C5 B

Cost and Efficiency

C5B Technical Annex 14
Raw Water Pumping Stations Investment Case:
Technical Approach and Business Case

NTPBP-INV-RAW-0540

BRISTOL WATER

Contents

Tables

Figures

1 Foreword

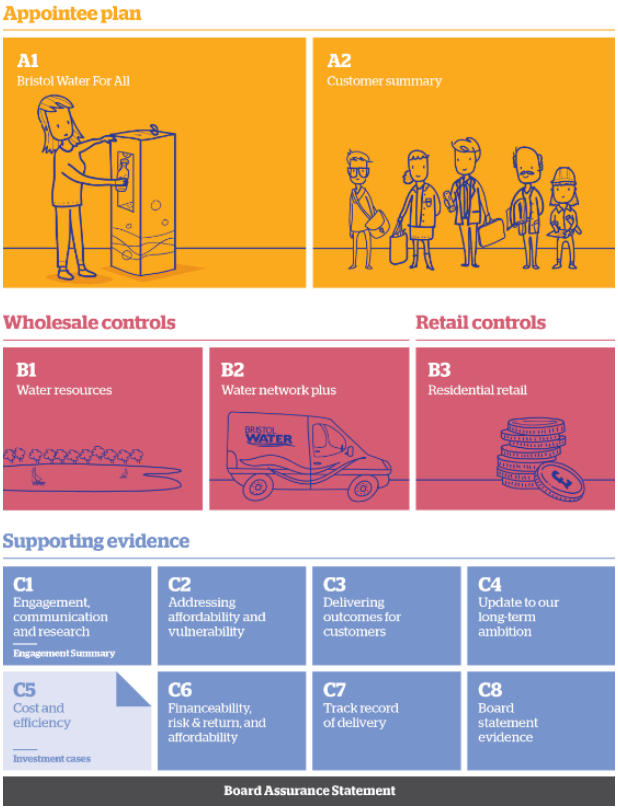
The raw water pumping stations investment case will address specific site operational or maintenance issues by implementing capital maintenance interventions of obsolescent plant which will contribute to a safe and reliable supply to our customers.

Raw Water Pumping Stations assets are associated with abstraction and transfer of water. There is an extensive network of raw water mains from the raw water source to the production works.

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 raw water pumping stations.

The investment case, one of 21, will summarise the facts, risks and investment requirements for raw water pumping stations for the next review period for 2020 to 2025. This investment case will also summarise performance for raw water pumping stations for the current review period from 2015 to 2020 and our methodology for determining and delivering the future raw water pumping stations 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 Resources Wholesale Control aspect of our business plan. It is recommended that this investment case is read in conjunction with the PR19 Investment Case 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 provide customers with a Safe and Reliable Supply, we will focus on maintaining the level of risk posed by our 25 raw water pumping stations. We will achieve this by using our totex investment approach which includes investment in base maintenance and capital expenditure of £3.743m. We will deliver one intervention that will contribute towards the unplanned outages and unplanned maintenance non infrastructure performance commitments. We will challenge ourselves to deliver more efficiently and apply innovation to the process we adopt to pump raw water. When considering our efficient and innovative approach we plan to deliver our raw water pumping station capital programme for £3.444m.

At Bristol Water we have completed an extensive customer engagement programme which has identified that one of five key priorities for customers is that we keep the water flowing to their tap and one of our four key outcomes is that we provide a Safe and Reliable Supply.

This investment case will address specific site operational or maintenance issues by utilising a totex approach to determine necessary capital maintenance investment to manage deteriorating assets.

To deliver our customers' priorities we will measure progress via performance commitments for which we have set delivery targets both for the end of AMP6 and for AMP7. In AMP7, Raw Water Pumping Station asset health is monitored by the number of unplanned maintenance events (target 3272) and unplanned outages (target 1.74%). This will also be the 2024/25 target.

As at July 2018 we are achieving our AMP6 target for unplanned maintenance (non-infrastructure) and forecast that we will continue to achieve it through the remainder of AMP6.

We have set the level of investment for our Raw Water Pumping Stations, so that it is sufficient to deliver our performance commitments and takes asset deterioration into account. This will ensure the continued performance of our Raw Water Pumping Stations and enables us to continue to deliver a safe, high quality, and reliable drinking water supply to our customers.

Raw Water Pumping Stations is a collective term for all assets associated with abstraction and transfer of raw or untreated water through the raw water network to a treatment works. Water Pumping Stations are covered in a separate case. At July 2018 we operate and maintain 25 Raw Water Pumping Stations.

The investment includes the renewal/refurbishment of the abstraction and booster assets at the Raw Water Pumping Station from Axbridge to Barrow including:

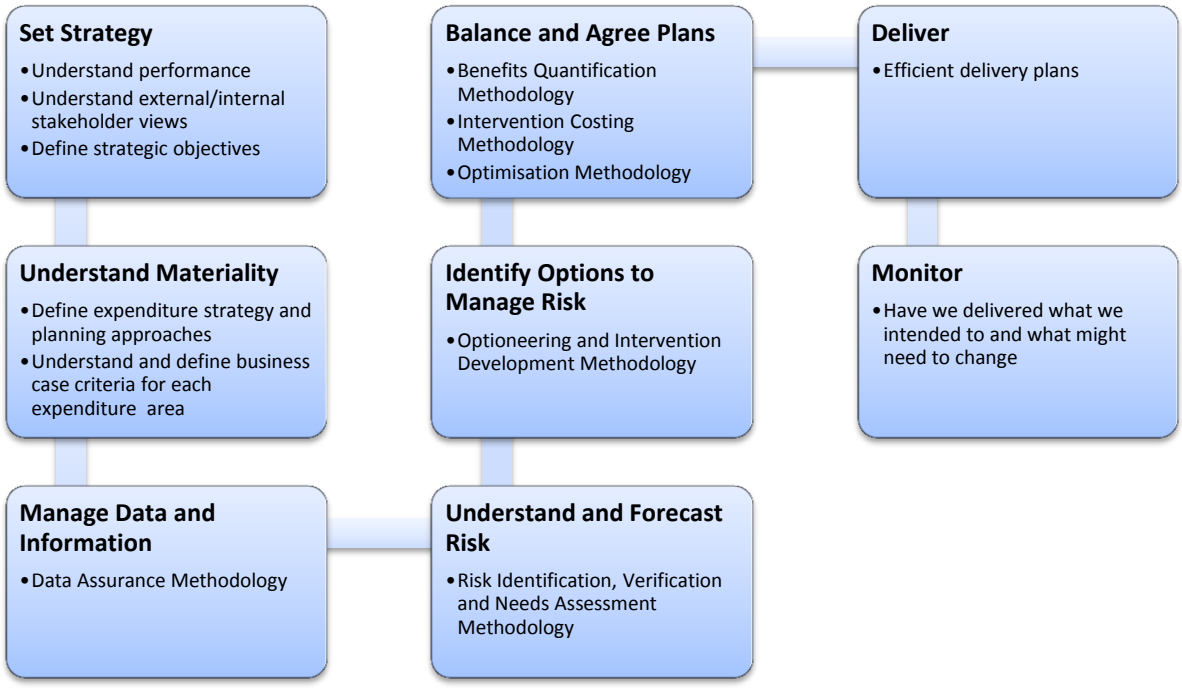
- Suction wells, inlet valves and penstocks, and instrumentation;
- Substructure pump chambers and pits;
- Mechanical, electrical, and instrument, automation and control (MEICA) systems associated with lifting or boosting water;
- External buried flow meters associated with pump control and monitoring; and
- Auxiliary services including lighting, ventilation, fire protection and security systems.

Should we fail to invest in Raw Water Pumping Stations or not achieve the two associated performance commitments mentioned above, the key risks are that we will not meet our customers' outcome of a Safe and Reliable Supply.

Given the function of a Raw Water Pumping Stations is to supply our treatment works; we must ensure that they are fit and well maintained. Therefore there is a risk that failure to invest in Raw Water Pumping Stations will mean we will be unable to operate our assets efficiently which will impact on the affordability of our customer's water bills.

In order to ensure that we meet customers' priorities and mitigate the risks associated Raw Water Pumping Stations we have adopted an asset management totex focused approach as set out in Figure 1.

Figure 1: Approach to meeting customer Priorities 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 £3.743m from 2020 to 2025 on refurbishing our Raw Water Pumping Stations in order to achieve the performance commitments associated with the outcome 'Safe and Reliable Supply of Water', as set out in Table 1.

We have set ourselves a challenging target of reducing costs by 8% during AMP7. This will be achieved by delivery of our business transformation programme and result in a post-efficiency investment of £3.444m.

Costs are allocated to the Water Resources Business Unit. Investment is all related to non-infrastructure assets and is capital maintenance expenditure.

