C5 B

Cost and Efficiency

C5B Technical Annex 06
Bulk Meters and Pressure Control Valves Investment Case:
Technical Approach and Business Case

NTPBP-INV-BUL-0531

BRISTOL WATER

Contents

Tables

Figures

1 Foreword

The Bulk Meters and Pressure Control Valves investment case will cover maintenance and upgrade works on our bulk meters and pressure reducing valves assets, and associated chambers and kiosks.

Bulk flow water meters are an instrument for recording the total quantity of water passing through a particular pipe. It is important that our bulk meters accurately record flows as these measurements are used in the supply/demand balance analysis and reporting assessments

The purpose of this document is to set out Bristol Water's customer led, outcome focused plan which will mitigate risks posed by and associated with bulk meters and pressure reducing valves.

The investment case, one of 21, will summarise the facts, risks and investment requirements for bulk meters and pressure reducing valves for the next review period for 2020 to 2025. This investment case will also summarise performance for bulk meters and pressure control valves for the current review period from 2015 to 2020 and our methodology for determining and delivering the future bulk meters and pressure reducing valves strategy.

This investment case document is a technical annex to section C5B of our overall business plan submission, as illustrated by the diagram below:

This investment case is aligned to the Water Network Plus Wholesale Control aspect of our business plan. It is recommended that this investment case is read in conjunction with the PR19 Investment Cases Summary Document[1] which outlines in detail our methodology for defining investment.

[1] Bristol Water PR19 Investment Cases Summary Document NTPBP-INV-PR1-0635

2 Executive Summary

In order to meet the customer priority of saving water before developing new supplies, we will replace 125 bulk meters located in our distribution mains and also replacing 15 bulk meters located at our water treatment works. We will achieve this by using our totex investment approach which includes investment in base maintenance and capital expenditure of £1.178m. We will deliver two interventions that will improve asset health, comply with statutory obligations, and contribute towards our leakage performance commitment. Our investment in assets will also improve our data accuracy and supply/demand monitoring and control. We will challenge ourselves to deliver more efficiently and apply innovation to the processes we adopt to renew our network assets. When considering our efficient and innovative approach we plan to deliver our bulk meters and pressure control valves capital programme for £1.083m.

At Bristol Water we have completed an extensive customer engagement programme which has identified that customers want us to focus on reducing the demand for water, through measures such as leakage reduction and water efficiency, when considering the long-term supply requirements within our operating area.

Managing leakage and water usage is important for delivering a resilient network in the long-term and avoiding over-abstraction of our water resources. Our Water Resources Management Plan indicates that demand management, including leakage reduction, will maintain our supply/demand balance.

Through our engagement programme, customers have told us that they want us to save water before developing new supplies. Our bulk meter and pressure control valve investment allows us improve our metering and pressure control systems to identify and implement improvements to leakage control, pressure control, and water efficiency.

Accurate and reliable bulk flow meters (and pressure control valves) are an essential part of our plans to improve the management of our system. Enhanced accuracy of our effluent flow (MCERT[2]) meters will contribute to monitoring the efficiency of our treatment works, and ensure that in complying with Environment Agency discharge conditions we are safeguarding the water quality of our lakes and rivers.

We will therefore invest to replace 15 effluent meters monitoring effluent discharge to the environment, and to replace 125 of our distribution bulk flow meters to enhance monitoring of our water transfer networks, with further replacement due in AMP8/9.

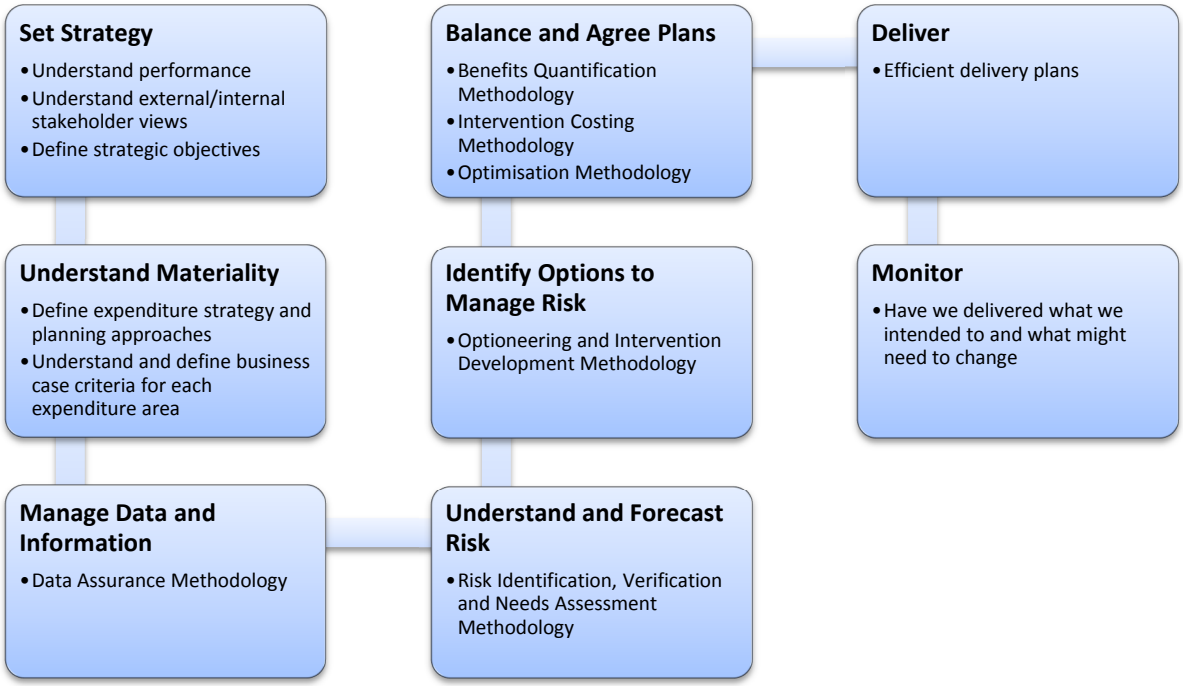
Pressure control valves reduce network over-pressures and leakage volumes. Risks related to our network pressure control valves have been analysed within this investment case. However, our leakage investment case includes the analysis and investment requirements related to pressure management, and covers maintenance for our reporting infrastructure, including the replacement of pressure reducing valves where required. Therefore no investment is included within this investment case for pressure control valve replacement, as the associated analysis is covered in the leakage investment case.

[2] MCERT is the Environment Agency's monitoring certification scheme.

Should we fail to invest in bulk flow meters and pressure control valves, a key risk is that we will not be able to manage and control our system performance and leakage, and we will be unable to meet our customers' preference for saving water before developing new supplies. There is also a risk of data inaccuracies being recorded and the subsequent risks associated with the usage of this flow data and information where both supply/demand calculations and flow discharge volumes could be in error. With these flows being required for both internal and regulatory reporting requirements there is also the potential for under or over reporting of flow information. Accurate flow meters are also essential to inform us when dealing with operational events, thereby mitigating the impact of these events.

To ensure that we meet our customers' preferences and mitigate the risks associated with bulk flow meters and pressure reducing valves, we have adopted the following standard methodology:

Figure 1: Approach to meeting customer Preferences and Mitigating Risks



This approach enables us to demonstrate full "line of sight" from customer priorities, through risk review, options analysis and investment optimisation, to outcomes and benefits provided for our customers.

We plan to invest £1.178m between 2020 and 2025 in order to achieve the performance commitments associated with the outcome 'Local Community and Environmental Resilience, as set out in Table 1.

We have set ourselves a challenging target of reducing our costs by 8% across all investment requirements during AMP7. This will be achieved by delivery of our business transformation programme results in in a post-efficiency investment of £1.083m.

Costs are allocated to the Treated Water Distribution Business Unit. Investment is a mix of both maintaining the long term capability of our non-infrastructure assets and other capital expenditure on infrastructure assets.

Table 1: Associated performance commitment targets and percentage contribution

Performance commitment	Unit	2019/20 Baseline	2024/25 Target	Total performance improvement required in AMP7	Bulk meters contribution to performance improvement
Leakage (annual)	Ml/d	43	36.5	6.5	1.49%

Our AMP7 investment in bulk meters and pressure control valves will help ensure our assets are being maintained appropriately to deliver resilient water services to current and future generations.

Full details of our outcomes, performance commitments, and outcome delivery incentives are provided in Section C3 of our business plan.

3 Background To Our Investment Case

3.1 Context

This investment case summarises the investment in AMP7 to provide customers with a resilient water supply, and meet their preference of saving water before developing new supplies, through the investigation, maintenance and replacement of our bulk meters located in our distribution mains and at our water treatment works.

