability of the abstraction with the increased production outputs. • The potential costs of the options, relative to the yield and the fact the site has historically shut down each year due to high nitrate concentrations.
P14	P14R WTW (increased production)	Production					For the scheme to be truly effective the dairy which currently controls the abstraction would need to be relocated. Would be politically challenging and for a relatively small yield.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
P15	P15R WTW (increased production)	Production					Option rejected due to: • The potential issues relating to the power supply required to increase production. • Scheme would require additional bankside storage.
P16	P16R WTW (increased production)	Production					Only viable by increasing the efficiency of the wash water return. Only brings a small increase in yield (~1Ml/d). Not likely to be cost-beneficial.
P17	P17R WTW (increased production)	Production					Option rejected due to: • The potential uncertainty in the yield. • The output of the scheme is dependent upon the varying water quality of the sources i.e. high levels of algae from Chew Reservoir can affect production. This is being addressed via option P06
P18	P18R WTW (increased production)	Production					Scheme will only bring a small increase in yield (0.5-1Ml/d). Not likely to be cost-beneficial. The Ozleworth Brook which this source affects is assessed as having a potential adverse environmental impact. Therefore, abstraction above recent/long term average may increase this impact.
P19	P19R WTW (increased production)	Production					Option rejected as increased abstraction from the River Axe is already considered in two resource options (R01 and R14) therefore any current production constraints would need to be addressed via the resource options.
P20	Reduced leakage from raw water mains (enhanced leakage detection / raw mains repairs/replacement)	Production					Option was assessed as a Constrained Option but revisions made for the revised draft WRMP19 following re-assessment of raw water losses during 2018 to take account of recent investment and new data from raw water system flow metering.

Option ID	Option Name	Option Type	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
P21	Increase supply from P01-01R Water Treatment Works by treating water from borehole source directly.	Production					Borehole is not used but its yield would be very small and quality is unknown. High cost and little increase in deployable output and the scheme is in any case very similar to option P01.
P22	Increase supply from P05R Water Treatment Works by increasing the abstraction from river	Production					Licence for river abstraction is unsustainable due to flashy nature of the source. Therefore, the site is considered licence and source constrained.
P23	Increase supply from P23R Water Treatment Works by improving network connectivity	Production					Site is constrained by network connectivity and high cost is required with only little additional deployable output of 0.1-0.4Ml/d
P24	Increase supply from P24R Water Treatment Works by improving the pipework	Production					Low yield with two potential issues relating to the pipework and collection chamber. High cost is required to improve the pipework and collection chamber issues.
P25	Increase supply from P25R Water Treatment Works by increasing licenced volume	Production					This option is rejected due to a fixed licence maximum with no potential for change in licence volumes.

Resource Options

Following representations made on the draft WRMP19, we have now agreed a change to our Wessex Water bulk export with Wessex Water as reported in the revised draft WRMP19. These agreed changes will be implemented after 2024/25 and result in an agreed reduction to the bulk export from 11.37 Ml/d to 4.4 Ml/d. This change is incorporated into the revised draft WRMP19 baseline supply forecast. Consequently, Option R32 to reduce this Wessex Water bulk export has been excluded from the revised draft WRMP19 Constrained Options list as it is already agreed included in the baseline supply-demand forecast. Option R32 has therefore been removed from the table below.

Option ID	Option Name	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
R01	Increase abstraction from River Axe to P10R Reservoir alongside catchment management measures to manage water quality risks					This option has been rejected due to: • The similarities to R14. • P10R Reservoir typically fills each winter and therefore the additional abstraction may not be required without additional storage. • Environment Agency (EA) has expressed concerns over the level of abstraction and environmental impacts
R02	Minor sources - increase abstraction at XXXXX (groundwater abstractions)					There are already specific options included in the unconstrained list, therefore, this generic option is removed. Option not screened as generic.
R03	Minor sources - any options to amend grouped licences to allow increased abstraction?					There are specific options already included in the unconstrained list, therefore, this generic option is removed. Option not screened as generic.
R04	Increase abstraction at XXXX by augmenting XXX river					There are specific options already included in the unconstrained list, therefore, this generic option is removed. Option not screened as generic.