Table 1: Performance Commitment Targets and Percentage Contribution from Raw Water Pumping Stations

Performance Commitment	Unit	2019/20 Baseline	2024/25 Target	Total Targeted Performance Commitment Improvement in AMP7	Raw Water Pumping Stations% Contribution to Performance Commitment Target
Unplanned Outage	%	1.74	1.74	0.00	n/a
Unplanned maintenance – non-infrastructure	Number of events	3976	3272	704	0.74%

Our AMP7 investment in raw water pumping stations will help ensure our assets are being maintained appropriately to deliver resilient water services to current and future generations.

Unplanned maintenance (non-infrastructure) – in total 23.24% of performance improvement is achieved through interventions within investment cases. The remaining performance improvement will be achieved through operational maintenance activities.

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 AMP7 investment required to meet our customer's expectations for a Safe and Reliable Supply through refurbishment of our Raw Water Pumping Stations, thus reducing the risk of unplanned outages and unplanned non-infrastructure maintenance due to Raw Water Pumping Stations failure. We have assets that will become less reliable as they continue to deteriorate during the AMP causing an increased operating cost, as the number of unplanned maintenance events rise, and an increased risk of an unplanned outage due to equipment failures. The profile of our assets' ages is shown in Table 2 below, with pumping assets typically of 20 to 40 year design life. These obsolescent assets require renewal to maintain customers' expectations of a safe and reliable supply as a reduction in asset age profile will lead to reduced unplanned maintenance events and unplanned outage.

Table 2: Age of our Raw Water Pumping Stations Assets

Age of Raw Water Pumping Stations assets in Years		% of total Raw Water Pumping Stations Assets
From	To	
51	100	10%
41	50	8%
31	40	2%
21	30	10%
11	20	28%
1	10	42%

One of the four customer priorities is "Keeping the water flowing to your tap". Reducing the impact on our customers from asset failure is a key strand to our strategy for delivering this priority.

A key aim, as set out in our long term strategy, is the provision of Safe and Reliable Supply for our customers, and operational reliability is a key element of our plans to achieve this.

This investment case covers our Raw Water Pumping Stations assets associated with abstraction and transfer of water in the raw water distribution network to our treatment works. These assets are classified into three types of pumping station and comprise of;

- Borehole abstraction assets –pumping equipment and other sundry equipment;
- River and reservoir abstraction assets – pumping equipment, weirs, screens, inlets, fish passes, stilling well, other sundry equipment and other assets that support abstraction; and
- Booster pumps, valves, meters and other equipment within the raw water network.

The Raw Water Pumping Stations assets have been scrutinised by a series of assessments and analyses against their ability to provide safe and reliable supplies and thereby meet our customers' priorities and outcomes

The following assets are related to, but are excluded from the Raw Water Pumping investment case as they have been included in other investment cases:

- Water pumping stations (see Water Pumping Stations)

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

- Water Pumping Stations – shared target of unplanned maintenance - non-infrastructure;
- Treatment Works Strategic Maintenance – shared target of unplanned outage and unplanned maintenance - non-infrastructure; and
- ICA and Telemetry – shared target of unplanned outage.

3.2 Strategy

Developing the investment needs for our raw water pumping stations 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 Plan provides the strategic framework that supports this vision and enables investment in our Raw Water Pumping Stations 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 our assets are, and remain, fit and well 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 is a specific outcome (Safe and Reliable Supply) and specific performance commitments (unplanned outage and unplanned maintenance – non-infrastructure) that have strategic targets and incentives that will be directly influenced by our investment needs for raw water pumping stations.

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 raw water pumping stations 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 customers and stakeholders.

We need to ensure that planned investment is sufficient for the continuation of business as usual activities and routine and reactive maintenance, and the continued provision of high quality water to our customers.

This investment case articulates the bottom-up asset interventions that are required in AMP7 to achieve the outcomes that customers, regulators and other stakeholders have told us they expect.

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
- 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 as follows:

- Excellent Customer Experiences
- Safe and Reliable Supply
- Local Community and Environmental Resilience
- 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 Raw Water Pumping Stations and one of our outcomes – Safe and Reliable Supply.

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. When discussing the Safe and Reliable Supply outcome with our customers, we found that they are understanding of one-off events and often focus more on how we

can improve our response to them. We asked them about investment in water quality and reliability and we asked what areas they felt most comfortable investing in. In our March 2018 customer panel, our customers prioritised reliability above local environment, resilience and customer experience[2]. Detailed analysis of customers' views on this area can be found in **section C3 – Delivering Outcomes for Customers.**

We consulted in three potential scenarios in relation to our Safe and Reliable Supply outcome

			2024/25 target		
Service	**Performance Commitment**	**2020 target**	**Slower improvement plan**	**Suggested improvement plan**	**Faster improvement plan**
Water quality	Compliance risk A lower score reflects a lower risk of water quality problems	1.22	0.7	0	0
Interruptions to supply	Supply interruptions greater than 3 hours (average minutes per property)	12.2	4.2 66% improvement	1.8 85% improvement	1.5 88% improvement
Water that doesn't look clear	Number of customer contacts about the appearance of tap water (contacts per 10,000 customers)	9.3	9.3	4.3 54% improvement	3.2 66% improvement
Water that doesn't taste or smell right	Number of customer contacts about the taste and smell of tap water (contacts per 10,000 customers)	3.0	3.0	2.5 17% improvement	1.4 53% improvement
Protection against a major water supply event	Risk of a major event - population centre size protected against critical asset failure	Centres over 25,000 people*	Centres over 25,000 people	Centres over 10,000 people (10 year programme)	Centres over 10,000 people (5 year programme)
Forecast increase to the average bill from additional investment			£5	£14	£18

* With 50% customers in these centres remaining at risk

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 Raw Water Pumping Stations, specific details planned investment as associated performance can be found in section 3.4.

[2] A4g: customer online panel March 2018

3.4 Asset Health Performance Commitments, 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 Raw Water Pumping Stations will help ensure our assets are being maintained appropriately for the benefit of current and future generations. We measure our asset health through some specific performance commitments, which for Raw Water Pumping Stations are unplanned maintenance events and unplanned outages. These performance commitments enable us to evaluate our long-term asset health performance.

Additionally, our investment in raw water pumping stations will support our AMP7 outcome 'Safe and Reliable Supply', by investing in our Raw Water Pumping Stations assets in order to provide high quality, reliable supplies for our customers. Our Safe and Reliable Supply outcome will be measured through a set of associated performance commitments.

Performance commitments associated with Raw Water Pumping Stations are set out in Table 3.

Table 3: Associated Performance Commitments

Performance Commitment	Unit	2019/20 Baseline	2020/21	2021/22	2022/23	2023/24	2024/25	Performance Improvement Required in AMP7
Unplanned outage	%	1.74	1.74	1.74	1.74	1.74	1.74	0
Unplanned maintenance (non-infrastructure)	Number of jobs	3972	3272	3272	3272	3272	3272	704

Unplanned outage is a new performance commitment in AMP7. This measure will be used as a means of assessing health of our above ground assets involved with water abstraction and water treatment activities. It is defined as the annualised unavailable flow, based on the peak week production capacity. This measure is proportionate to the frequency of asset failure as well as the criticality and scale of the assets that are causing an outage. Our AMP7 target has been set based on our average historical performance to date and on the expert knowledge of our staff, taking into account that the dataset required for measurement is immature. Our investment in raw water pumping stations will support our ability to sustain our average historical level of performance.

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

There are no statutory or compliance obligations that are influencing the development of interventions in this investment case and the investment for AMP7.

3.6 AMP6 Investment And Performance

A summary of our AMP6 investment in raw water pumping stations is provided in Table 4 below. This investment supports our ability to meet our performance commitment for asset reliability and unplanned maintenance - non-infrastructure. Our investment in AMP6 will also underpin our performance commitments for unplanned maintenance - non-infrastructure and unplanned outage in AMP7.

AMP6 investment related to raw water pumping stations Raw Water Pumping Stations is summarised in Table 4. 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 4: AMP6 capex investment

Year	Raw Water Pumping Stations Capex (£m)
2015/16 actual	0.039
2016/17 actual	0.000
2017/18 actual	0.031
2018/19 forecast	0.108
2019/20 forecast	0.000
AMP6 forecast	**0.178**

Our AMP6 investment delivers minor improvements to three of our Raw Water Pumping Stations to address specific asset health risks. These improvements, coupled with our operational maintenance activities, have allowed us to achieve our best historic performance for unplanned maintenance events and to maintain ‘stable’ asset reliability performance.

The AMP6 performance commitments that are related to Raw Water Pumping Stations investment and our performance are given in Table 5.