We define a bulk flow water meter as an instrument for recording the total quantity of water passing through a particular pipe. It is important that our bulk meters accurately record flows as these measurements are used in the supply/demand balance analysis and reporting assessments.

Bulk flow meters are installed at key points within our distribution network, typically on the main supply to a waste water meter district, or trunk mains linking waste water meter districts. The ability to remotely monitor flow in and out of each zone allows us to determine if the demand patterns differ from the normal demand, which may be indicative of leakage. Likewise, the correct placement and accuracy of our raw water bulk meters ensures that we are not over-abstracting from raw water resources.

This investment case addresses our three main bulk meter applications, as listed below:

1. **Monitoring flows in the distribution network**

   Bulk meters that monitor flows in the distribution network are typically installed on the delivery to waste of water meter districts. UK Water Industry Research Ltd (UKWIR) carried out a survey and reported on the accuracy of bulk flow meters in their report The Accuracy of District Meters[3]. This report identifies that the accuracy of turbine meter decreased with age of the meter. It recommended that to ensure that meters provide accurate data, those with ≥12 years' service should be replaced. This replacement strategy was peer reviewed by our key operational stakeholders, who confirmed the need for investment for proactive replacement of our obsolescent mechanical turbine (Helix) meters.

2. **Monitoring raw water abstraction**

   Our monthly production efficiency reporting has identified discrepancies between our abstracted flows and our treated water flows. Further investigation raised concerns regarding the accuracy of flow monitoring in the raw water network. As a result there is a risk that we are over-abstracting some of our sources, and that we are failing to achieve the required compensation flows required by the Environment Agency.

3. **Monitoring effluent discharges to the environment**

   We have 15 effluent discharge meters. New Environment Agency regulations require these meters to comply with the MCERT[4] specification, or we could incur a fine for non-compliance. Knowing accurately how much we are discharging as effluent is important in understanding how much water is being used so as to establish our flow and supply/demand balance. Also, complying with

[3] UK Water Industry Research Ltd, 2015, The Accuracy of District Meters, 15/WM/08/54

Environment Agency discharge conditions ensures we are safeguarding the water quality of our lakes and rivers.

This investment case has been developed as part of strategies to managing leakage and water usage to deliver a resilient network in the long-term, and to avoid over-abstraction of our water resources. It has also been developed to ensure compliance with the new Environment Agency standards for monitoring effluent discharges to the environment.

The investment case covers replacement of obsolescent and non-compliant bulk meters. This includes replacement or refurbishment of existing assets and the associated chambers and kiosks.

An assessment of any risks generated in connection of our network pressure reducing valves has been included within the Bulk Meters and Pressure Control Valves investment case; however the leakage investment case also includes investment for pressure management. The leakage investment case include investment for the maintenance for our pressure management and monitoring infrastructure and includes pressure control valve replacement where required. Therefore no investment has been included within this investment case for pressure reducing valve replacement.

The following assets are included within other investment cases:

- Instrumentation, control and automation and telemetry (see instrumentation, control and automation and telemetry investment case)
- Bulk meters and pressure reducing valves installed as part of new mains installation and mains rehabilitation (see trunk mains, distribution mains, and resilience investment cases) and as part of leakage reduction (see leakage investment case).

Flow meter systems are maintained as specified in our maintenance schedule appropriate to the assigned asset grade. MCERT meters undergo 5 yearly inspections by Environment Agency Inspectors. Our raw water and distribution bulk meters, while not requiring the same Environment Agency accreditation, are managed and maintained to the same standard as the MCERT meters.

This investment case is also interdependent with the following investment cases as they share the same performance commitment targets of leakage.

- Trunk Mains
- Distributions Mains
- Network Ancillaries
- Network Monitoring
- Leakage

3.2 Strategy

Developing the investment needs for our bulk meters and pressure control valves is underpinned by our long term corporate strategy which has the vision ***"Trust beyond water-we provide excellent experiences"***. Our Outcomes Delivery Framework, together with our Strategic Asset Management

[4] MCERT is the Environment Agency's monitoring certification scheme.

Plan, provides the strategic framework that supports this vision and enables investment in our bulk meters and pressure control valves to clearly focus in delivering against outcomes and Performance commitments.

Our long term strategy, as set out in the Outcome Delivery Framework (Section C3 of our Business Plan), has a focus on resilience and a growing need to ensure that our assets are, and remain, maintained and effective in meeting our performance requirements. There are three strategic drivers identified that together, ensure we meet our current and future needs for customers and stakeholders. These are:

- **Operational Resilience** - which have performance commitments to reflect reliability, resilience and quality of water
- **Customer Focused** - performance commitments to reflect customer service and affordability
- **A Sustainable Business** - performance commitments to reflect the environment representing our community and sustainable resources

Within this strategy there are specific outcomes (local community and environmental resilience) and specific performance commitments (leakage) that have strategic targets and incentives that will be directly influenced by our investment needs for bulk meters and pressure control valves.

Our Asset Management Strategy has objectives developed in alignment with the long-term strategy and delivery of corporate objectives and outcomes. These objectives cover both our short-term needs and longer-term aims, and drive the capability development plan and asset planning activities. Delivery of the investment for our bulk meters and pressure control valves will be driven through the Asset Management Framework, which is designed to enable the efficient and effective planning and delivery of all our asset related activities, to successfully deliver our business and customer outcomes. The framework aligns to, and interacts with, our corporate drivers, which in turn are there to deliver the external expectations and requirements placed upon us by our stakeholders.

Our Strategy for bulk meters and pressure control valves is to maintain a risk level within our networks that translates into a stable and acceptable level of service for our customers. It also aligns to the Water Resources Management Plan options appraisal and reflects the resulting recommended activities.

We also need to ensure that planned investment is sufficient to maintain the health of our assets, to allow the continuation of business as usual activities through routine and reactive maintenance, and to enable the continued provision of high quality water to our customers.

3.3 Customer Priorities

Customer priorities relating to Bristol Water's outcomes and performance commitments have been determined through our extensive programme of customer engagement and research. During the development of our business plan we have engaged with over 37,000 customers and conducted over 50 pieces of research. By delivering customer engagement, we have ensured that we can build on the customer insights that we have gained, producing a business plan influenced by our engagement events. This ensures that at Bristol Water we have engaged effectively with our customers on longer-term issues, and have taken into account the needs and requirements of different customers including those in vulnerable circumstances and also our future customers.

Through this process our Customers have told us that their top priorities have remained largely unchanged from PR14 and have been identified as follows:

- You can get a bill you can afford;
- Keeping the water flowing to your tap;
- Help to improve your community;
- Save water before developing new supplies; and
- You get the best possible experience every time you need us.

Our engagement with our customers has resulted in the development of four specific outcomes for PR19, which capture what our Customers and stakeholders have said; these are:

- Excellent Customer Experiences;
- Safe and Reliable Supply;
- Local Community and Environmental Resilience; and
- Corporate Financial Resilience.

In order to deliver our customers' priorities and outcomes we will measure progress via twenty six performance commitments for which we have set delivery targets.

There is a clear relationship between our investment in bulk meters and pressure control valves our outcome Local Community and Environmental Resilience.

We undertook more detailed discussions at phase 2 of our engagement process; gathering evidence (see section **C1 – Customer engagement, communication and research** appendix to our business plan) which gave us a wealth of information about how our customers' view Bristol Water, our services, and long term plans. We also explored short and long-term trade-offs in decision making and asked customers to tell us how we should approach long term issues of resilience and how we could best respond to service interruptions. Our research shows that leakage is a consistently high priority for customers. 98% of customers in our annual survey, and on our online customer panel, said it is quite important or very important to them[5]. When we talked to customers in detail about how we can address leakage as part of our WRPM deliberative workshops[6],they told us that they favour Active Leakage Control, followed by pressure management. Identifying where leakage is occurring through the data provided by bulk flow meters provides an essential contribution to identifying abnormal flow patterns attributable to leakage within our zonal distribution areas.