Option ID	Option Name	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
R05	Increasing the height of P16R Reservoir embankments (up to 300 mm)					This option has been rejected due to: • The technical difficulty of raising the dam height on all sides and the associated costs. • The small increase in yield due to the small increase in reservoir volume (EA feedback).
R06	Abstraction from Bristol Docks					This option has been rejected due to: • Concerns regarding poor water quality (and the requirement to upgrade the treatment works). • The multiple dependencies i.e. Bristol Council, Port Authority and the EA. • The potential effects on the harbour (i.e. lowering of water levels) and the effect of reduced freshwater input into the transitional River Avon.
R07	Raise Blagdon Reservoir dam crest by 300 mm					This option has been rejected due to: • The potential environmental and social effects of increasing the area of the reservoir (i.e. land take). • The fact the reservoir does not fill every winter and therefore the increase in water resources may not materialise every year. • The potential effects on the downstream watercourse. The Congresbury Yeo has been subject to an AMP6 investigation to assess the effects of the reservoir on the river and mitigation measures via adaptive management are required to improve the status of the river. Therefore, any increase in reservoir volume would affect the spill frequency of the reservoir, potentially impacting the downstream river environment. • The potential impact on the WFD status of the river.
R08.1	New water sources within Bristol Water area: Options include: 1) R08.1					In addition this scheme has a lower level of feasibility assessment in comparison to other resource options and as a result, a much lower level of certainty. Better options are included in the Final Constrained List of options.

Option ID	Option Name	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
R08.2	New water sources within Bristol Water area: Options include: 2) R08-02R					Option was assessed as a Constrained Option
R08.3	New water sources within Bristol Water area: Options include: 3) R08-03R					Option was assessed as a Constrained Option
R08.4	New water sources within Bristol Water area: Options include: 4) R08.4R(Tidal Limit)					This scheme has a lower level of feasibility assessment in comparison to other resource options, and as a result a much lower level of certainty. The water quality of the R08.4Rmay also poor due to being at the bottom of the catchment. There may also be risk of saline intrusion during high tides affecting production.
R08.5	New water sources within Bristol Water area: Options include: 5) R08.5R					This option was rejected due to the extremely high uncertainty of yield (volume not confirmed with quarry operator, lack of certainty on future licence requirements for dewatering) in comparison to other options. The dewatering water is currently pumped into watercourses to provide mitigation for the quarry activity; the EA would not wish to see this water used at the expense of the environment at the current stage of quarry development.
R08.6	New water sources within Bristol Water area: Options include: 6) R08.6R					This option has been rejected due to: • High level of uncertainty in terms of yield and likely high cost - better options are included in the Final Constrained List.
R08.7	New water sources within Bristol Water area: Options include: 7) R08.7R					The option has been rejected due to the following reasons: • Site of previous Wessex Water RSA reduction. EA has commented that an abstractor is unlikely to get a significant consumptive licence here because the Wessex Water abstractions at Upton Scudamore were investigated in AMP5, resulting in licence 17/53/010/G/011 being reduced by 6Ml/d and licence 17/53/010/S/011 adjusted so that a new Prescribed Flow was applied, ensuring abstraction ceased from the springs at a higher flow than previously. This site currently has issues which affects its long term viability.

Option ID	Option Name	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
R08.8	New water sources within Bristol Water area: Options include: 8) R08.8R					The option has been rejected due to the following reasons: • Potential site of Wessex Water PR19 investigations into adverse effects of abstraction. • EA will be assessing stress on the water bodies in this area. At that time, EA will have better information if a more detailed review will support a viable source option. The sustainable catchment assessment shows pressure on some of these water bodies so it is unlikely that there will be much resource available.
R08.9	New water sources within Bristol Water area: Options include: 9) R08.9R					The option has been rejected due to the following reasons: • Site of heightened public concern over environmental impact • EA has strongly recommended avoiding this catchment.
R08.10	New water sources within Bristol Water area: Options include: 10) R08.10R					The following sub-option has been rejected due to the following reasons: • Possible site of water resources abstraction concerns • EA has strongly recommended avoiding this catchment. This is a very high profile catchment for public concern and this would lead to high levels of political / public challenge should Bristol Water consider to progress an option in this area.
R09	Desalination treatment works					Option rejected due to a number of reason which include political (planning issues, potential stakeholder issues), customer (taste and potential adverse customer perception), engineering (requires large bankside storage to manage the salinity changes over the tidal cycle), carbon costs (very energy intensive) and environmental factors (may affect salinity regime in the local estuarine region).
R10	Desalination and transfer scheme replacing all supply sources					Option is not practical and therefore removed. Energy requirements very unlikely to be made available. This option refers to large scale scheme to produce 450 Ml/d powered by sea bed turbines or barrage. All other minor / major sources to be surrendered. Water would be taken to P16R, P15R and P13R to distribute into the system.
R11.1	Cheddar Reservoir - two options 1) Standard WRMP14 design					Option was assessed as a Constrained Option