Table 5: Historic AMP6 Performance related to Raw Water Pumping Stations

Performance Commitment		2015/16	2016/17	2017/18	2018/19 (Forecast)	2019/20 (Forecast)
Asset reliability – non infrastructure						
Bristol Water	Target	stable	stable	stable	stable	stable
	Company performance	stable	stable	stable	stable	stable
Unplanned outage (%)						
Bristol Water	Target	-	-	-	-	-
	Company performance	1.52	1.52	1.5	1.74	1.74
Unplanned maintenance (non-infrastructure)						
Bristol Water	Target	3976	3976	3976	3976	3976
	Company performance	3353	2870	3279	3976	3976

Our asset reliability non-infrastructure performance commitment consists of two sub-indicators, which are - turbidity at water treatment works and unplanned maintenance - non-infrastructure. Our performance against these two sub-indicators is used to assess our capability of delivering customers expected level of service both now and in the future.

As we have met our target for the turbidity sub-indicator and outperformed the unplanned maintenance events sub-indicator, we have met our target for this performance commitment, which has been assessed as 'stable' for the third consecutive year of AMP6 (measures are: improving, stable, marginal, deteriorating).

In AMP7, these two sub-indicators will be reported as separate performance commitments.

Our AMP6 forecast for unplanned maintenance events is set at the target (3976) as the availability and reliability of supporting data at present does not allow a better assessment of performance. We are working to improve our asset data practices to better inform our performance forecasts.

There is no historical target for the unplanned outage performance commitment because it is a new commitment for PR19.

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 (opex) or capital (capex) 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

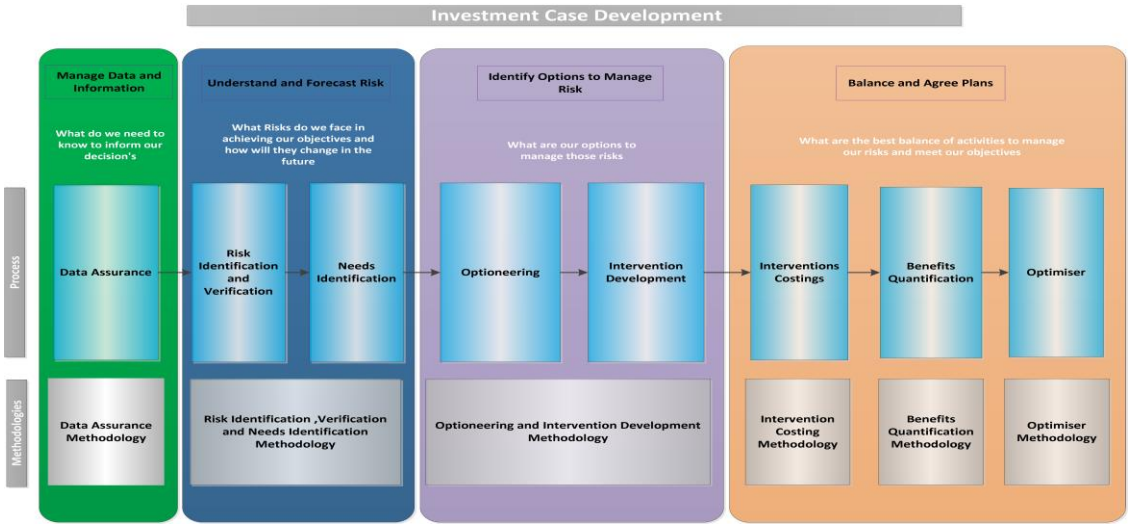
We have created and implemented a process that is supported by a set of six methodologies. When developing the methodologies, we wanted to ensure that they:

- 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 two hundred and eighty six individual data types. We have evaluated all two hundred and eighty six 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;
- 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;
- 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. Where the risk was confirmed, it was developed into a needs statement. Where the risk was not confirmed (for example it is currently being addressed in AMP6 or the risk was assessed to be not as significant as initially scored), it was not considered further as part of the PR19 investment planning process.

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.

The risks that were not considered further as part of the PR19 investment planning 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.

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 risk 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 intervention in a planned way, we have labelled it as 'capex after'. This is the expected capital cost of the intervention.

Cost estimates were usually based on high level scopes, which contained activity schedules, and sketches 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 capex or savings in 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 capex and opex expenditure.

Expected Capital Cost (capex before)

If we deliver the capital 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 (opex) 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 opex 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; or
- 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 (slower Improvement plan, suggested improvement plan and faster improvement plan).

4.2 Applying the investment process to Raw Water Pumping Stations

Each of the following sections describes the specific details associated with the application of the investment case development process for raw water pumping stations.

4.2.1 Risk Identification, Verification & Needs Assessment

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

Three risks were selected and developed into need statements. The risk descriptions, scoring and associated needs statements are captured in the Strategic Risk Register. These selected risks are provided below in Table 6.

Fourteen risks were not selected and these risks will be monitored and reviewed under our business as usual risk management process. These non-selected risks are listed in Table 6.

Table 6: Non-selected 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
SRR54	Axbridge TW	If river axe pumps fail, then site is down (Axbridge-Area 3)	2	1	2	1	1	1	2	4
SRR56	Cheddar TW	IF Cheddar Spring Pumps are not uprated and refurbished THEN Cheddar TW will have Unplanned Outage if Axbridge Cheddar pumps are out of service.	1	1	3	1	1	1	3	3
SRR76	Cheddar TW	**IF** Cheddar Cliff pumps fail due to age and condition **THEN** then site would be out of service potentially losing a source of raw water for the Cheddar Reservoir.	1	1	1	1	1	1	1	1
SRR190	Chew Stoke PS	Falling from height (H&S) because there are no guard rails along spillway and compensation channel. (Chew Stoke PS - spillway)	3	4	2	3	4	1	4	12
SRR355	Rowberrow PS	Main Incoming Switchboard original and could fail	2	1	3	3	3	4	4	8
SRR356	Rowberrow Raw Water PS	Pumps not in use, but Treatment works fed from this switchboard	1	1	1	1	1	4	4	4
SRR632	All Pumping Stations	IF aging assets at small pumping stations are not refurbished or replaced to improve PS reliability THEN number of unplanned maintenance events will increase and customer connections will be at an increasing risk of low pressure or loss of supply.	3	1	3	1	4	4	4	12
SRR633	All Pumping Stations	If Bristol Water improves its condition based monitoring on critical high value assets THEN asset maintenance can be optimised to avoid asset failures and unnecessary maintenance reducing Unplanned Non-infrastructure Maintenance and overall operational costs.	3	1	3	1	4	1	4	12
SRR635	All Pumping Stations	IF an oil spill occurs at a site where facilities do not comply with the least bulk fuel oil storage regulations THEN fines, litigation, environmental and reputational damage will occur.	2	4	4	3	5	1	5	10
SRR684	Axbridge PS	IF Transformer 1 fails THEN loss of power at site and no generator backup (Axbridge PS)	3	1	4	1	1	1	4	12
SRR685	Axbridge PS	IF Transformer 2 fails THEN run standby generator, reduced output and possible loss of power at site (Axbridge PS)	3	1	4	1	1	1	4	12
SRR688	Chew Stoke PS	IF Site Transformer fails THEN standby generator used to support Stowey TW transfer, loss of Barrow transfer due to reduced power at site (Chew Stoke PS)	3	1	3	1	1	1	3	9
SRR694	Purton Severn Intake Works PS	IF Intake Transformer 2 fails THEN reduced output from site as reduced power at site(Purton Severn Intake Works PS)	4	1	3	1	3	1	3	12
SRR697	Rowberrow PS	IF site Transformer fails THEN standby generator used and reduced output from site as reduced power (Rowberrow PS)	1	1	3	1	3	1	3	3

For example, for the unselected risk relating to Cheddar Spring Pumps at Cheddar TW it was determined that the pump station was unlikely to fail before AMP 8 or 9 and therefore was allocated a likelihood score of 1. The consequence of such a failure were assessed to be small, primarily because of good resilience in the network which enables Cheddar supply zone to be supplied from Barrow by the Southern Resilience Scheme. The 'Line of Sight' for the whole process, beginning with the selected

risks, the source of the risk, a record of source documents used to verify the risks, and the needs statements, is captured in the Raw Water Pumping Station investment case intervention register.

4.2.2 Optioneering & Intervention Development

Three risks were selected and developed into needs statements. Four options were identified, and four of these were developed into interventions. These four interventions included two interventions against risk SRR135; these were identified as mutually exclusive during intervention selection. The three selected risks and the four associated options and interventions are shown in Table 7.

Once interventions were developed, costs could be prepared.