We consulted on three potential scenarios in relation to Local Community and Environmental Resilience outcomes, as summarised below:

[5] A5: Annual survey 2018
[6] B23: WRMP demand reduction deliberative events

			2024/25 target		
Service	**Performance Commitment**	**2020 target**	**Slower improvement plan**	**Suggested improvement plan**	**Faster improvement plan**
Leakage	The amount of water lost from pipes (million litres per day)	43.0	41.0 5% reduction	36.5 15% reduction	36.0 16% reduction
Water used by customers	Water use per person (litres per day)	142	138 3% reduction	135 5% reduction	129 9% reduction
Enhancing your local environment	Biodiversity index (score)*	17,658	17,683 25 point increase	17,711 53 point increase	17,858 200 point increase
Customers satisfied with our contribution to the local community	Community satisfaction survey	N/A – new measure	Continue current initiatives such as 'Refill' and Water Bar	Enhanced recreational benefits from our sites Working in partnership to deliver community benefit, such as reduced use of resources	Accelerated programme to deliver wider community benefits
Forecast increase to the average bill from additional investment			**£3**	**£10**	**£12**

10 points is equivalent to approximately 1 hectares of great new habitat

When discussing local community and environmental resilience outcome with our customers in our draft business plan consultation, the performance commitments under this outcome had some of the highest levels of support for the faster plan, and for the slowest plan, reflecting the mixed views our customers have about how much of a priority these issues should be for investment.

Results show affordability concerns have driven some customers to choose the slower plan, whereas customers also value the service improvements in the suggested plan. In summary, we consider that a plan with a lower bill level with the suggested improvement plan is more likely to be acceptable to more customers (particularly low-income groups). You can see more about how the feedback from our draft business plan consultation influenced each of our performance commitments in section C3.

The level of support for our plan expressed by our customers, both those we have engaged with over a period of time and those we met for the first time, gives us confidence that our final business plan strikes the right balance of delivering service improvements that customers value at a price that is acceptable to the majority.

This investment case describes how we will achieve the suggested improvement plan and associated level of performance through our investment in bulk meters and pressure control valves, specific details on our planned investment and associated performance can be found in Section 3.4.

3.4 Asset Health, AMP7 Performance Commitments, & Outcome Delivery Incentives

The health of our assets is a key element in delivering resilient water services to our customers. Our investment in bulk meters and pressure control values will help ensure our assets are being maintained appropriately for the benefit of current and future generations.

This investment case supports the outcome 'Local Community and Environmental Resilience', by investing to make our services robust to what the future may hold.

The Local Community and Environmental Resilience outcome will be measured through a set of associated performance commitments. Our planned investment in bulk meters and pressure control valves will support the achievement of the performance commitments set out in Table 2.

Table 2: Associated performance commitments

Performance commitment	Unit	2019/20 Baseline	2020/21	2021/22	2022/23	2023/24	2024/25	Performance improvement required in AMP7
Leakage (annual)	Ml/d	43	42	41	39.5	38	36.5	6.5

Full details of our outcomes, performance commitments, and outcome delivery incentives are provided in Section C3 of our business plan

A detailed diagram illustrating the full line of sight between customers, outcomes, performance commitments, and outcome delivery incentives related to this investment case is included in Appendix A.

3.5 Compliance Obligations

Statutory and compliance obligations have influenced the development of interventions in this investment case and the investment for AMP7.

We have a compliance obligation under the Environmental Permitting Regulations 2010 to ensure that all of our licenced discharges meet our effluent discharge consent conditions including daily discharge volumes and the rate of discharge.

All flow meters monitoring effluent discharges to the environment are required to meet standards identified by the Environment Agency's monitoring certification scheme (MCERTS) for self-monitoring of flows.

The MCERTS standard specifies the Environment Agency's minimum requirements for meters, and covers:

- Performance requirements for flow-metering installations in terms of a target measurement uncertainty; and
- Management system requirements to ensure the on-going performance of flow metering installations

Within this investment case there are specific risks that we are seeking to mitigate in order to ensure our continued compliance with these consents. While effluent discharge flow meters are installed and operational on our waste discharges, we know that there is an outstanding requirement to upgrade these meters to ensure that they are fully compliant with the Environment Agency metering requirements.

3.6 AMP6 Investment And Performance

Our AMP6 investment in bulk meters and pressure control valves supports our ability to meet our performance commitment for leakage. Our investment in AMP6 will also underpin our performance commitments for leakage in AMP7.

AMP6 capex investment related to bulk meters and pressure control valves is summarised in Table 3. We have re-categorised data used in line with the scope of our investment cases. For historic data we have used the 2016/17 wholesale cost assessment data (data tables 1 and 2). Forecast data has been derived from PR19 data (data tables WS1 and WS2).

Table 3: AMP6 capital investment

Year	Bulk meters and pressure control valves investment capex (£m)
2015/16 actual	0.000
2016/17 actual	0.021
2017/18 actual	0.035
2018/19 forecast	0.160
2019/20 forecast	0.186
AMP6 forecast	**0.403**

Our AMP6 investment provides targeted replacement of operational trunk main flowmeters, and the installation of next generation consumption monitors at key locations in our network.

The AMP6 performance commitments that are related to bulk meters and pressure control valves investment, and our performance is given in Table 4.

Table 4: AMP6 performance related to bulk meters and pressure control valves

Performance commitment		2015/16	2016/17	2017/18	2018/19 (Forecast)	2019/20 (Forecast)
Leakage (Current Leakage) (Ml/d) (annual)						
Bristol Water	Target	48.0	47.0	45.0	44.0	43.0
	Company Performance	44.2	46.4	46.6	44.0	43.0

At PR14, we set ourselves challenging leakage targets; to reduce leakage by 12% between 2015 and 2020. Our 2017/18 performance was below target due to a number of factors primarily the exceptional weather at the beginning of 2018. We underperformed against our target for 2017/18 due to the exceptional weather in 2017/18. Excluding our estimate of a 1.7Ml/day impact of the cold weather in March 2018, our actual current leakage performance after technical data adjustments improves from 46.6Ml/day to 44.9Ml/day. This would have been in line with our target of 45Ml/day. Towards the end of 2017/18 we began to see benefits from our deployment of additional resource and the impact of

improving the effectiveness of our leakage response. We have implemented an action plan to improve on our Leakage performance to ensure we meet our AMP6 target. We are currently forecasting to achieve the final year AMP6 target of 43 Ml/d. Our investment in AMP6 will also underpin our performance commitment for Leakage in AMP7. Full commentary on our Leakage performance is provided in our 2017/18 Annual Performance Report.

4 Developing Our Investment Plan

As we have discussed earlier, the starting point for investment case development is to understand our customers' priorities and determine associated performance commitments. We have adopted totex principles to determine how we should invest in order to deliver these priorities and associated commitments. The totex approach we have adopted considers which the best solution is because it is the lowest cost over the whole life of the asset, regardless of whether it is operational or capital expenditure.

Whilst we do not currently have health and risk indices across our asset groups, we do have a wealth of data. In some cases, analytical models such as the mains deterioration model, provides us with a view of how our assets are performing, as well as a view on their deterioration. The following section describes the process we have created and followed in order to develop our investment cases.

4.1 Investment Case Development Process

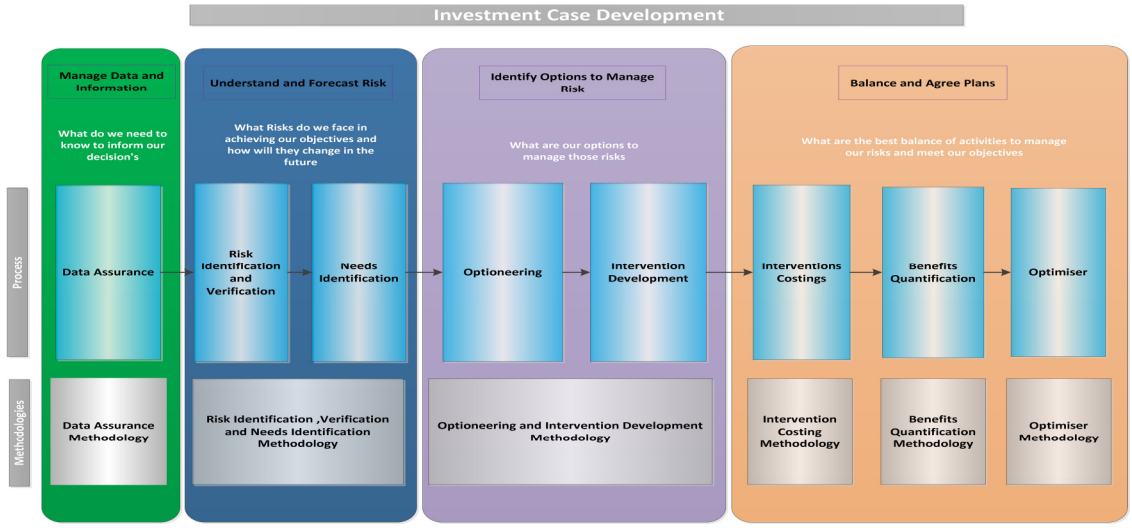
We have created and implemented a process that is supported by a set of six methodologies. When developing the methodologies, we wanted to ensure that they:

- Deliver what the customers have asked for;
- Satisfy our business needs; and
- Deliver a high quality business plan in accordance with Ofwat's Company Monitoring Framework.