Option ID	Option Name	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
R11.2	Cheddar Reservoir - two options (2) smaller capacity and/or modular staged development					The cost of modular P10R reservoir options is expected to be too high and it will be difficult to justify this option considering the anticipated future deficit.
R12	Reservoir desilting / dredging to increase capacity (Cheddar, Blagdon, Chew)					This option is rejected due to the small expected yield it will bring alongside the impact of distributing the silt (i.e. releasing phosphorus into the reservoir, damaging habitat (most reservoirs are SSSI or SPA (Chew only)). Performs poorly on the overall assessment score.
R13.1	1) Increase Gloucester-Sharpness canal supply from River Severn supported by increased River Severn regulation using third party water sources					This option to be removed as the option has a lower level of feasibility/assessment in comparison to other options (and therefore greater uncertainty). The EA has indicated there may be a hand off flow restriction which may affect the viability of the scheme.
R13.2	2) increased River Severn winter abstraction with new storage reservoir at P15R					This option has a lower level of assessment in comparison to other options and therefore less certainty in the yield or feasibility of option. The EA has indicated there may be a hand off flow restriction which may affect the viability of the scheme.
R14	Increase abstraction from R14R and pump to Blagdon Reservoir, via Cheddar Reservoir. Implementation of catchment management to manage water quality risks on River Axe.					This option was removed as modelling has indicated that the option will not provide any additional yield due to water available for abstraction in the worst drought conditions (1933-34) not being constrained by the hands-off flow.
R15	Pumped Refill of Chew Valley Reservoir from the R15					Option rejected because of the potential impact on Chew Reservoir (which is an SSSI/SPA), in particular, adding high phosphorus water from the River Avon to the reservoir. There is also a risk of spreading invasive species (in light of new EA guidance on invasive species). Wessex Water already abstracts from the R15 in a number of locations and therefore there is a low certainty of supply availability from the River Avon. There may be a low yield during dry weather which is the period in which this scheme would be required most.

Option ID	Option Name	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
R16	Increase capacity at Chew Valley Reservoir by raising dam crest by 300mm					This option has been rejected due to: • The potential environmental and social effects of increasing the area of the reservoir (i.e. land take). • The fact the reservoir does not fill every winter and therefore the increase in water resources may not materialise every year. • The potential effects on the downstream watercourse. The River Chew has been subject to an AMP6 investigation to assess the effects of the reservoir on the river and mitigation measures via adaptive management are required to improve the status of the river. Therefore, any increase in reservoir volume would affect the spill frequency of the reservoir, potentially adversely affecting the downstream river. EA have expressed concerns regarding this option.
R17	Other options for storing water? [e.g. gravel pits, Somerset Levels, storm water runoff]					This Is a generic option and there are already a number of specific options for storing water.
R18	Import water from development of a regional shared resource (or resources) outside the Bristol Water area					This option has been rejected due to: • Option requires further, significant consultation with neighbouring water companies and the EA. • There is the potential to deliver non-shared water resources within the Bristol Water supply area. • Wessex Water is Bristol Water's closest neighbour. Wessex Water is currently forecasting a surplus and therefore there is no requirement for a shared resource.
R19	Aquifer Storage and Recovery (use of the Frome and/or Malmesbury aquifers to store 'spare' winter water for abstraction and treatment during the summer					Performs poorly on the overall assessment criteria. The options performed poorly on scheme dependencies, engineering complexity, ability to adapt and yield. These largely reflect a lack of suitable aquifers within the Bristol Water supply area for ASR. EA expressed concerns over the abstraction and previous sustainability reductions.

Option ID	Option Name	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
	period).					
R20	Rain cloud seeding					New technology and at present significant uncertainty in feasibility. The technology for rain cloud seeding is not considered to be sufficiently developed to make this option technically viable. There may be impacts on environment which are unacceptable.
R21	Malmesbury aquifer management scheme					The scheme would be difficult to promote as these sources have been part of a long running sustainable abstraction programme with Wessex Water (EA feedback also raised concerns). There may be high costs involved in either new groundwaters or delivering mains supply. High number of dependencies (including ensuring no derogation to private borehole owners and Wessex Water as well as gaining abstraction licence from the EA).
R22	Artificial Groundwater Recharge					Performs poorly on the overall assessment criteria. The option performed poorly on scheme dependencies, engineering complexity, ability to adapt and yield. These largely reflect a lack of suitable aquifers within the Bristol Water supply area for artificial groundwater recharge.
R23.1	Purchase water from third parties: 1) from water companies					Option was assessed as a Constrained Option
R23.2	Purchase water from third parties: 2) from other third parties or acquire third party sources					This option was removed as no third party sources had been identified as viable options.
R24	Bring R24R source back into supply					Option was assessed as a Constrained Option
R25	Imports by sea - Icebergs					Significant uncertainty in feasibility / reliability of this option. Icebergs may become less common with climatic change.