Table 7: Selected risks, options identified, and interventions developed

Strategic Risk Register (SRR) Reference	SRR Revised Risk Description	Risk Need		Identification & Viability of Options			Proposed Interventions	
		SRR Need ID	Need Description (from SRR)	Proposed Option Name	Proposed Option Description	Option Viability?	Ref. No.	Intervention Title
SRR55	IF 40 year old, life expired assets at Cheddar Transfer PS are not replaced THEN unplanned outage risks from a catastrophic failure will increase. Supplies to Cheddar TW will be significantly reduced and supplied from a source with a high risk of cryptosporidium increasing the health risks to customers. Alternative treated water supplies from the southern relief main will increase the operational costs.	SRRN23	Cheddar TW has an average annual output of 23Ml/d and accounts for approximately 8% of BWs total output. The TW main source of supply is Axbridge PS, Cheddar Transfer pumps which were installed in 1983 (2No) and 1992. The pumps and electrical assets will be between 30 and 40 years old by the end of AMP7 and beyond their normal life expectancy of 25-30 years. Between 2010 and 2016 Unplanned Non-Infrastructure Maintenance events recorded on SAP for Axbridge PS, Cheddar Transfer pumps was on average 9 failures/annum. With each of these failures is the risk that a catastrophic failure will occur leading to a health and safety risk and an Unplanned Outage of the Cheddar TW. The new southern relief scheme will allow water to be supplied to the zone but this will be at an increased operational cost. An intervention is Needed to refurbish the Axbridge PS; Cheddar Transfer pumps to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigates the risk of an Unplanned Outage of the Cheddar TW ensuring safe and reliable raw water supplies for customer.	Axbridge to Cheddar PS - Refurbishment	Refurbish PS - replace switchgear, pumps, motors, drives, valves and above ground pipework.	This is a viable option and the most cost effective.	22.001.01	Axbridge to Cheddar PS - Refurbishment

Strategic Risk Register (SRR) Reference	SRR Revised Risk Description	Risk Need		Identification & Viability of Options			Proposed Interventions	
		SRR Need ID	Need Description (from SRR)	Proposed Option Name	Proposed Option Description	Option Viability?	Ref. No.	Intervention Title
SRR135	IF 60 year old, life expired 11kV and 3.3kV electrical assets at Axbridge PS are not replaced THEN health and safety, and unplanned outage risks from a catastrophic failure under load will increase. Barrow TW, and potentially Cheddar TW, transfer pumps will not operate and there will be a loss of source to Rowberrow and Barrow TW reducing overall network resilience. Alternative treated water supplies from the southern relief main will increase the operational costs.	SRRN24	Barrow TW has an average annual output of 57.3Ml/d and accounts for approximately 16% of BWs total output. Banwell TW 17.7Ml/d and accounts for 6% of BWs total output. Cheddar TW has an average annual output of 23Ml/d and accounts for approximately 8% of BWs total output. All 3 TW are to some extent supported with raw water transported by Axbridge PS through either the Barrow or Cheddar Transfer Pumps. The Barrow Transfer pumps are driven by 3.3kV electric motors and starters which are supplied by a single 11/3.3kV power transformer supplied from an 11kV electrical switchboard. The switchboard also supplies an 11/0.415kV transformer which supplies the Cheddar Transfer Pumps. The Barrow Transfer Pumps and electrical systems were installed in1964. The HV system no longer meets current design and safety standards mainly due to the use of obsolescent oil filled switchgear. Obtaining spare parts and carrying out maintenance is difficult. The age and condition of the switchboards creates a fire/explosion health and safety risk for operators, and an operational risk which could cause a significant Unplanned Outages event at Cheddar TW. In addition, raw water supplies available to Barrow and Banwell TW will be reduced. An intervention is Needed to refurbish the Axbridge PS, Barrow Transfer pumps and electrical installations to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigate the risk of an Unplanned Outage of the Cheddar TW and loss of alternative raw water supplies to Barrow and Banwell TW, ensuring safe and reliable raw water supplies for customer.	Axbridge to Barrow PS - Refurbishment	Refurbish PS - replace transformers, HV switchgear, LV switchgear, pumps, motors, drives, valves and above ground pipework.	This is a viable option.	22.001.02	Axbridge to Barrow PS - Refurbishment
				Axbridge to Barrow PS - Refurbishment Phase 1	Phased installation of Refurbish PS - replace transformers, HV switchgear, LV switchgear, pumps, motors, drives, valves and above ground pipework.	Axbridge to Barrow PS - Refurbishment Phase 1	22.001.20	Axbridge to Barrow PS - Refurbishment Phase 1

Strategic Risk Register (SRR) Reference	SRR Revised Risk Description	Risk Need		Identification & Viability of Options			Proposed Interventions	
		SRR Need ID	Need Description (from SRR)	Proposed Option Name	Proposed Option Description	Option Viability?	Ref. No.	Intervention Title
SRR693	IF 50 year old, life expired 11kV electrical assets at Purton canal and intake PS are not replaced THEN health and safety, and unplanned outage risks from a catastrophic failure under load will increase. Purton TW operation will be restricted and possible loss of supply to raw water tank aerators.	SRRN54	Purton TW has an average annual output of 95.4Ml/d and accounts for approximately 34% of BWs total output. The TW is supplied with water from the Sharpness canal by the Purton canal and transfer pumping station raw water pumping station. The pumping station LV electrical installation was refurbished in AMP5. However, the HV electrical switchboard and transformers, and the pumps and pipework date back to 1974 and at 50 years of age by the end of AMP7 will be life expired. The HV system no longer meets current design and safety standards mainly due to the use of obsolescent oil filled switchgear. Obtaining spare parts and carrying out maintenance is difficult. The age and condition of the switchboards creates a fire/explosion health and safety risk for operators, and an operational risk which could cause a significant Unplanned Outages event at Purton TW. The pumps are less efficient than modern pumps and it is expected that efficiency gains would be made with new pumps. An intervention is Needed to refurbish the Purton canal and transfer pumps and HV electrical installations to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigate the risk of an Unplanned Outage of the Purton TW ensuring safe and reliable raw water supplies for customers.	Purton Canal and Return Pumps Refurbishment	Refurbish the Purton canal and transfer pumps and HV electrical installations to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigate the risk of an Unplanned Outage of the Purton TW ensuring safe and reliable raw water supplies for customers.	This is a viable option.	22.002.01	Purton Canal and Return Pumps Refurbishment

4.2.3 Intervention Costing

In this investment case costs for all interventions were calculated in collaboration with ChandlerKBS.

Raw Water Pumping Station Investment Case Cost Estimation

For each of the four interventions, high level scope documents were developed including an activity schedule, and where appropriate, explanatory sketches and annotated drawings. ChandlerKBS utilised a water industry unit cost data base to complete 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. An example of this are the historic costs for AMP5 pumping station refurbishment at Almondsbury and Purton, and the new Pumping station at Lockleaze.

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: Axbridge to Barrow Pumping Station Refurbishment

An intervention is needed to refurbish the Axbridge PS Barrow Transfer pumps and electrical installations to improve the reliability of the assets, reduced unplanned maintenance events and mitigates the risk of an unplanned outage of the Cheddar Treatment Works and loss of alternative raw water supplies to Barrow and Banwell Treatment Works. This will ensure safe and reliable raw water supplies for our customers.

We have established a direct cost of undertaking the works of £3.22m; this 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 £0.522m for internal activities associated with the intervention, such as project management, land & compensation, legal, environmental costs, commissioning/handover, contract management, operations & system support, consultants and administration.

All of the direct costs above gave us an intervention cost of £3.742m to implement the intervention in a planned way (the capex after).

If however we had to undertake this work in a reactive manner, we would be able to undertake a repair to return it to operation. However in this particular instance the repair would not be as extensive as the refurbishment option described in the capex after evaluation above. Our assessment is that we would expect to pay £3.698m to repair the failed asset. In this particular instance the repair would not be an extensive refurbishment and substantial risks would remain with potential for further repairs during the period.

We have established that if undertook the above intervention in a planned way then there would be an opex saving of £0.013m (opex after).

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

4.2.4 Benefits Quantification

Four interventions were assessed for direct and indirect benefits. These are presented in Appendix E:

In terms of indirect benefits the performance commitments that relate to this investment case are discussed below.

Unplanned Outages

The unplanned outage was assessed using operational data from our corporate financial and asset management system via routine asset performance reports. This information was cross-checked against operational pumping station flow data to establish the reduction in output (flow) and the duration of each outage. The information was recorded in the relevant benefits calculation and the impact was assessed. This process was undertaken in accordance with Ofwat guidance for measurement of unplanned outages.

Unplanned Maintenance - Non-Infrastructure

The unplanned maintenance - non-Infrastructure contribution was assessed using operational data from our core company systems. Data for the years 2010–2016 was used to identify the number of unplanned maintenance events. The information was recorded in the relevant benefits calculation and the overall impact on the company output, as a percentage, was assessed.

While a specific intervention would not be expected to fully eradicate unplanned maintenance events, a reduction of 80% was considered a reasonable assumption. The change in unplanned maintenance events before and after implementation of the intervention was recorded in the benefits calculation for input to the investment optimiser input form.