The collective application of these methodologies has enabled us to develop investment proposals that are well evidenced through a line of sight approach, ensuring our investment plan achieves the required targets at the optimal cost.

Figure 2 Illustrates, at a high level, the process required to identify risks that require addressing in AMP7, and the subsequent development of appropriate interventions.

Figure 2: Investment case process overview - Level 1 diagram



An overview of each of the key stages is described below and all of the methodologies are provided in the PR19 Investment Cases Summary Document.

4.1.1 Data & Data Assurance

The development of our investment cases is dependent on having consistent, accurate and assured data. We therefore recognise that we must be able to demonstrate the quality of the data and information used in the development of our investment cases.

Wherever possible, we have utilised data from our core company systems in order to undertake our analysis and we have sense checked the quality of the data as we have used it.

However, in addition, we have applied a data assurance methodology. We have assessed data quality in terms of completeness, accuracy and reliability. In addition, the methodology also assesses whether data is used as part of the Annual Performance Report to Ofwat, and hence already subject to existing Annual Performance Report assurance mechanisms.

In total we have developed twenty one investment cases. The values of these investment cases range from less than £1m to over £37m. Our overall capital investment plan totals circa £212m.

We have selected a sample of nine investment cases, and have applied detailed data assurance based on their value and complexity. The total value of these nine investment cases represents 66% (circa £140m) of the total capital investment plan, and represents 286 individual data types. We have evaluated all 286 data types and we have evaluated them for quality and their use in the Annual Performance Report process. The overall data quality assessment identified 93% of the data as being good quality, and 55% as having been used and assured through the Annual Performance Report process.

This investment case was not included as part of the sample of nine investment cases. We will continue to focus on improving the quality of our data and the associated assurance processes.

4.1.2 Risk Identification, Verification & Needs Assessment Methodology

The purpose of our risk identification, verification and need assessment is to ensure that:

- The risks that we are currently facing are captured in a single risk register; and
- Each risk is assessed and verified to determine details about the nature and magnitude of the risk and whether any mitigation is currently planned in this AMP period; and
- Each risk is scored on a common basis to allow risks to be compared; and
- The most significant risks are identified, and that for each a clear and uniquely referenced statement of need is produced to define the problem as clearly as possible, and to identify what benefits or performance commitments mitigation of this risk will achieve.

The risk score is the product of the likelihood and consequence, each is scored 1 to 5 and then multiplied together to provide a potential maximum risk score of 25.

Risks scoring 15 to 25 are the most significant strategic risks, and these were developed into needs statements.

Those scoring 10 or 12 were subject to a further round of review and where it was considered that mitigation of the risk will enhance our ability to meet our performance commitments, the risk was selected and developed into a needs statement.

The risks scoring 1 to 9 were considered to be risks of a lower priority and were therefore not considered further as part of the PR19 investment planning process.

Unselected risks will continue to be monitored and assessed as part of the live business and on-going business as usual risk management process. Where there is a need to mitigate these risks within the AMP, we will respond with appropriate action, such as increased base maintenance.

Further development of our business as usual risk management process is on-going and we are looking to innovate by developing smarter systems to optimise this process.

We developed need statements for all selected risks.

4.1.3 Optioneering & Intervention Development Methodology

The next stage in our process is to develop options of how we could meet the needs of the selected risks.

To generate the options, data was gathered from a number of sources (see Appendix B). This included meetings with stakeholders and historical records, including reviews following operational events, previous scheme proposal reports and previous options assessment reports.

We then progressed to data assimilation, analysis and consultation with key stakeholders. Multiple options were developed and recorded. These options were reviewed and all options identified as not viable were discarded.

All viable options were identified as proposed interventions with a unique reference number and were taken forward for further scope development, benefits calculation and costing.

4.1.4 Intervention Costing Methodology

In order to provide assurance of our investment costs and to ensure standardisation, we engaged ChandlerKBS as our costing partner. They were selected in part due to their ability to provide us with industry comparable cost data, often at intervention level. They supported us in several ways:

- In some instances development and analysis of intervention costs, and
- Support to build our cost database.

Indirect overheads, such as contractor costs, design costs, contract management, and our overheads have been applied at intervention level. Wherever possible we used our data or if unavailable, we used industry average costs.

Therefore we have to assess the expected capital cost of each intervention.

Expected Capital Cost (capex after)

If we deliver the capital expenditure intervention in a planned way, we have labelled it as capital expenditure (capex) after'. This is the expected capital cost of the intervention.

Cost estimates were usually based on high level scopes, which contained activity schedules provided by ourselves, and were developed using the cost model we developed with ChandlerKBS.

4.1.5 Benefits Quantification Methodology

The benefits for each intervention are those which are considered to affect company performance during subsequent AMP periods.

Benefits can be assessed as either being:

- Direct – savings in reactive capital expenditure (capex) or savings in operational expenditure (opex); or
- Indirect – improvement in performance commitments or other resultant effects on the company's performance.

Both direct and indirect benefits are considered and quantified.

Direct Benefits

We have a totex approach which considers both capital and operational expenditure.

Expected Capital Cost (capex before)

If we deliver the capital expenditure intervention in an unplanned way, we have labelled it as 'capex before'. This is the reactive cost that would potentially arise if we had to deliver the intervention in an unplanned way.

We could respond to this scenario in one of two ways:

- 'Patch and Repair' or
- Implementation of the intervention in an un-programmed accelerated manner.

The capex before was estimated for each intervention. For most interventions the estimate is site specific. A risk factor, taken from the likelihood score recorded in the risk register, was applied to the initial capex value to produce the final capex before value.

Where a 'patch & repair' solution would not be appropriate, should the risk materialise, this would lead to the immediate implementation of the intervention. The cost of the intervention in this scenario is the expected capital cost of the intervention (capex after), with the application of a suitable uplift to cover the costs associated with fast-tracking the intervention, for example, the cost of labour at premium rates.

The expected capex before effectively formed the 'Do Nothing' option.

Expected Opex Before & Opex After

In most cases we have made an estimate of the operational expenditure levels either with investment - opex after or without investment - opex before. Opex includes power, chemicals, materials, contract hire and in house labour.

Opex before represents the opex expenditure associated with not mitigating a risk through capital investment, for example, increased maintenance visits or replacement of components.

Opex after represents the additional opex cost to the business after the implementation of an intervention. These could include negative values associated with predicted savings associated with increased plant efficiency or performance, or positive values where there is an operational cost increase, for example greater inspection levels.

Indirect Benefits

To measure our performance against our customers' priorities and the associated performance enhancements associated with interventions; we measure the impact that each intervention had on the performance commitment measure.

Other Benefits

In addition to the performance commitments described above, other indirect benefits which do not relate to performance commitments were calculated and recorded in the benefits calculations where appropriate. This includes avoidance of health and safety penalties, customer compensation payments, and environmental penalties. These benefits have been monetised.

Once the benefits were prepared, the interventions were put forward for investment optimisation.

4.1.6 Investment optimisation & Intervention Selection

The investment optimisation process determines which interventions are selected to provide the optimal AMP7 investment plan, by delivering the targeted performance commitment improvements, at the lowest cost. We have utilised a water industry standard system (Servelec 'Pioneer') to optimise our AMP7 investment plan. Pioneer provides the functionality for us to assess all interventions developed across all of the investment cases. It will assess the interventions both individually and in comparison to other interventions. It is a decision support tool that produces an optimal investment plan to meet the targeted performance commitment improvements required in AMP7.

The Pioneer investment optimiser model assesses interventions primarily on the overall benefit, which takes account of performance and whole life costs. The investment optimiser calculates the whole life cost as the net present value (NPV) over 40 years. This determines if an intervention is cost beneficial.

We will select interventions for one or more of the following reasons:

- The intervention is mandated (i.e. Drinking Water Inspectorate - water quality requirement).
- The intervention is cost-beneficial
- The intervention is required to achieve the performance commitment targets.

Any performance commitment improvement obtained from mandated or cost-beneficial interventions will contribute to overall performance improvement.

A series of business reviews and sense checks of the investment optimiser results have been undertaken prior to finalising the AMP 7 investment plan.

We can of course model any number of scenarios, and during the process of engaging our customers we ran three scenarios as described in Appendix C1 of our business plan (slower Improvement plan, suggested improvement plan and faster improvement plan).