Option ID	Option Name	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
R26	Direct Effluent Water Re-Use 1) Avonmouth Sewage Treatment Works Direct Effluent Re-use 2) Effluent re-use for industrial customers [Reclaimed industrial wastewater and sewage treatment effluent for use by industry]					This option was rejected because the effluent from Avonmouth Sewage Treatment Works is not owned by Bristol Water. Therefore any direct supply to industrial customers would be undertaken by Wessex Water and or a third party.
R27	Sewage treatment works (STW) indirect effluent re-use - discharge into reservoir (from Weston-Super-Mare STW to P10R Reservoir)					Option rejected due to the potential impact on the reservoir of inputting high phosphorus water into P10R Reservoir, which may affect WFD and SSSI status. There may be issues regarding water treatment and nano-pollutants. The yield of this source may also be dependent upon the dilution factor from other freshwater sources. Potential customer perception issues may arise. Bristol Water has been involved with a Wessex Water scheme to reduce the risk of sewage discharges into Blagdon Reservoir and therefore this scheme may bring mixed political messages. Any effluent would need to be purchased from Wessex Water.
R28	Sewage treatment works (STW) indirect effluent re-use – pumping from a coastal water STW and discharging enhanced treated effluent into a river for subsequent downstream abstraction. The key coastal STWs include Avonmouth, Weston- Super-Mare, P23R and Kingston Seymour STWs.					This option was rejected due to the potential customer concerns of effluent reuse and nano-pollutants which may be difficult to treat. The effluent may also affect the local watercourse by inputting high phosphorus effluent into a river. Would require pumping effluent back upstream which would increase the size and complexity of the scheme. Any effluent would need to be purchased from Wessex Water.

Option ID	Option Name	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
R29	Reclaimed domestic wastewater - in situ (not greywater)					The use of domestic sources may result in high costs in reclaimed wastewater for reuse. This could result in poor performance and additional costs. The option considers the reuse of effluent from wastewater treatment works, which includes domestic, commercial and industrial effluent. Reuse of domestic wastewater would require separate wastewater collection systems.
R30	Abstraction from R30R during winter and transfer to P10R Reservoir					This option has been rejected due to the fact P10R Reservoir fills most years and therefore without additional capacity or new storage, there is little benefit of this scheme.
R31	Severn Spring source (Severn Tunnel) and transfer across Severn Estuary					Option rejected due to the uncertainty of the yield and the engineering complexity of conveyance of the water from the spring (which is on the Welsh side of the estuary) to the Bristol Water supply area. The option also has a high number of dependencies (source owner and potential Welsh Water plans for the use of this source).
R33	Imports by sea – bags					Requires a high number of bags to meet demand. Likely to be very expensive and require intensive resources to be viable.
R34	Reduce supply to major industrial users during a period of drought					Considered to be unacceptable due to impacts on economic activities (beyond drought order to prohibit prescribed water uses)
R35	Imports by sea tankers- potable water from overseas					Very expensive option and challenging operational requirements – consider as an option for extreme drought only as an emergency measure.
R36	Water supply from neighbouring water companies					Option already considered in Option R23 and therefore removed.
R37	Bulk water supply direct from canals within the Bristol Water area (excluding Gloucester & Sharpness Canal)					No other canals located within the Bristol Water boundary

Option ID	Option Name	Stage 1	Stage 2	Stage 3	Stage 4	Reason For Rejection
R38	Reduce level of service to 1 in 5 years for water use restrictions					Option rejected as worsening levels of service is unlikely to be acceptable to customers following customer research findings
R39	Imports by road - tankers					Option would require a high number of tankers by road to meet the required demand. This would increase local traffic pressure to local treatment or distribution centres.
R40	Imports via sea					Very expensive option and challenging operational requirements – consider as an option for extreme drought.
R41	Imports by sea - tankers - raw water - from overseas					Very expensive option and challenging operational requirements – consider as an option for extreme drought
R42	Imports by sea - tankers - potable water - from UK					Very expensive option and challenging operational requirements – consider as an option for extreme drought

WRMP Final Constrained Option Descriptions (Stage 4)

This final Constrained Options list for the revised draft WRMP19 excludes options D22 and R32, and includes the modifications to Option D21 and P20 for the reasons described earlier.