5 Outcome

5.1 Selected Interventions

The four developed interventions were assessed through the investment optimisation process. Of these four interventions, one has been 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 raw water pumping station selected intervention is set out in Table 8, along with details of the associated costs and contribution to performance improvement.

Table 8: Selected intervention, costs, and % performance contribution

ID	Intervention title	Total capex (£)	Change in opex per annum (£)	Unplanned outages	Unplanned maintenance – non-infrastructure
22.001.20	Axbridge PS - Barrow Zone Refurbishment – Phase 1	£3,742,986	-£12,649	-	0.74%
Raw Water Pumping Stations capital investment (pre-efficiency)		**£3,742,986**	**-£12,649**	**-**	**0.74%**
Raw Water Pumping Stations capital investment with 8% capex efficiency		**£3,443,547**			

Axbridge Pumping Station - Barrow Zone Refurbishment – Phase 1 has been selected because it is cost-beneficial, helping to offset future bill increases for our customers. Additionally, the intervention also provides contributions to achieving the unplanned maintenance – non-infrastructure performance commitment target.

The intervention is described in the following section.

Axbridge Pumping Station – Barrow Zone Refurbishment – Phase 1

The Axbridge pumping station transports raw water through three sets of transfer pumps to three of our key treatment work sites at Barrow, Banwell, and Cheddar. These three sites have an average annual output of approximately 98Ml/d, which is circa 30% of our total production output. Within Axbridge Pumping Station, the Barrow Transfer Pumps are driven by 3.3kV electric motors and starters. These electric motors and starters are supplied by a single 11/3.3kV power transformer supplied from an 11kV electrical switchboard. The switchboard also supplies an 11kV/415V transformer which supplies the Cheddar Transfer Pumps. The Barrow Transfer Pumps and electrical systems were installed in 1964.

The high voltage system no longer meets current design and safety standards mainly due to obsolescence of the oil filled switchgear. Obtaining spare parts and carrying out maintenance is difficult. The condition of the switchboards creates a fire/explosion health and safety risk for operators, and an operational risk which could cause a significant unplanned outage event at Cheddar treatment works. In addition, raw water supplies available to Barrow and Banwell Treatment Works will be reduced.

Replacement and refurbishment of the Barrow transfer pumps and electrical installations will improve the reliability of the asset and reduce unplanned maintenance events. It will also mitigate the risk of an unplanned outage of the Cheddar treatment works and loss of alternative raw water supplies to Barrow and Banwell treatment works, ensuring safe and reliable raw water supplies for our customers.

The total raw water pumping stations investment is aligned to the Water Resources Wholesale Control category of our Business Plan. Costs are allocated to the Water Resources Business Units. Investment is all related to the maintaining the long term capability of the non-Infrastructure assets. Water Service and Business Unit Allocation for raw water pumping station investment is summarised in Table 9.

Table 9: Water Services and Business Unit Allocation

Wholesale Control	**Water Resources**	**Total**
Business Unit Allocation	***01 Water Resources***	
Raw Water Pumping Stations - total investment (%)	**100.0%**	**100%**
Raw Water Pumping Stations - total investment	**£3.743m**	**£3.743m**
Maintaining the long term capability of the assets - non-infra	£3.743m (100%)	**£3.743m (100%)**
Raw Water Pumping Stations - total investment with 8% capex efficiency	**£3.444m**	**£3.444m**

5.2 Contribution to performance improvement

Table 10 set outs the percentage contribution to performance improvement provided by the selected raw water pumping stations intervention. These percentage contributions are discussed in the following sections.

Table 10: Contribution to performance targets from selected interventions

Performance Commitment	Unit	2019/20 Baseline	2020/21	2021/22	2022/23	2023/24	2024/25	Performance improvement required in AMP7	Raw water pumping stations % contribution to improvement
Unplanned outage	%	1.74	1.74	1.74	1.74	1.74	1.74	0	-
Unplanned maintenance (non-infrastructure)	Number of jobs	3972	3272	3272	3272	3272	3272	704	0.74%

Asset Health

Our AMP7 investment in raw water pumping stations will help ensure our assets are being maintained appropriately to deliver resilient water services to current and future generations.

Unplanned Outage

Our AMP7 target is to sustain our 2019/20 performance level of 1.74%. Our investment in raw water pumping stations will also support our ability to sustain this level of performance.

Unplanned Maintenance – Non-Infrastructure

Our AMP7 investment in raw water pumping stations will additionally contributes 0.74% towards our required AMP7 performance improvement. 23.24% of our overall performance improvement will be achieved through investment case interventions. We will achieve the remaining performance improvement through our operational asset health and maintenance activities.

5.3 Non-Selected Interventions

Of the four interventions developed within this investment case, three were not selected because they did not provide the most cost beneficial way of meeting performance commitment targets compared to other interventions available. However, one of these four interventions (22.001.02 Axbridge to Barrow Pumping Station - Refurbishment) was mutually exclusive with one intervention that was selected by the investment optimiser.

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 if the process requires these risks to be mitigated, we will respond with appropriate action. Details of the three non-selected interventions are given Table 11.

Table 11: Non-selected interventions and residual risks

SSR ID	Risk & Need Statement	Non-Selected Intervention & Residual Risk
SRR55	Cheddar TW has an average annual output of 23Ml/d and accounts for approximately 8% of BWs total output. The TW main source of supply is Axbridge PS, Cheddar Transfer pumps which were installed in 1983 (2No) and 1992. The pumps and electrical assets will be between 30 and 40 years old by the end of AMP7 and beyond their normal life expectancy of 25-30 years. Between 2010 and 2016 Unplanned Non-Infrastructure Maintenance events recorded on SAP for Axbridge PS, Cheddar Transfer pumps was on average 9 failures/annum. With each of these failures is the risk that a catastrophic failure will occur leading to a health and safety risk and an Unplanned Outage of the Cheddar TW. The new southern relief scheme will allow water to be supplied to the zone but this will be at an increased operational cost. An intervention is Needed to refurbish the Axbridge PS; Cheddar Transfer pumps to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigates the risk of an Unplanned Outage of the Cheddar TW ensuring safe and reliable raw water supplies for customers.	Non-Selected Intervention: 22.001.01 Axbridge to Cheddar PS – Refurbishment Residual Risk: IF 40 year old, obsolescent assets at Cheddar Transfer PS are not replaced THEN unplanned outage risks from a catastrophic failure will increase. The raw water supply to Cheddar TW will be taken directly from Cheddar springs rather than the reservoir. Cheddar springs has a higher turbidity and therefore Cheddar TW will operate at a reduced output. Supply to the Cheddar zone will therefore need to be supplemented by water from Barrow delivered through the Southern Resilience Scheme. This will increase operational cost.
SRR135	Barrow TW has an average annual output of 57.3Ml/d and accounts for approximately 16% of BWs total output. Banwell TW 17.7Ml/d and accounts for 6% of BWs total output. Cheddar TW has an average annual output of 23Ml/d and accounts for approximately 8% of BWs total output. All 3 TW are to some extent supported with raw water transported by Axbridge PS through either the Barrow or Cheddar Transfer Pumps. The Barrow Transfer pumps are driven by 3.3kV electric motors and starters which are supplied by a single 11/3.3kV power transformer supplied from an 11kV electrical switchboard. The switchboard also supplies an 11/0.415kV transformer which supplies the Cheddar Transfer Pumps. The Barrow Transfer Pumps and electrical systems were installed in1964. The HV system no longer meets current design and safety standards mainly due to the use of obsolescent oil filled switchgear. Obtaining spare parts and carrying out maintenance is difficult. The age and condition of the switchboards creates a fire/explosion health and safety risk for operators, and an operational risk which could cause a significant Unplanned Outages event at Cheddar TW. In addition, raw water supplies available to Barrow and Banwell TW will be reduced. An intervention is Needed to refurbish the Axbridge PS, Barrow Transfer pumps and electrical installations to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigate the risk of an Unplanned Outage of the Cheddar TW and loss of alternative raw water supplies to Barrow and Banwell TW, ensuring safe and reliable raw water supplies for customer	Non-Selected Intervention: 22.001.02 Axbridge to Barrow PS – Refurbishment. Residual Risk: **This intervention was mutually-exclusive with the selected intervention (20.001.20 Axbridge to Barrow PS - Refurbishment Phase 1). The selected intervention provides a phased installation of Refurbishment. Therefore while the selected intervention reduces the risk to an acceptable level, further refurbishment work may be required in the future.** We will continue to monitor this residual risk throughout AMP7, and if the process requires this risk to be mitigated further, we will respond with appropriate action

SSR ID	Risk & Need Statement	Non-Selected Intervention & Residual Risk
SRR693	Purton TW has an average annual output of 95.4Ml/d and accounts for approximately 34% of BWs total output. The TW is supplied with water from the Sharpness canal by the Purton canal and transfer pumping station raw water pumping station. The pumping station LV electrical installation was refurbished in AMP5. However, the HV electrical switchboard and transformers, and the pumps and pipework date back to 1974 and at 50 years of age by the end of AMP7 will be life expired. The HV system no longer meets current design and safety standards mainly due to the use of obsolescent oil filled switchgear. Obtaining spare parts and carrying out maintenance is difficult. The age and condition of the switchboards creates a fire/explosion health and safety risk for operators, and an operational risk which could cause a significant Unplanned Outages event at Purton TW. The pumps are less efficient than modern pumps and it is expected that efficiency gains would be made with new pumps. An intervention is Needed to refurbish the Purton canal and transfer pumps and HV electrical installations to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigate the risk of an Unplanned Outage of the Purton TW ensuring safe and reliable raw water supplies for customer.	Non-Selected Intervention: 22.002.01 Purton Canal and Return Pumps Refurbishment Residual Risk: IF 50 year old, life expired 11kV electrical assets at Purton canal and intake PS are not replaced THEN health and safety, and unplanned outage risks from a catastrophic failure under load will increase. Purton TW operation will be restricted and possible loss of supply to raw water tank aerators.