4.2 Applying the investment process to bulk meters and pressure control valves

Each of the following sections describes the specific details associated with the application of the investment case development process for bulk meters and pressure control valves.

4.2.1 Risk Identification, Verification & Needs Assessment

There were four risks identified in the strategic risk register associated with this investment case. Every risk went through a process of assessment, scoring, and review.

All of the four identified risks were selected and developed into need statements. The risk descriptions, scoring and associated needs statements are captured in the strategic risk register and are provided in Appendix C.1.

An assessment of any risks generated in connection of our network pressure control valves has been included within the bulk meters and pressure control valves investment case; however the leakage investment case also includes investment for pressure management. The leakage investment case includes investment for maintenance for our reporting infrastructure and includes pressure control valve replacement where required. Therefore, while the assessment of risk related to pressure control valve replacement have been undertaken as part of investment case for bulk meter, no interventions or investment is included for pressure control valve replacement.

4.2.2 Optioneering & Intervention Development

All four risks were developed into needs statements. Two risks related raw water metering were covered by a single need statement.

For the three interventions assessed (including that of raw water flow meters), six options were established and peer reviewed. For this investment case the only options identified as alternatives to the proposed interventions were the ‘do nothing’ options. The ‘do nothing’ options were peer reviewed. The ‘do nothing’ option was rejected because it does not mitigate the risk.

All options developed for the bulk meters are presented in Table 5.

Table 5: Options selection

Strategic Risk Register (SRR) Reference	SRR Revised Risk Description	Risk Need		Identification & Viability of Options			
		SRR Need ID	Need Description (from SRR)	Proposed Option Name	Proposed Option Description	Option Viability?	Option to be Developed into an Intervention?
SRR712	Bristol Water has 15 effluent discharge meters. IF these meters are not upgraded to meet the latest MCERT specification as per the EA Regulations THEN there is a greater risk that Bristol Water will be fined for non-compliance.	SRRN123	Bristol Water has 15 effluent discharge meters. New EA Regulations require the meter installation to comply with MCERT specification or BW could incur a fine for non-compliance. Investment is required to bring all effluent discharge meter installations up to the new specification.	Do Nothing	Do not upgrade any meters and risk being fined by EA	Option does not mitigate risk or meet need, will not be a carried forward and turned into an intervention for these reasons.	N
				MCERT Meter Installations	Upgrade all 15 of Bristol Water's effluent discharge meters to MCERT specification as per Environment Agency regulations.	Option will mitigate risk of EA fine as new meters will meet EA specification.	Y
SRR713	UKWIR Report 'The Accuracy of District Meters', Ref No 15/WM/08/54 published in 2015 recommends replacement of network turbine meters older than 12 years. IF network meters older than 12 years are not replaced THEN the risk of turbine meters failing at low flows will be greater than 50%. The benefits of replacing turbine meters older than 12 years will give greater confidence in district meter data which will lead to more robust leakage estimates, enabling better targeting and use of resources for leakage control.	SRRN124	Bristol Water has some 245 Turbine (Helix) meters that are older than 12 years. These are likely to be failing at low flows and without the accuracy of data from these meters Bristol Water will be compromised in trying to meet its leakage target.	Do Nothing	Do not replace Helix Meters	Option does not mitigate risk or meet need, will not be a carried forward and turned into an intervention for these reasons.	N
				Bulk Meter Replacement Programme	Replacement of 125 Helix meters over 12 years old during AMP7.	Yes	Y
SRR707	The leakage from the raw distribution system provides an indication of the condition of the system. IF raw water flows cannot be accurately measured THEN then knowledge on the condition of the raw water system cannot be gained and this leads to increased probability of Unplanned outage of the works due to raw water supply failure.	SRRN114	Bristol Water has over 94km of raw water distribution mains and aqueducts with an average age of 86 years and an average diameter of 30". Some parts of the system are some 150 years old. This system supplies water to treatment works including Barrow, Banwell and Cheddar and as such supplies about 1/3 of all production. Failure of part of the system could result in unplanned outage of a treatment works. However the condition of this system is very poorly understood. The level of leakage from the raw network can provide a indication of the condition but there are very few flow meters and those that exist are not calibrated. Investment is needed to understand leakage better so that unplanned outage of treatment works can be avoided. Reduction of leakage from the raw water network is a key part of the Water Resources Management Plan 19 and the installation of flow meters is the first step in understanding where this leakage is occurring.	Raw water meters	This option involves the installation of raw water bulk meters at 25 sites across the raw water distribution system.	Yes	Y
SRR708	IF raw water flows cannot be accurately measured THEN there is an increased probability that a source will be over-abstracted and BW will incur a fine from the Environment Agency.						

All viable options were developed as interventions and given a unique reference number, all viable options were taken forward for further scope development, benefits calculation and costing. A total of three interventions were identified in this way.

Once interventions were developed, costs could be prepared which are discussed in Section 4.2.3.

4.2.3 Intervention Costing

In this investment case costs for all interventions were initially calculated in collaboration with ChandlerKBS, based on activity schedules supplied by Bristol Water.

For each of the three interventions, high level scope documents were developed including an activity schedule and, where appropriate, annotated drawings. ChandlerKBS utilised a water industry unit cost data base to complete their estimation in accordance with their own assured methodology.

The costed activity schedules were returned to Bristol Water for peer review, leading to further refinement in collaboration with ChandlerKBS. Often, we used historical data to cross check through this process.

A peer review was undertaken of the ChandlerKBS cost estimates for meters. For the MCERT meters costs, the review concluded that as there are a number of large diameter meters, it was appropriate to use the ChandlerKBS costs for this intervention. However the peer review challenged the ChandlerKBS cost estimate for replacement of turbine meters as it was notably higher than our anticipated cost, and in this case we reverted to use in-house estimation based upon our historical cost data.

The cost for each developed intervention is presented in Appendix E. An example of how those costs have been developed is outlined below.

Cost Example: MCERT Meter Installations

Investment is required to replace 15 bulk meters of 5 different sizes with certificated MCERT meters on all of our effluent discharges to the environment. A timely intervention now will avoid the need for unplanned work in the future for which we would expect to have to pay a premium for, if the Environment Agency were to insist on upgrade of our meters.

We have established a cost of undertaking the works of £0.727m. As well as the costs of the 15 meters, this cost includes labour and materials as well as contractual costs. The latter includes items such as (but not limited to) contractor accommodation, contractor management, contractor overhead and profit and design.

We have then applied Bristol Water's overhead of £0.116m for activities associated with the intervention such as project management, land and compensation, legal, environmental costs, commissioning handover, contract management, operations and system support, consultants and administration.

All of the direct costs above give us an intervention cost of £0.843m, if we undertake the investment intervention in a planned way (capex after).

If however, we did not undertake the work to repair the asset proactively, then we would have to complete it reactively. Should we have to undertake this work reactively we would expect to have to pay a premium for delivery. We have therefore used the implementation of the intervention in an un-

programmed accelerated manner calculated at £0.843 for replacing all 15 meters. At premium rates, our assessment is that we would increase the delivery cost by £0.422m, leading to a total cost of £1.265m.

We have applied a factor to account for the likelihood of the risk materialising within the 5 year AMP, we have assessed this likelihood as 10% (1 in 10), giving a reactive cost of £0.126m (£1.264m multiplied by 1 in 10).

We have established that regardless of whether we undertook the above intervention in either a planned or reactive way, there would be no change in operational expenditure (opex after).

Once interventions were costed, benefits could be calculated which are discussed in Section 4.2.4.

4.2.4 Benefits Quantification

Three interventions were assessed for Direct and Indirect benefits. These are presented in Appendix E.

The performance commitments that relate to this investment case are discussed below.

Leakage

The leakage benefit from replacing bulk meters within the distribution network was assessed based on the assumption that leakage can be better detected when meters are accurate. A suspected leak typically identified when the night flow is above expected trigger values. Therefore if the night flow is not measured accurately leakage will not be identified accurately.

Other Benefits

In addition to the performance commitments described above, other indirect benefits which do not relate to performance commitments have been calculated and recorded in the benefits calculations where appropriate. This may include health and safety penalties, customer compensation payments, and environmental penalties. These benefits have been monetised and included on the investment optimiser input form as ‘Other Benefits’.

For this investment case ‘Other Benefits’ are the avoidance of environmental penalties which would be imposed by over abstraction of sources or discharging flows to watercourses above our consented limits.

5 Outcome

5.1 Selected Interventions

The three interventions developed within the bulk meters and pressure control valves investment case were assessed through the investment optimisation process. Of these three interventions, two were selected.