Option Name	Option Name	Option Description
C26-01	Promotion of Water Efficiency to customers- Enhanced water efficiency communications campaign (different messages for different seasons)	This option includes enhanced water efficiency communication campaigns within the local community for different seasons, for example during the summer months and periods of peak demand. The idea behind this option is to vary the message of water efficiency to reduce the risk of customers becoming desensitised to the message. It is assumed that all communications are via the internet, customer magazine and via attending local events. The work is expected to result in a demand reduction of 0.08 Ml/d and would be run every year. A total of four key seasonal campaigns would be run, resulting in 1,000km of vehicle trips a year. Carbon has been estimated at 100gCO2e/km (in modern van) and 1,000 trips per annum. Total operational carbon is 0.1 tonnes CO2e/year.
C26-02	Promotion of Water Efficiency to customers- Education programme on water efficiency on different key stages (primary, secondary, further and higher education)	This option involves working in partnership with schools to promote water efficiency. This would be undertaken for the different key stages. The aim is that education regarding water efficiency starts at an early age and therefore will result in long term demand savings. It is assumed that 40 school visits would be made each year, reaching 30 students per visit (at 20km vehicle movements per visit). The work would be undertaken by three full time employees. The overall yield benefit has been estimated at 0.08 Ml/d. Work would be undertaken every year. Carbon has been estimated at 40 school visits at 20km per visit and 100g C02e/km. The total operational carbon has been estimated at 0.8 tonnes of C02e/year.

Option Name	Option Name	Option Description
C26-03	Promotion of Water Efficiency to customers. Household water efficiency devices installation programme (Partnering or Company led approach, home visit), plus selective water saving devices ranging from 1-5 devices . This could include fitting of showers, low flow shower heads, cistern displacement, low flush toilets, dual flush toilets, timing devices, water butts, flush controllers for urinals, trigger nozzles for hoses, timing devices, fitting people detectors, spray taps and water efficient taps	This option entails household audits and the installation of water saving devices including fitting of showers, low flow shower heads, cistern displacement, low flush toilets, dual flush toilets, timing devices, water butts, flush controllers for urinals, trigger nozzles for hoses, timing devices, fitting people detectors, spray taps and water efficient taps. This would 'free up' resources to be used by other customers. There would be a cost saving to customers. Assumed that 35,000 properties targeted with a 20% uptake up (equates to 7,000 properties and a yield of 0.266 Ml/d). There would be a total of 5km of vehicle movements based on the assumption that 50 properties are visited per day. This option is expected to result in a greater yield in comparison to self-installation as there is greater certainty that devices are installed. Assumed that roll out will be voluntary and promoted through Bristol Water magazine, water bills, and social media. Embodied and operational carbon has been estimated at 5.25 tonnes and 3.5 tonnes CO2e respectively.
CO8	Selective metering of domestic customers based on high consumption e.g. sprinkler use and/or zones of high demand	This option involves selective metering of all customers with large water consumption (such as those with large gardens or with swimming pools) and/or areas of high demand. It is assumed the largest users of water will be targeted first. It is assumed that 2,000 properties would be targeted p.a (10,000 over 5 years) and on average will result in a 15% reduction total demand (50 litres per property per day). It is assumed that there is 1km of vehicle movements per meter installed. The key 10,000 properties of assumed high consumption and/or areas of high demand would be targeted by this scheme. Work would be undertaken over 5 years. Yield of 0.57 Ml/d. 1km van travel per meter installed (0.1 kg CO2e) plus 12.65 kg per meter installed (based on 5kg mixed plastics use for meter and Atplas box (note that meters installed by BW are now plastic rather than gunmetal)). Excavation and backfill 0.55 kg CO2e per meter based on 0.05 m3 excavation in soil, giving a total of 13.8kg CO2e per meter installed (0.0128 tonnes C02e per meter).
C12	Enhanced promotion of free water meters to unmeasured households beyond the promotion assumed in baseline demand forecast	This option includes enhanced promotion of free water meters to unmeasured households beyond the promotion assumed in baseline demand forecast. The option should promote additional uptake of metering and therefore additional water saving. The long term effectiveness of this measure is unknown and likely to result in diminishing returns. It is assumed that 10,000 properties would be targeted over AMP7 (2,000 a year) and on average will save 15% of demand in total (50 litres per property per day). Yield of 0.572 Ml/d. 1km van travel per meter installed (0.1 kg CO2e) plus 12.65 kg per meter installed (based on 5kg mixed plastics use for meter and Atplas box (note that meters installed by BW are now plastic rather than gunmetal)). Excavation and backfill 0.55 kg CO2e per meter based on 0.05 m3 excavation in soil, giving a total of 13.8kg CO2e per meter installed (0.0128 tonnes C02e per meter).