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 section 11 of the PR19 Investment Cases Summary Document. There are no additional specific assumptions related to this investment case.

5.5 AMP 8

We are not planning to change the number of raw water pumping stations in our network in AMP7 and therefore there will still be 25 as we proceed into AMP8.

We anticipate that the strategic replacement and renewal of our raw water pumping station assets will follow a similar pattern in AMP8 as proposed for AMP7.

There are a number of risk items that were developed into interventions which have not been selected for inclusion in the AMP7 business plan (as given in the Table 11). These will be reappraised for investment in AMP8. However it is predicted that the risks that remain unaddressed will increase in severity due to asset deterioration and as a consequence are more likely to materialise.

Any unselected risks will continue to be monitored and assessed as part of the live and on-going business as usual risk management process. Where this process requires these risks to be mitigated, we will respond with appropriate action such as base maintenance.

5.6 Base Maintenance

We have established minimum levels of investment in relation to the base maintenance of Raw Water Pumping Stations, as set out in the Non-Infrastructure base maintenance investment case. These minimum levels provide investment for routine and reactive maintenance, to ensure the continuation of 'business as usual'. The minimum value for mechanical and electrical assets within treatment works and pumping stations is £21.0m. These minimum levels have been determined through a combination of analysis of historical activity and costs, deterioration modelling to establish underlying asset deterioration, and investment planning analysis. Full details are provided in the Non-Infrastructure Base maintenance investment case.

The investment planned through this investment case contributes towards the minimum investment levels, as the selected interventions improve the performance our raw water pumping stations assets above current levels.

In relation to this investment case, the Non-Infrastructure base maintenance investment case defines minimum levels of expenditure for mechanical and electrical assets in treatment works and pumping stations. The minimum investment levels are summarised in Table 12.

Table 12: Contribution to minimum non-infrastructure base maintenance investment

Non-Infrastructure Base Maintenance Asset Group	Minimum AMP7 asset group investment to maintain asset health (£m)	AMP7 raw water pumping stations investment (£m)	Total AMP7 asset group investment (£m)	Additional investment requirement as Base Maintenance (£m)
Treatment works and pumping stations – mechanical and electrical assets	21.0	2.589	18.233	2.767

The assessment of the contribution from AMP7 raw water pumping stations investment to base maintenance minimum spend applies 70% of the capex before (reactive cost) of the interventions, to account for the typical cost of a proactive intervention being approximately 70% of the cost of reactive intervention. Full details of this assessment methodology are provided in the non-infrastructure base maintenance investment case.

5.7 Historical & AMP7 Investment Comparison

A summary of historical raw water pumping stations investment is provided in Table 13, along with our AMP7 investment in raw water pumping station 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 13: Historical and AMP7 investment

AMP	Values	Investment (£m)
AMP5	AMP5 actual	4.408
AMP6	2015/16 actual	0.039
	2016/17 actual	0.000
	2017/18 actual	0.031
	2018/19 forecast	0.108
	2019/20 forecast	0.000
	AMP6 forecast	0.178
AMP7	AMP7 pre-efficiency	**3.743**
	AMP7 8% capex efficiency applied	**3.444**

Our AMP7 investment in raw water pumping stations will be similar to that in AMP5, but significantly greater than that in AMP6. Our AMP6 investment delivers low cost improvements to three of our raw water pumping stations to address specific asset health risks. In AMP7, we are proposing to undertake one significant improvement scheme at Axbridge to implement a cost-beneficial solution to an identified risk, to replace electrical assets at Axbridge pumping station and avoid unplanned outage events resulting from a catastrophic failure.

6 Conclusion

To ensure our 25 raw water pumping stations assets continue to deliver our customers' priorities, we will measure progress via performance commitments for which we have set delivery targets.

In AMP7, the raw water pumping stations measures are the occurrence of unplanned maintenance events (target 3272) and unplanned outages (target 1.74%). These performance commitments measure asset health.

An initial list of fourteen risks was narrowed to three risks and four potential interventions. These interventions were developed and assessed through our asset management totex focused processes, and put forward for investment optimisation. Of these four interventions, one was selected on the basis that it is a cost beneficial intervention that meets our outcome of a Safe and Reliable Supply and contributes to associated asset health performance commitments.

We plan to invest a pre-efficiency total of £3.743m on raw water pumping stations. The intervention selected will reduce our opex by approximately £13k per annum. 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 £3.444m.

The intervention proposed contributes to ensuring our assets are maintained appropriately for the benefit of current and future generations. The intervention proposed is expected to contribute 0.74% of the targeted improvement for the unplanned maintenance – non-infrastructure performance commitment and will support our ability to sustain our performance against unplanned outages.

If we fail to invest and do not refurbish Axbridge Pumping station, its asset health will ultimately continue to deteriorate to unacceptable levels. A consequence of asset deterioration at this site will be an increased number of unplanned outages and unplanned maintenance events, leading to us failing to deliver our customers' priority of keeping water flowing to their tap.

Those interventions not selected during investment optimisation form residual risk that will be carried during AMP7. The risks associated with these interventions will continue to be monitored and if the process requires these risks 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 DWI and the UK Government.

7 Appendices

- Appendix A: Line of Sight
- Appendix B: Datasets
- Appendix C1: Selected Risks
- Appendix C2: Non-Selected Risks
- Appendix D: Options Considered
- Appendix E: Interventions Developed
- Appendix F: Non-Selected Interventions

7.1 Appendix A: Line of Sight

Raw Water Pumping Stations Line of Sight

Investment Case
NTPBP-INV—RAW-0540

Customer Priorities

- Top Quality Water Supplies
- Reliability
- Best Experience
- Carries Out Work Effectively

Performance Commitments

Optimiser Input Form Reference

NTPBP-CAL-RAW-0359

Safe and Reliable Supply of Water

Slower Plan
Suggested Plan
Faster Plan
Based on lockdown 5

Unplanned Outages — 1.74 | 1.74 | 1.74

Customer High Priority

ODI — Common Reward and Penalty

Unplanned non Infra Maintenance — 3272 | 3272 | 3272

Customer High Priority

ODI — Bespoke Reward and Penalty

Interventions

22.001.01
22.001.02
22.002.01
22.001.20

22.001.01
22.001.02
22.002.01
22.001.20

OFWAT Initial Assessment Tests

Test Area	Assessment
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: NTPBPP-MET-RAW0724

7.2 Appendix B: Datasets

This appendix lists the datasets used in this investment case and where they have been utilised.