When it comes to delivering our programme of works we know that we must continue to be innovative and efficient. We have set ourselves a challenging target of improving our cost efficiency by 8% during AMP7. This will be achieved by delivery of our business transformation programme.

We see innovation as integral to our everyday working at Bristol Water: We have deliberately embedded it within the business-as-usual processes of our asset management teams by embracing the full flexibility that totex and outcomes enables. We will look to be innovative in the following ways:

- **Open Innovation:** We have defined our strategic innovation challenges and run events such as our "Innovation Exchange" that invite suppliers to present their innovative solutions to predefined challenges that we set
- **Market Scanning:** We conduct market scanning through for cutting edge technology against our strategic innovation challenges and feed this into our optioneering process. In particular we subscribe to the Technology Approval Group which regularly scans and meets with water companies to unearth the most promising innovations for the sector
- **Partnering:** we undertake leading research into areas that we provide effective solutions for the future.

We will specifically look for process innovations that mean we can contribute to our 8% efficiency challenge and keep our customer's bills low into the future.

The two selected bulk meters interventions are set out in Table 6, along with details of the associated costs and contribution to performance improvement.

Table 6: Selected Interventions, costs, and % performance contribution

ID	Intervention Title	Capex (£)	Change in Opex per annum (£)	Leakage
06.001.01	MCERT Meter Installations	£843,175	£0	-
06.001.02	Bulk Meter Replacement Programme	£334,342	£0	1.49%
Bulk meters capex investment (pre-efficiency)		**£1,177,517**	£0	**1.49%**
Bulk meters capex investment with 8% capex efficiency		**£1,083,316**		

The MCERT Meter Installations intervention is selected because it is considered a mandatory requirement to meet our obligations under the new Environment Agency regulations.

The Bulk Meter Replacement Programme intervention is selected because it maintaining our asset health and provides contributions to the achievement of our leakage target.

The individual interventions are described in detail in the following sections.

MCERT Meters Installations

Our customers have told us that they recognise that caring for the environment is important for the benefit of future generations. If our flow meters are not accurate then we may be exceeding the permitted effluent discharge; excessive discharge of effluent over and above the conditions of the Environment Agency licence, or at a rate that exceeds the permitted rate, could result in pollution of the receiving body of water.

Knowing accurately how much we are discharging as effluent is important in understanding how much water is being used and in establishing our flow and demand balance. Our customers tell us that they prefer us to use existing water supplies more efficiently by reducing leakage before developing new supplies, an accurate picture of our effluent discharge is essential to understanding our flow balance

In addition, new Environment Agency regulations require the meter installation to comply with MCERT standard or we could incur a fine for non-compliance. We have 15 effluent discharge meters. Investment is required to bring all 15 of these effluent discharge meter installations up to the new standard.

The recorded risk states that if these meters are not upgraded to meet the latest MCERT specification in line with Environment Agency regulations, then there is a risk that we may be fined for non-compliance. As this is a statutory requirement the intervention has been selected for inclusion in our investment case.

Bulk Meter Replacement

The risk of inaccurate bulk flow metering states that the UK Water Industry Research Ltd Report The Accuracy of District Meters[7] found that the probability of a turbine meter giving poor results increases as age of the meter increases. The report recommended that to ensure that the risk of the meter failing at low flows is less than 50%, turbine meters that have been in service for 12 years or more should be replaced.

The requirement for bulk meter replacement was agreed following discussion with our key operational stakeholders, who confirmed the need for investment for proactive replacement of mechanical turbine (Helix) meter on the basis of the findings of the UKWIR report shown above.

We currently have 789 bulk flow helix meters which are more than 12 years old (i.e. installed before 2005). These are likely to be failing at low flows, and due to the age of the asset, no replacement parts are available for this type of meter. We require accurate data from these meters to support meeting our leakage target. A programme of replacement has been drafted to replace approximately 15% of all

[7] UK Water Industry Research Ltd, 2015, The Accuracy of District Meters, 15/WM/08/54

Helix meters in AMP7 – typically 25 meter replacements per year. This equates to 125 meter replacements, with further replacement planned for AMP8 and beyond.

The benefits of replacing turbine meters older than 12 years will give greater confidence in district meter data which will lead to more robust leakage estimates, enabling better targeting and use of resources for leakage control.

The total bulk meters investment, including Water Service and Business Unit Allocation, is summarised in Table 7. This Investment Case is aligned to the Water Network Plus Wholesale Control category of our Business Plan. Costs are allocated to the Treated Water Distribution Business Unit. Investment is a mixture of non-infrastructure maintenance and other capital expenditure – infrastructure.

Table 7: Water Service and Business Unit Allocation

Wholesale Control	**Water Network Plus**	**Total**
Business Unit Allocation	***04 Treated Water Distribution***	
Bulk meters capex investment (%)	**100.0%**	**100%**
Bulk meters capex investment	**£1.178m**	**£1.178m**
Maintaining the long term capability of the assets – non-infra	£1.178m (100%)	**£1.178m (100%)**
Bulk meters capex investment with 8% capex efficiency	£1.083m	£1.083m

5.2 Contribution to Performance Commitments

Table 8 set outs the percentage contribution to performance commitment improvement provided by the selected bulk meters interventions.

Table 8: Bulk Meters – Contribution to performance targets from selected interventions

Performance commitment	Unit	2019/20 Baseline	2020/21	2021/22	2022/23	2023/24	2024/25	Total performance improvement required in AMP7	Bulk meters contribution to performance improvement
Leakage (annual)	Ml/d	43	42	41	39.5	38	36.5	6.5	1.49%

Asset Health

Our AMP7 investment in in bulk meter replacement will help ensure our assets are being maintained appropriately to deliver resilient water services to current and future generations

Leakage

Our AMP7 target is to achieve a 6.5Ml/d performance improvement by 2025. Our investment in bulk meters will provide a 1.49% contribution towards this target.

5.3 Non-Selected Interventions

Of the three interventions developed within this investment case, one was not selected because it did not provide the most cost beneficial way of meeting performance commitment targets compared to other interventions available. The risks associated with these interventions represent residual risks that will be carried during AMP7. We will continue to monitor these residual risks throughout AMP7, and where this process requires these risks to be mitigated, we will respond with appropriate action. Details of the non-selected intervention are given in Table 9.

Table 9: Non-selected intervention and residual risk

SSR ID	Risk Statement	Need Statement	Non-Selected Intervention & Residual Risk
SRR707	The leakage from the raw distribution system provides an indication of the condition of the system. If raw water flows cannot be accurately measured then then knowledge on the condition of the raw water system cannot be gained and this leads to increased probability of Unplanned outage of the works due to raw water supply failure.	Bristol Water has over 94km of raw water distribution mains and aqueducts with an average age of 86 years. Some parts of the system are some 150 years old. Failure of any part of the raw water network could result in unplanned outage of a treatment works. However we require better understanding of the condition of this system, and additional metering will substantially increase our understanding of the level of raw water leakage. Investment is needed to better manage our raw water resources; Reduction of leakage from the raw water network is a key part of the Water Resources Management Plan and the installation of flow meters will inform on where this leakage is occurring.	Non-Selected Intervention: **06.001.03 Raw Water Meters** Residual risk: (i) raw water flows may be inaccurately measured and knowledge on the condition of the raw water system may not be complete; (ii) sources may be over-abstracted, and we may incur a fine from the Environment Agency.
SRR708	If raw water flows cannot be accurately measured then there is an increased probability that a source will be over-abstracted and we will incur a fine from the Environment Agency.		

5.4 Assumptions

There are a number of general assumptions that have been made in the development of our investment cases. These are discussed in detail in the PR19 Investment Cases Summary Document[8].

5.5 AMP 8

We have committed to continually improve the resilience of water supplies, requiring us to deliver across a wide range of areas, including leakage and water efficiency through out AMP8 and beyond.

In addition to the 125 obsolescent distribution bulk flow meters that we will replace in AMP7, we intend to extend our replacement programme into AMP8 with an additional replacement of a further 125 bulk flow meters that are over 12 years old. This replacement strategy will continue with further replacement due in AMP9 of any remaining aged meters.

In AMP8, it is predicted that the risks driving the intervention not selected (raw water metering) will continue to impact on our supply and demand balance. Investment will therefore be required in AMP8 to fully mitigate this risk, our future strategy described in our WRMP 2019, includes improved

[8] Bristol Water, 2018, PR19 Investment Cases Summary Document, NTPBP-INV-PR1-0635.

monitoring of our raw water flows and 4.7Ml/d reduction in leakage from our raw water network by 2034-35.