Option Name	Option Name	Option Description
C20	Installation of rainwater harvesting in new build households and non-households	This option would involve the installation of rainwater harvesting systems in new build households and non-households. Bristol Water would bear the costs of the installation of rainwater systems. The rationale behind this option is that rainwater would be used for non-potable purposes instead of potable water from the public supply system, reducing demand. Option would require engagement with builders. It is assumed that 500 properties would be addressed over AMP7 with a saving of 25 litres per customer per day. A total saving of 0.029 Ml/d is expected (assuming an average Bristol Water occupancy rate of 2.34 persons). Carbon footprint per installation: 2 cubic metres excavation at 22 kg CO2e, 0.5 cubic metres concrete for capping works at 148.5 kg CO2e, product weight 113.1 kg mixed plastics at 286.14 kg CO2e, total 456.64 kg CO2e per property (0.45 tonnes C02e). It is assumed the work will result in no additional vehicle movements a year, above those relating to the construction of new builds.
P01-01	Increase performance of existing sources (P01-01R) to increase deployable output to near licensed volume	This scheme would involve the maximisation of the yields from existing operational source at P01-01R (which is currently constrained by the performance of the membrane plants). This option requires the upgrade of the water treatment works. The key actions include (from WR31 P01-01R TW Upgrade): • Refurbishment (as required) to bring the Upper Spring collection system back into use; • Upgrade of the raw water feed and low lift pumping arrangement; • Decommissioning and removal of obsolete equipment including the pressurised membrane system; • Modifications to the contact tanks to allow for use as duty/standby water storage volume; • Building extension and building services (to include building ventilation and insulation); • Installation of prefiltration (Boll filters 300µm); • Installation of submerged membrane packaged plant; • Refurbishment/modification of control and telemetry systems as required to integrate new works; • Replacement of gas chlorine with electrochlorination and static mixer. Other than the upgraded treatment processes at the site, no further infrastructure requirements are expected as the pipe network already exists. The work will increase yield by 1.7 Ml/d. Estimated emissions of embodied carbon during construction (158.2 tonnes CO2e) over 1 year period. Operational carbon is estimated at 485.0 tonnes CO2e/year from pumping and additional water treatment. Work is expected to result in additional 2,288km of vehicle movements/year.

Option Name	Option Name	Option Description
P01-02	Increase performance of existing sources (P01-02R) to increase deployable output to near licensed volume	This scheme would involve the maximisation of the yield from an existing operational source at P01-02R (which is currently constrained by the performance of the membrane plants). A number of potential approaches to improving output are described in the WR30 P01-02R TW Upgrade report, which recommends a submerged membrane. The key works include: • Decommissioning and removal of obsolete equipment including the pressurised membrane system • Building extension and building services (to include building ventilation and insulation) • New Boll prefiltration (300 µm) • Installation of submerged membranes • Refurbishment/modification of control and telemetry systems as required to integrate new works • Condition survey of retained existing structures and repair/renovation as required • Replacement of gas chlorine with OSEC Other than the upgraded treatment processes at the site, no further infrastructure requirements are expected as the pipe network already exists. The work will increase the yield by 2.64 Ml/d. Estimated emissions of embodied carbon during construction (156.3 tonnes CO2e) over 1 year period. Operational carbon is estimated at 329.5 tonnes CO2e/year from pumping and additional water treatment. Work is expected to result in additional 2,288km of vehicle movements/year.
P06	Catchment Management of the Mendip Lakes (Chew, Blagdon and Cheddar) to manage outage risk from algal blooms	This option would improve the outage risk resulting from Chew, Blagdon and Cheddar reservoir which currently suffers from high algal counts, which at times affect production at P17R, P16R and P10R WtW. Both reservoirs are part of catchment management schemes to reduce phosphorus levels, currently funded for AMP6 but not long term. The schemes require long term funding in order to be effective. Catchment management would be implemented over the entire upstream catchment. Option will include implementation of the catchment grant scheme to support farms investing in improved infrastructure to aid clean and dirty water separation, storage of slurry, effluent and manures. Also advice and support towards management options that reduce diffuse pollution risk, such as cultivation of over-wintering cover crops after maize, and use of an integrated manures and fertilizer management plan. A reduction in nutrients is expected to reduce algal blooms and therefore reduce the outage risk at P17R, P16R and P10R WTW. The yield benefit has been assessed as 0.394 Ml/d based on the assumption of 0.5% of the deployable output of the Mendip reservoir sources (total of 78.8Ml/d). Work would be undertaken over the period of the WRMP. Embodied carbon emissions are estimated to be 371 tonnes CO2e/year. Operational carbon is estimated at 2.4 tonnes CO2e/year. Work will result in 24km of vehicle movements a year.