Dataset File Name	Data Summary	Process In Which Data Has Been Used			
		Risk Identification, Verification and Needs Assessment	Optioneering	Intervention Costing	Benefits Quantification
NTPBP-INT-DG3-UNP-0703 DG3 Report - All Interruptions to Supply - Oct-01 to Dec-16.xlsx	Unplanned customer Minute Lost (DG3) Report	✓	-	-	✓
REQ-0215 2017-18 KPI energy efficiency summary snapshot 270418.xlsx	Energy efficiency summary	✓	-	✓	✓
NTPBP-CAL-PUM-0701 - Pumping station consequence of failure.xlsx	Network modelling to support pumping station risk review	✓	-	-	-
NTPBP-INT-PUM-0697 Pumping station Site Survey - 2017.pdf	Observations from pumping station site surveys conducted in 2017.	✓	-	-	-
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	✓	-	-	-

7.3 Appendix C1: Selected Risks

This appendix shows the 3 selected risks of the 17 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
SRR55	Axbridge PS	IF 40 year old, life expired assets at Cheddar Transfer PS are not replaced THEN unplanned outage risks from a catastrophic failure will increase. Supplies to Cheddar TW will be significantly reduced and supplied from a source with a high risk of cryptosporidium increasing the health risks to customers. Alternative treated water supplies from the southern relief main will increase the operational costs.	4	1	2	2	2	4	4	16
SRR135	Axbridge PS	IF 60 year old, life expired 11kV and 3.3kV electrical assets at Axbridge PS are not replaced THEN health and safety, and unplanned outage risks from a catastrophic failure under load will increase. Barrow TW, and potentially Cheddar TW, transfer pumps will not operate and there will be a loss of source to Rowberrow and Barrow TW reducing overall network resilience. Alternative treated water supplies from the southern relief main will increase the operational costs.	4	1	3	2	3	4	4	16
SRR693	Purton Severn Intake Works PS	IF 50 year old, life expired 11kV electrical assets at Purton canal and intake PS are not replaced THEN health and safety, and unplanned outage risks from a catastrophic failure under load will increase. Purton TW operation will be restricted and possible loss of supply to raw water tank aerators.	4	1	3	1	3	1	3	12

7.4 Appendix C2: Non-Selected Risks

This appendix shows the 14 non-selected risks of the 17 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
SRR54	Axbridge TW	IF the River Axe pumps fail at Axbridge TW, THEN output from the site is lost. (Axbridge-Area 3)	2	1	2	1	1	1	2	4
SRR56	Cheddar TW	IF the Spring Pumps are not upgraded and run, **THEN** output from site from the site could be reduced as the pumps woul;d not be available when needed (Cheddar-Area 3)	1	1	3	1	1	1	3	3
SRR76	Cheddar TW	**IF** the Cheddar Cliffs pumps fail, **THEN** output from works is reduced (Cheddar-Area 3)	1	1	1	1	1	1	1	1
SRR190	Chew Stoke PS	Falling from height (H&S) because there are no guard rails along spillway and compensation channel. (Chew Stoke PS - spillway)	3	4	2	3	4	1	4	12
SRR355	Rowberrow PS	**IF** the Main Incoming Switchboard fails **THEN** output from the site would be reduced	2	1	3	3	3	4	4	8
SRR356	Rowberrow Raw Water PS	Pumps not in use, but Treatment works fed from this switchboard	1	1	1	1	1	4	4	4
SRR632	All Pumping Stations	IF aging assets at small pumping stations are not refurbished or replaced to improve PS reliability THEN number of unplanned maintenance events will increase and customer connections will be at an increasing risk of low pressure or loss of supply.	3	1	3	1	4	4	4	12
SRR633	All Pumping Stations	If Bristol Water improves its condition based monitoring on critical high value assets THEN asset maintenance can be optimised to avoid asset failures and unnecessary maintenance reducing Unplanned Non-infrastructure Maintenance and overall operational costs.	3	1	3	1	4	1	4	12
SRR635	All Pumping Stations	IF an oil spill occurs at a site where facilities do not comply with the least bulk fuel oil storage regulations THEN fines, litigation, environmental and reputational damage will occur.	2	4	4	3	5	1	5	10
SRR684	Axbridge PS	IF Transformer 1 fails THEN loss of power at site and no generator backup (Axbridge PS)	3	1	4	1	1	1	4	12
SRR685	Axbridge PS	IF Transformer 2 fails THEN run standby generator, reduced output and possible loss of power at site (Axbridge PS)	3	1	4	1	1	1	4	12
SRR688	Chew Stoke PS	**IF** the site transformer at Chew Stoke PS fails **THEN** the standby generator is used to support Stowey TW transfer and the Barrow transfer is lost due to reduced power at site (Chew Stoke PS)	3	1	3	1	1	1	3	9
SRR694	Purton Severn Intake Works PS	IF Intake Transformer 2 fails THEN reduced output from site as reduced power at site(Purton Severn Intake Works PS)	4	1	3	1	3	1	3	12
SRR697	Rowberrow PS	**IF** the site Transformer at Rowborow PS fails **THEN** a standby generator used and output from site is reduced. (Rowberrow PS)	1	1	3	1	3	1	3	3

7.5 Appendix D: Options Considered

This appendix shows the 7 options considered from the 3 selected risks

		Risk Need		Identification & Viability of Options			
Strategic Risk Register (SRR) Reference	SRR Revised Risk Description	SRR Need ID	Need Description (from SRR)	Proposed Option Name	Proposed Option Description	Option Viability?	Option to be Developed into an Intervention?
SRR55	IF 40 year old, life expired assets at Cheddar Transfer PS are not replaced THEN unplanned outage risks from a catastrophic failure will increase. Supplies to Cheddar TW will be significantly reduced and supplied from a source with a high risk of cryptosporidium increasing the health risks to customers. Alternative treated water supplies from the southern relief main will increase the operational costs.	SRRN23	Cheddar TW has an average annual output of 23Ml/d and accounts for approximately 8% of BWs total output. The TW main source of supply is Axbridge PS, Cheddar Transfer pumps which were installed in 1983 (2No) and 1992. The pumps and electrical assets will be between 30 and 40 years old by the end of AMP7 and beyond their normal life expectancy of 25-30 years. Between 2010 and 2016 Unplanned Non-Infrastructure Maintenance events recorded on SAP for Axbridge PS, Cheddar Transfer pumps was on average 9 failures/annum. With each of these failures is the risk that a catastrophic failure will occur leading to a health and safety risk and an Unplanned Outage of the Cheddar TW. The new southern relief scheme will allow water to be supplied to the zone but this will be at an increased operational cost. An intervention is Needed to refurbish the Axbridge PS, Cheddar Transfer pumps to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigate the risk of an Unplanned Outage of the Cheddar TW ensuring safe and reliable raw water supplies for customer.	Do Nothing	Do nothing	Option does not mitigate risk therefore is not viable.	No
				Axbridge to Cheddar PS - Refurbishment	Refurbish PS - replace switchgear, pumps, motors, drives, valves and above ground pipework.	This is a viable option and the most cost effective.	Yes
SRR135	IF 60 year old, life expired 11kV and 3.3kV electrical assets at Axbridge PS are not replaced THEN health and safety, and unplanned outage risks from a catastrophic failure under load will increase. Barrow TW, and potentially Cheddar TW, transfer pumps will not operate and there will be a loss of source to Rowberrow and Barrow TW reducing overall network resilience. Alternative treated water supplies from the southern relief main will increase the operational costs.	SRRN24	Barrow TW has an average annual output of 57.3Ml/d and accounts for approximately 16% of BWs total output. Banwell TW 17.7Ml/d and accounts for 6% of BWs total output. Cheddar TW has an average annual output of 23Ml/d and accounts for approximately 8% of BWs total output. All 3 TW are to some extent supported with raw water transported by Axbridge PS through either the Barrow or Cheddar Transfer Pumps. The Barrow Transfer pumps are driven by 3.3kV electric motors and starters which are supplied by a single 11/3.3kV power transformer supplied from an 11kV electrical switchboard. The switchboard also supplies a 11/0.415kV transformer which supplies the Cheddar Transfer Pumps. The Barrow Transfer Pumps and electrical systems were installed in1964. The HV system no longer meets current design and safety standards mainly due to the use of obsolete oil filled switchgear. Obtaining spare parts and carrying out maintenance is difficult. The age and condition of the switchboards creates a fire/explosion health and safety risk for operators, and an operational risk which could cause a significant Unplanned Outages event at Cheddar TW. In addition, raw water supplies available to Barrow and Banwell TW will be reduced. An intervention is Needed to refurbish the Axbridge PS, Barrow Transfer pumps and electrical installations to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigate the risk of an Unplanned Outage of the Cheddar TW and loss of alternative raw water supplies to Barrow and Banwell TW, ensuring safe and reliable raw water supplies for customer.	Do Nothing	Do nothing	Option does not mitigate risk therefore is not viable.	No
				Axbridge to Barrow PS - Refurbishment	Refurbish PS - replace transformers, HV switchgear, LV switchgear, pumps, motors, drives, valves and above ground pipework.	This is a viable option.	Yes
				Axbridge to Barrow PS - Refurbishment Phase 1	Phased installation of Refurbish PS - replace transformers, HV switchgear, LV switchgear, pumps, motors, drives, valves and above ground pipework.	This is a viable option.	Yes