5.6 Base Maintenance

Our Grade 1 MCERT meters and Grade 2 distribution bulk meters require appropriate maintenance to be carried out. This involves maintenance and servicing at pre-defined intervals (for example, according to manufacturers' instructions or operating procedures) and whenever a significant deterioration (such as removal of fouling) is noticed and the frequency of scheduled maintenance activities recorded.

We keep up to date maintenance records, which for our MCERT meters are available to Environment Agency inspectors (Environment Agency inspections of MCERT flow meters are required every 5 years).

In order to maintain a base level of performance upon which performance improvement can be achieved, we have identified minimum levels of expenditure on infrastructure assets. Base maintenance will be required for maintenance and calibration of all installed meters; however where we are replacing existing bulk meters and/or MCERT Meters then there will be no change from current operational requirements.

5.7 Historic & AMP7 Investment Comparison

A summary of historical investment values bulk meters and pressure control valves are provided in Table 10 along with the planned AMP7 investment value from bulk meters and pressure control valves interventions. We have re-categorised data used in line with the scope of our investment cases. For historic data we have used the 2016/17 wholesale cost assessment data (data tables 1 and 2). Forecast data has been derived from PR19 data (data tables WS1 and WS2).

Table 10: Historical & AMP7 capital investment

AMP	Capital investment values	Investment (£m)
AMP5	AMP5 actual	0.387
AMP6	2015/16 actual	0.000
	2016/17 actual	0.021
	2017/18 actual	0.035
	2018/19 forecast	0.160
	2019/20 forecast	0.186
	AMP6 forecast	0.403
AMP7	AMP7 pre-efficiency	1.178
	AMP7 8% capex efficiency applied	1.083

In AMP7, our investment in bulk meters will increase compared to AMP5 and AMP6. In AMP5 we delivered improvement to the turbidity monitoring and flow control of our 15" Chelvey to Portishead main, in addition to a programme of operational flowmeter replacement.

In AMP6 we are continuing our targeted replacement of operational trunk main flowmeters, and we are also installing next generation consumption monitors at key locations in our network. In AMP7 will invest in targeted improvements to replace 125 of our obsolescent bulk meters, and to meet statutory Environment Agency obligations through the replacement of our 15 effluent discharge meters with meters that meet the required MCERT standard.

6 Conclusions

To ensure our bulk meters assets continue to deliver our customers' priorities, we will measure progress via performance commitments for which we have set delivery targets. In AMP7, our bulk meters investment supports the delivery of our leakage performance commitment (target 36.5Ml/d). Our investment also ensures we continue to appropriately maintain the health of our assets, and comply with the new Environment Agency MCERT standard for effluent discharge meters.

An initial list of four risks was narrowed to three potential interventions. These interventions were developed and assessed through our asset management totex focused processes, and put forward for investment optimisation. Of these three interventions, one was selected on the basis that meets our outcome of a safe and reliable supply, and the other selected as it ensures we meet our statutory obligations.

We plan to invest a pre-efficiency total of £1.178m on our bulk meter assets. We have set ourselves a challenging target of reducing our costs by 8% during AMP7. This will be achieved through delivery of our business transformation programme, resulting in a post-efficiency investment of £1.083m.

The interventions proposed contribute to ensuring our assets are maintained appropriately for the benefit of current and future generations. The interventions proposed are expected to contribute 1.49% to our leakage target of 36.5 Ml/d.

If we fail to invest and do not replace bulk meters, asset health will ultimately continue to deteriorate to unacceptable levels, and will impact our ability to meet our leakage performance commitment. If we fail to invest and do not replace our effluent discharge meters, we will not comply with the new Environment Agency regulations.

The intervention not selected during investment optimisation forms a residual risk that will be carried during AMP7. The risks associated with this intervention will continue to be monitored and if the process requires the risk to be mitigated, we will respond with appropriate action. Interventions developed but not selected for AMP7 will be reappraised for investment in AMP8.

Our business plan provides assurance to both deliver and monitor the delivery of its outcomes, it will meet relevant statutory requirements and licence obligations imposed by the UK Government.

7 Appendices

- Appendix A: Line of Sight
- Appendix B: Datasets
- Appendix C.1: Selected Risks
- Appendix C.2: Non-Selected Risks
- Appendix D: Options Considered
- Appendix E: Interventions Developed
- Appendix F: Non-Selected Interventions

7.1 Appendix A: Line of Sight

Bulk Meters and Pressure Control Valves - Line of Sight

Investment Case
NTPBP-INV-BUL-0473

Customer Priorities

- Saving Water
- Leakage
- Top Quality Water Supplies
- Reliability

Performance Commitments

Optimiser Input Form Reference

NTPBP-CAL-BUL-0350

Slower Plan
Suggested Plan
Faster Plan

Local Community Resilience

- Leakage — 41 | 36.5 | 36
- Customer High Priority
- ODI — Common Reward and Penalty

Safe and Reliable Supply of Water

- Unplanned Outages — 1.74 | 1.74 | 1.74
- Customer High Priority
- ODI — Common Reward and Penalty

Other Monetised Benefits

Interventions

- 06.001.01
- 06.001.03
- 06.001.01
- 06.001.003

OFWAT Initial Assessment Tests

Test Area	OFWAT Initial Assessment Tests
Engaging Customers	What is the quality of the Company's customer engagement and participation and how is it incorporated into the companies business plan and ongoing operations
Securing long term resilience	How well has the company used the best available evidence to objectively assess and prioritise the diverse range of risks and consequences of disruptions to its systems and services and engaged effectively with customers on its assessment of the risks and consequences
	How well has the company objectively assessed the full range of mitigating options and selected the solutions that represent the best value for money over the long term and support from customers
Targeted controls , markets and innovation	To what extent has the company clearly demonstrated that it has considered whether all relevant projects are technically suitable for direct procurement for customers. Where it has one or more such projects, to what extent has the Company provided a well reasoned and well evidenced value for money assessment
Securing Confidence and Assurance	To what extent does the company have a good track record of producing high quality data, taking into account the company's data submission, assurance process and statement of high quality , and our 2018 assessment of the company under the Company Monitoring Framework
Board Requirements	
Customer Engagement	Assurance that the company's business plan has been informed by customer engagement and feedback from the company's CCG about the quality of its customer engagement and how this has been incorporated into the plan
Resilience	Assurance that the company's business plan has been informed by a robust and systematic assessment of the resilience of the company's systems and services; customer views on managing resilience and a comprehensive and objective assessment of interventions to manage resilience in customers long term interests
Business Planning	How has it challenged an satisfied itself that the overall strategy for data assurance and governance processes delivers a high quality data
	How has it challenged and satisfied itself that the business plan will enable the company to meet its statutory and licence obligations , now and in the future and take account of the UK and Welsh governments strategic policy statements.
	How has it challenged and satisfied itself that its plan will deliver operational financial and corporate resilience over the next control period and the long term through its governance and assurance processes, taking into account of its track record of performance

Performance Commitment Key

- Common Performance Commitment
- Common New Performance Commitment
- Bespoke Performance Commitment
- Bespoke New Performance Comittment

Document Number: NTPBP-MET-BUL-0721

7.2 Appendix B: Datasets

Dataset File Name	Data Summary	Process In Which Data Has Been Used			
		Risk Identification, Verification and Needs Assessment	Optioneering	Intervention Costing	Benefits Quantification
Company Meters-20062017.xlsx	Asset inventory and failures - ID, date installed, size, removal date	-	-	-	✓
NTPBP-CAL-MON-0085 Monthly Failures Report.xlsx	Maintenance Report examples from asset performance. Repeat failure reports. Unscheduled maintenance reports back to 2010. Example of monthly report to OTMs	-	-	-	✓
NTPBP-INT-SIT-0096 Site Design Output.xlsx	Site design outputs and average flow data	-	-	-	✓

7.3 Appendix C.1: Selected Risks

This appendix shows the 4 selected risks of the 4 relevant risks.