Option Name	Option Name	Option Description
P08	P08R WTW (increased production)	The output is constrained physically by processes on site, which is the size of membranes (currently 5 Ml/d). In 2013 a feasibility assessment (P08R WtW Membrane Replacement with UV) was undertaken which assessed increasing production via an increase in membrane capacity or via UV treatment. The report recommended UV treatment to increase capacity to 7 Ml/d. Therefore the works include the replacement of the current membranes to UV treatment. Note, a detailed assessment has yet to be undertaken. The site has been identified as a WINEP investigation due to abstraction concerns and there are also reports of local complaints regarding low flows which may increase if abstraction was increased. This scheme would result in a yield of 2 Ml/d. It is assumed the work will be undertaken over 2 years. 75km of additional vehicle movements are expected. Embodied carbon are estimated to be 69 tonnes CO2e. Operational carbon estimated to increase of 6.9 tonnes CO2e/year.
P10	P10R WTW (increased production)	Raw water quality at P10R Reservoir is deteriorating, demonstrated by increasing algal blooms. This has been recognised by the EA and there is a WFD Safeguard Zone Action Plan for the Drinking Water Protected Area P10R Reservoir for total algae. Climate change is perceived as a major factor, with warmer temperatures favouring conditions for algal growth resulting in more frequent and more significant algal blooms. The ability of P10R Water Treatment Works to sustain design output under these conditions is also compromised as filter down time increases due to increased Slow Sand Filter skim frequency increases and filter re-sanding. An assessment (P10R TW Water Quality Improvement) was undertaken by Bristol Water to review options available. The report recommended Dissolved Air Floatation (DAF) and Rapid Gravity Filters (RGF) to be added to the treatment process to deal with high levels of algal biomass and therefore maintaining production. The work will increase the design capacity of the works by 4 Ml/d. This is the assumed yield benefit of the work is 4 Ml/d. Work would be undertaken over a 2 year period and result in 18,250km of vehicle movements a year. Embodied carbon are estimated to be 58,533 tonnes CO2e. Operational carbon is estimated at 4.1 tonnes CO2e/year.
P20	Reduced leakage from raw water mains (enhanced leakage detection / raw mains repairs/replacement)	This option will address leakage from raw water mains. It is assumed that all raw water mains will be investigated for potential leakage. Bristol Water have 94 km of raw water mains spread throughout the supply area. The work will include detection of leakage via metering (24 sites in total) and replacement/repair of the mains network. It is assumed that 1% (0.94km) of the network would be replaced each year, over a 5 year period. Bristol Water's updated assessment of raw water losses carried out in spring 2018 has indicated that a reduction in losses could result in a supply benefit of 5.5 Ml/d from the reported baseline raw water losses included in the revised draft WRMP19. The scheme is expected to have low levels of vehicle movements and those related to construction are captured with the embodied carbon. Negligible vehicle movements during operation due to low levels of required maintenance. Embodied and construction carbon emissions are estimated to be 1,236 tonnes CO2e/year.

Option Name	Option Name	Option Description
R08-02	New water sources within Bristol Water CAMS area for the location R08-02R	This option is the development of a new supply source on the R08-02R. Abstraction would be from the R08-02R (a new pumping station of 2.5 Ml/d, 93 mhd would be adjacent). Water would be treated on site via a new membrane plant (capacity of 2.5 Ml/d). Water would be then pumped to R08-02Ra Service Reservoir via a 12.7km (300mm diameter) pipeline. A booster pumping station would be located at R08-02Rb (2.5 Ml/d, 93 mhd). The option was developed from the Bristol Avon and North Somerset CAMS assessment. The maximum available water based on the CAMS assessment (77% reliability at Q95) is 30.9Ml/d. The scheme has an assumed yield of 1.4 Ml/d (this results from the 2012 CAMS assessment which has 1.4 Ml/d with 100% certainty). It has been estimated that the work would result in 5,200km/yr. of vehicle movements during the operation of the scheme. Construction of the scheme would be undertaken over 1.5 years. Embodied carbon emissions are estimated to be 4,560 tonnes CO2e. Operational carbon estimated to increase of 1,148 tonnes CO2e/year.
R08-03	New water sources within Bristol Water CAMS area for the location R08-03R	This option is the development of a new supply source on the R08-03R (abstraction would be from this location). Water will be pumped to P13R Water Treatment Works via a 13.2km (300mm diameter) pipeline for treatment and distribution. A pumping station would be located on the abstraction site (1.1 Ml/d, 66 mhd). No upgrades are required at P13R treatment works. The option was developed from the Bristol Avon and North Somerset CAMS assessment. The yield has been assessed as 1.1 Ml/d. The operation of the scheme is expected to result in 5,200km/year of vehicle movements. Construction would be over 1.5 years. Embodied carbon emissions are estimated to be 3,911 tonnes CO2e. Operational carbon estimated to increase of 66 tonnes CO2e/year.