		Risk Need		Identification & Viability of Options			
Strategic Risk Register (SRR) Reference	SRR Revised Risk Description	SRR Need ID	Need Description (from SRR)	Proposed Option Name	Proposed Option Description	Option Viability?	Option to be Developed into an Intervention?
SRR693	IF 50 year old, life expired 11kV electrical assets at Purton canal and intake PS are not replaced THEN health and safety, and unplanned outage risks from a catastrophic failure under load will increase. Purton TW operation will be restricted and possible loss of supply to raw water tank aerators.	SRRN19	Purton TW has an average annual output of 95.4Ml/d and accounts for approximately 34% of BWs total output. The TW is supplied with water from the Sharpness canal by the Purton canal and transfer pumping station raw water pumping station. The pumping station LV electrical installation was refurbished in AMP5. However, the HV electrical switchboard and transformers, and the pumps and pipework date back to 1974 and at 50 years of age by the end of AMP7 will be life expired. The HV system no longer meets current design and safety standards mainly due to the use of obsolete oil filled switchgear. Obtaining spare parts and carrying out maintenance is difficult. The age and condition of the switchboards creates a fire/explosion health and safety risk for operators, and an operational risk which could cause a significant Unplanned Outages event at Purton TW. The pumps are less efficient than modern pumps and it is expected that efficiency gains would be made with new pumps. An intervention is Needed to refurbish the Purton canal and transfer pumps and HV electrical installations to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigate the risk of an Unplanned Outage of the Purton TW ensuring safe and reliable raw water supplies for customer.	Purton Canal and Return Pumps Refurbishment	Refurbish the Purton canal and transfer pumps and HV electrical installations to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigate the risk of an Unplanned Outage of the Purton TW ensuring safe and reliable raw water supplies for customers.	This is a viable option a	Yes
				Do Nothing	Do Nothing.	Option will not mitigate risk or meet need.	No

7.6 Appendix E: Interventions Developed

This appendix shows the 4 interventions developed from the 7 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 (£)	Change in Opex (£)	Unplanned Outages (%)	Unplanned Maintenance Non Infra
SRR55	IF 40 year old, life expired assets at Cheddar Transfer PS are not replaced THEN unplanned outage risks from a catastrophic failure will increase. Supplies to Cheddar TW will be significantly reduced and supplied from a source with a high risk of cryptosporidium increasing the health risks to customers. Alternative treated water supplies from the southern relief main will increase the operational costs.	SRRN23	Cheddar TW has an average annual output of 23Ml/d and accounts for approximately 8% of BWs total output. The TW main source of supply is Axbridge PS, Cheddar Transfer pumps which were installed in 1983 (2No) and 1992. The pumps and electrical assets will be between 30 and 40 years old by the end of AMP7 and beyond their normal life expectancy of 25-30 years. Between 2010 and 2016 Unplanned Non-Infrastructure Maintenance events recorded on SAP for Axbridge PS, Cheddar Transfer pumps was on average 9 failures/annum. With each of these failures is the risk that a catastrophic failure will occur leading to a health and safety risk and an Unplanned Outage of the Cheddar TW. The new southern relief scheme will allow water to be supplied to the zone but this will be at an increased operational cost. An intervention is Needed to refurbish the Axbridge PS, Cheddar Transfer pumps to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigate the risk of an Unplanned Outage of the Cheddar TW ensuring safe and reliable raw water supplies for customer.	Axbridge to Cheddar PS - Refurbishment	Refurbish PS - replace switchgear, pumps, motors, drives, valves and above ground pipework.	This is a viable option and the most cost effective.	22.001.01	Axbridge to Cheddar - Refurbishment	£1,078,220	-£580	0.0101	7.2

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 (£)	Change in Opex (£)	Unplanned Outages (%)	Unplanned Maintenance Non Infra
SRR135	IF 60 year old, life expired 11kV and 3.3kV electrical assets at Axbridge PS are not replaced THEN health and safety, and unplanned outage risks from a catastrophic failure under load will increase. Barrow TW, and potentially Cheddar TW, transfer pumps will not operate and there will be a loss of source to Rowberrow and Barrow TW reducing overall network resilience. Alternative treated water supplies from the southern relief main will increase the operational costs.	SRRN24	Barrow TW has an average annual output of 57.3Ml/d and accounts for approximately 16% of BWs total output. Banwell TW 17.7Ml/d and accounts for 6% of BWs total output. Cheddar TW has an average annual output of 23Ml/d and accounts for approximately 8% of BWs total output. All 3 TW are to some extent supported with raw water transported by Axbridge PS through either the Barrow or Cheddar Transfer Pumps. The Barrow Transfer pumps are driven by 3.3kV electric motors and starters which are supplied by a single 11/3.3kV power transformer supplied from an 11kV electrical switchboard. The switchboard also supplies a 11/0.415kV transformer which supplies the Cheddar Transfer Pumps. The Barrow Transfer Pumps and electrical systems were installed in1964. The HV system no longer meets current design and safety standards mainly due to the use of obsolete oil filled switchgear. Obtaining spare parts and carrying out maintenance is difficult. The age and condition of the switchboards creates a fire/explosion health and safety risk for operators, and an operational risk which could cause a significant Unplanned Outages event at Cheddar TW. In addition, raw water supplies available to Barrow and Banwell TW will be reduced. An intervention is Needed to refurbish the Axbridge PS, Barrow Transfer pumps and electrical installations to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigate the risk of an Unplanned Outage of the Cheddar TW and loss of alternative raw water supplies to Barrow and Banwell TW, ensuring safe and reliable raw water supplies for customer.	Axbridge to Barrow PS - Refurbishment	Refurbish PS - replace transformers, HV switchgear, LV switchgear, pumps, motors, drives, valves and above ground pipework.	This is a viable option.	22.001.02	Axbridge to Barrow - Refurbishment	£5,222,330	-£12,650	0.0368	5.2
				Axbridge to Barrow PS - Refurbishment Phase 1	Phased installation of Refurbish PS - replace transformers, HV switchgear, LV switchgear, pumps, motors, drives, valves and above ground pipework.	This is a viable option.	22.001.20	Axbridge to Barrow - Refurbishment - Phase 1	£3,742,986	-£12,650	0.0368	5.2

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 (£)	Change in Opex (£)	Unplanned Outages (%)	Unplanned Maintenance Non Infra
SRR693	IF 50 year old, life expired 11kV electrical assets at Purton canal and intake PS are not replaced THEN health and safety, and unplanned outage risks from a catastrophic failure under load will increase. Purton TW operation will be restricted and possible loss of supply to raw water tank aerators.	SRRN19	Purton TW has an average annual output of 95.4Ml/d and accounts for approximately 34% of BWs total output. The TW is supplied with water from the Sharpness canal by the Purton canal and transfer pumping station raw water pumping station. The pumping station LV electrical installation was refurbished in AMP5. However, the HV electrical switchboard and transformers, and the pumps and pipework date back to 1974 and at 50 years of age by the end of AMP7 will be life expired. The HV system no longer meets current design and safety standards mainly due to the use of obsolete oil filled switchgear. Obtaining spare parts and carrying out maintenance is difficult. The age and condition of the switchboards creates a fire/explosion health and safety risk for operators, and an operational risk which could cause a significant Unplanned Outages event at Purton TW. The pumps are less efficient than modern pumps and it is expected that efficiency gains would be made with new pumps. An intervention is Needed to refurbish the Purton canal and transfer pumps and HV electrical installations to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigate the risk of an Unplanned Outage of the Purton TW ensuring safe and reliable raw water supplies for customer.	Purton Canal and Return Pumps Refurbishment	Refurbish the Purton canal and transfer pumps and HV electrical installations to improve the reliability of the assets, reduced Unplanned Maintenance Events and mitigate the risk of an Unplanned Outage of the Purton TW ensuring safe and reliable raw water supplies for customers.	This is a viable option a	22.002.01	Purton Return and Canal Pumps	£1,887,501	-£6,490	0	12.8

7.7 Appendix F: Non-Selected Interventions

This appendix shows the 3 non-selected interventions. See appendix D for costs or performance commitments.

Ref. No.	Intervention Title	Expected Capex after (£)	Change in Opex (£)	Residual Risk
22.001.01	Axbridge to Cheddar - Refurbishment	£1,078,220	-£580	IF 40 year old, life expired assets at Cheddar Transfer PS are not replaced THEN unplanned outage risks from a catastrophic failure will increase. Supplies to Cheddar TW will be significantly reduced and supplied from a source with a high risk of cryptosporidium increasing the health risks to customers. Alternative treated water supplies from the southern relief main will increase the operational costs.
22.001.02	Axbridge to Barrow - Refurbishment	£5,222,330	-£12,650	IF 60 year old, life expired 11kV and 3.3kV electrical assets at Axbridge PS are not replaced THEN health and safety, and unplanned outage risks from a catastrophic failure under load will increase. Barrow TW, and potentially Cheddar TW, transfer pumps will not operate and there will be a loss of source to Rowberrow and Barrow TW reducing overall network resilience. Alternative treated water supplies from the southern relief main will increase the operational costs.
22.002.01	Purton Return and Canal Pumps	£1,887,501	-£6,490	IF 50 year old, life expired 11kV electrical assets at Purton canal and intake PS are not replaced THEN health and safety, and unplanned outage risks from a catastrophic failure under load will increase. Purton TW operation will be restricted and possible loss of supply to raw water tank aerators.