SRR ID	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score
SRR707	Raw distribution	The leakage from the raw distribution system provides an indication of the condition of the system. IF raw water flows cannot be accurately measured THEN then knowledge on the condition of the raw water system cannot be gained and this leads to increased probability of Unplanned outage of the works due to raw water supply failure.	5	1	3	2	3	1	3	15
SRR708	Raw distribution	IF raw water flows cannot be accurately measured THEN there is an increased probability that a source will be over-abstracted and BW will incur a fine from the Environment Agency.	2	4	3	2	5	1	5	10
SRR712	Waste Effluent sites	Bristol Water has 15 effluent discharge meters. IF these meters are not upgraded to meet the latest MCERT specification as per the EA Regulations THEN there is a greater risk that Bristol Water will be fined for non-compliance.	3	3	3	2	4	2	4	12
SRR713	Whole Network	UKWIR Report 'The Accuracy of District Meters', Ref No 15/WM/08/54 published in 2015 recommends replacement of network turbine meters older than 12 years. IF network meters older than 12 years are not replaced THEN the risk of turbine meters failing at low flows will be greater than 50%. The benefits of replacing turbine meters older than 12 years will give greater confidence in district meter data which will lead to more robust leakage estimates, enabling better targeting and use of resources for leakage control.	3	2	4	1	3	1	4	12

7.4 Appendix C.2: Non-Selected Risks

Not applicable - all relevant risks were chosen for this investment case.

7.5 Appendix D: Options Considered

This appendix shows the 5 options considered from the 4 selected risks.

Strategic Risk Register (SRR) Reference	SRR Revised Risk Description	Risk Need		Identification & Viability of Options			
		SRR Need ID	Need Description (from SRR)	Proposed Option Name	Proposed Option Description	Option Viability?	Option to be Developed into an Intervention?
SRR712	Bristol Water has 15 effluent discharge meters. IF these meters are not upgraded to meet the latest MCERT specification as per the EA Regulations THEN there is a greater risk that Bristol Water will be fined for non-compliance.	SRRN123	Bristol Water has 15 effluent discharge meters. New EA Regulations require the meter installation to comply with MCERT specification or BW could incur a fine for non-compliance. Investment is required to bring all effluent discharge meter installations up to the new specification.	Do Nothing	Do not upgrade any meters and risk being fined by EA	Option does not mitigate risk or meet need, will not be a carried forward and turned into an intervention for these reasons.	N
				MCERT Meter Installations	Upgrade all 15 of Bristol Water's effluent discharge meters to MCERT specification as per Environment Agency regulations.	Option will mitigate risk of EA fine as new meters will meet EA specification.	Y
SRR713	UKWIR Report 'The Accuracy of District Meters', Ref No 15/WM/08/54 published in 2015 recommends replacement of network turbine meters older than 12 years. IF network meters older than 12 years are not replaced THEN the risk of turbine meters failing at low flows will be greater than 50%. The benefits of replacing turbine meters older than 12 years will give greater confidence in district meter data which will lead to more robust leakage estimates, enabling better targeting and use of resources for leakage control.	SRRN124	Bristol Water has some 245 Turbine (Helix) meters that are older than 12 years. These are likely to be failing at low flows and without the accuracy of data from these meters Bristol Water will be compromised in trying to meet its leakage target.	Do Nothing	Do not replace Helix Meters	Option does not mitigate risk or meet need, will not be a carried forward and turned into an intervention for these reasons.	N
				Bulk Meter Replacement Programme	Replacement of 125 Helix meters over 12 years old during AMP7.	Yes	Y
SRR707	The leakage from the raw distribution system provides an indication of the condition of the system. IF raw water flows cannot be accurately measured THEN then knowledge on the condition of the raw water system cannot be gained and this leads to increased probability of Unplanned outage of the works due to raw water supply failure.	SRRN114	Bristol Water has over 94km of raw water distribution mains and aqueducts with an average age of 86 years and an average diameter of 30". Some parts of the system are some 150 years old. This system supplies water to treatment works including Barrow, Banwell and Cheddar and as such supplies about 1/3 of all production. Failure of part of the system could result in unplanned outage of a treatment works. However the condition of this system is very poorly understood. The level of leakage from the raw network can provide a indication of the condition but there are very few flow meters and those that exist are not calibrated. Investment is needed to understand leakage better so that unplanned outage of treatment works can be avoided. Reduction of leakage from the raw water network is a key part of the Water Resources Management Plan 19 and the installation of flow meters is the first step in understanding where this leakage is occurring.	Raw water meters	This option involves the installation of raw water bulk meters at 25 sites across the raw water distribution system.	Yes	Y
SRR708	IF raw water flows cannot be accurately measured THEN there is an increased probability that a source will be over-abstracted and BW will incur a fine from the Environment Agency.						

7.6 Appendix E: Interventions Developed

This appendix shows the 4 interventions developed from the 5 options

Strategic Risk Register (SRR) Reference	SRR Revised Risk Description	Risk Need		Identification & Viability of Options			Proposed Interventions		Costs		Benefits		
		SRR Need ID	Need Description (from SRR)	Proposed Option Name	Proposed Option Description	Option Viability?	Ref No	Intervention Title	Capex After (£M)	Change in Opex (£)	Other Monetised Benefits (£)	Leakage (Ml/day)	Unplanned Outage (%)
SRR712	Bristol Water has 15 effluent discharge meters. IF these meters are not upgraded to meet the latest MCERT specification as per the EA Regulations THEN there is a greater risk that Bristol Water will be fined for non-compliance.	SRRN123	Bristol Water has 15 effluent discharge meters. New Environment Agency Regulations require the meter installation to comply with MCERT specification or BW could incur a fine for non-compliance. Investment is required to bring all effluent discharge meter installations up to the new specification.	MCERT Meter Installations	Upgrade all 15 of Bristol Water's effluent discharge meters to MCERT specification as per Environment Agency regulations.	Option will mitigate risk of Environment Agency fine as new meters will meet Environment Agency specification.	06.001.01	MCERT Meter Installations	£843,175	£0	£25,600	-	-
SRR713	UKWIR Report 'The Accuracy of District Meters', Ref No 15/WM/08/54 published in 2015 recommends replacement of network turbine meters older than 12 years. IF network meters older than 12 years are not replaced THEN the risk of turbine meters failing at low flows will be greater than 50%. The benefits of replacing turbine meters older than 12 years will give greater confidence in district meter data which will lead to more robust leakage estimates, enabling better targeting and use of resources for leakage control.	SRRN124	Bristol Water has some 245 Turbine (Helix) meters that are older than 12 years. These are likely to be failing at low flows and without the accuracy of data from these meters Bristol Water will be compromised in trying to meet its leakage target.	Bulk Meter Replacement Programme	Replacement of 125 Helix meters over 12 years old during AMP7.	Option is viable	06.001.02	Bulk Meter Replacement Programme	£334,341	£0		0.1146	-

Strategic Risk Register (SRR) Reference	SRR Revised Risk Description	Risk Need		Identification & Viability of Options			Proposed Interventions		Costs		Benefits		
		SRR Need ID	Need Description (from SRR)	Proposed Option Name	Proposed Option Description	Option Viability?	Ref No	Intervention Title	Capex After (£M)	Change in Opex (£)	Other Monetised Benefits (£)	Leakage (Ml/day)	Unplanned Outage (%)
SRR707	The leakage from the raw distribution system provides an indication of the condition of the system. IF raw water flows cannot be accurately measured THEN then knowledge on the condition of the raw water system cannot be gained and this leads to increased probability of Unplanned outage of the works due to raw water supply failure.	SRRN114	Bristol Water has over 94km of raw water distribution mains and aqueducts with an average age of 86 years and an average diameter of 30". Some parts of the system are some 150 years old. This system supplies water to treatment works including Barrow, Banwell and Cheddar and as such supplies about 1/3 of all production. Failure of part of the system could result in unplanned outage of a treatment works. However the condition of this system is very poorly understood. The level of leakage from the raw network can provide an indication of the condition but there are very few flow meters and those that exist are not calibrated. Investment is needed to understand leakage better so that unplanned outage of treatment works can be avoided. Reduction of leakage from the raw water network is a key part of the Water Resources Management Plan 19 and the installation of flow meters is the first step in understanding where this leakage is occurring.	Raw water meters	This option involves the installation of raw water bulk meters at 25 sites across the raw water distribution system.	Option is viable	06.001.03	Raw water meters	£498,624	£0	£6,020	-	0.2676
SRR708	IF raw water flows cannot be accurately measured THEN there is an increased probability that a source will be over-abstracted and BW will incur a fine from the Environment Agency.												

7.7 Appendix F: Non-Selected Interventions

This appendix shows the non-selected intervention. See appendix D for costs or performance commitments.

ID	Intervention Title	Expected Capex after (£)	Change in Opex (£k)	Residual Risk
06.001.03	Raw water meters	£499,000	£0	The leakage from the raw distribution system provides an indication of the condition of the system. IF raw water flows cannot be accurately measured THEN then knowledge on the condition of the raw water system cannot be gained and this leads to increased probability of Unplanned outage of the works due to raw water supply failure.
				IF raw water flows cannot be accurately measured THEN there is an increased probability that a source will be over-abstracted and BW will incur a fine from the Environment Agency.