Option Name	Option Name	Option Description
R11	Cheddar Reservoir Standard WRMP14 design	This option would involve the construction of a new 9,000 Ml impounding/pump storage reservoir on land to the south of the existing Cheddar Reservoir. The scheme would maximise the use of the current licence by enabling the capture of more water at times of higher flows, and by conjunctive use with the River Axe and the storage component of the reservoir. The scheme would require the diversion of R11R (or complete capture of the stream). The infrastructure requirements include the construction of the reservoir of the above stated capacity, including an inflow weir and multi-level draw-off tower. The reservoir embankments would be constructed from an earth bund with clay core, lined with a concrete wave wall. In contrast to the existing reservoir, the construction of the reservoir would include environmental enhancements such as reduction of bund gradient, screening and planting and naturalising of embankments. There would also be the requirement for the redesign of intake arrangements for the monitoring weir and to increase the intake capacity to the full 250 Ml/d to capture storm inflows. This would require a 10 m by 20 m concrete intake chamber and automated valves and compensation control. The scheme would require 5km metres of 1500mm diameter HDPE pipe. Construction would last 3 years and involve a significant (undefined) capital investment. A yield of 16 Ml/d has been estimated. Significant emission of carbon during construction equivalent to 87,000 tonnes CO2e, principally embodied in construction materials. Operational energy use would be lower (-94 tonnes CO2e/a) than present as water is currently pumped out of the reservoir to optimise storage, which wouldn't be necessary with additional storage.
R23-01	Purchase water from third parties from water companies	This option would involve a supply being made available from Wessex Water's R23-01Ra service reservoir, located to the South West of Bridgwater, and transferred via a new 27.6 km main to Bristol Water's P09R treatment works. A 2.5km spur from this main would feed the R23-01Rbservice reservoir. A new pumping station would be required at R23-01Ra. The option would involve the transfer of 'spare' resource within the capacity of Wessex Water's distribution system, would be within existing licence and would not require any 'new' abstraction licences. The option has an estimated the 3 year construction period. Estimated 1,000 HGV movements projected over the construction period. It is also assumed that Bristol Water would need to contribute to the upgrade of R23-01R WtW in order to provide the additional resource. Embodied carbon in materials and emissions from construction estimated at 14,881 tonnes CO2e. Operation carbon emission is estimated at 644 tonnes CO2e/year.

Option Name	Option Name	Option Description
R24	Bring R24R source back into supply	R24R Well is currently out of service due to high turbidity and associated risk of cryptosporidium. To bring this well back into service it is proposed to pump water from R24R to P10R Water Treatment Works. This option would involve the construction of a new pumping station at the R24R site and the construction of a new 4.2km 300mm diameter pipeline. The construction involves 'low' capital investment. The scheme will bring a yield of 2.4 Ml/d. Embodied carbon during construction is equivalent to 1,583 tonnes CO2e. Operational carbon emission is estimated at around 108 tonnes CO2e/a.
D21.01	Active Leakage Control	The Active Leakage Control (ALC) option covers the continuation of the current leakage detection find and fix policy. It represents the next tranche of leakage reduction through find and fix activities (Active Leakage Control) beyond the revised draft WRMP19 baseline leakage level of 39.33 Ml/d from 2024/25. The methods of this form of leakage control include sounding using leak noise detection equipment and zonal step tests to isolate areas of leakage. Extra activity will reduce the length of time that leaks run, which is the most significant component of leakage. This revised option for the revised draft WRMP19 will lead to a reduction in leakage from 39.33 to 36.5 Ml/d. Embodied and construction carbon emissions are estimated at 134 tonnes CO2e over 5 years. This estimate covers fuel use between sites, fuel use on site, traffic diversions, traffic disruption and materials consumption. The option will result in a decrease in energy use associated with the treatment and pumping of water, and this is estimated at 234.5 tonnes CO2e/a once fully implemented.
D21.02	Active Leakage Control	The ALC option covers leakage reduction beyond that which would be achieved by implementing Option D21.01. The methods of this form of leakage control include sounding using leak noise detection equipment and zonal step tests to isolate areas of leakage. Extra activity will reduce the length of time that leaks run, which is the most significant component of leakage. This revised option for the revised draft WRMP19 will lead to a reduction in leakage from 36.5 Ml/d to 35.0 Ml/d. Embodied and construction carbon emissions are estimated at 71 tonnes CO2e over 5 years. This estimate covers fuel use between sites, fuel use on site, traffic diversions, traffic disruption and materials consumption. The option will result in a decrease in energy use associated with the treatment and pumping of water, and this is estimated at 122.5 tonnes CO2e/a once fully implemented.

Option Name	Option Name	Option Description
D23	Asset Renewal	This option would involve the replacement and renewal of trunk mains. This option excludes replacement of communication pipes and Customer Supply Pipes (CSP) (from the property boundary to inside the property). Embodied and construction carbon emissions resulting from the associated vehicle movements, plant excavations and new pipeline have been estimated at 21,046 tonnes of CO2e. The option will result in a minor decrease in energy use associated with the treatment and pumping of water, and this is estimated as between 1-100 tonnes CO2e/a once fully implemented.