Cadent
Your Gas Network

Appendix 10.01

Uncertainty Mechanism Case

Repex - Tier 2a iron mains, including Pipes above safety threshold (PAST)

Cadent’s systematic approach to developing uncertainty mechanisms to manage forecast uncertainty

1. Defining our customers’ needs

- What is the area?
- Why is it important to customers and stakeholders?
- What insights are shaping our thinking?
  - Customer insights
  - Stakeholder insights
  - Legislative insights
  - BAU operational information
  - Historic insights
  - Wider research

2. Evidencing forecast uncertainty

- What do we know about future workload & costs in this area?
- Why can’t expenditure be forecast with sufficient confidence?
  - For example using historical / independent benchmarks
- Why are levels of expenditure outside of network control?
- What customer / network impacts could there be from a forecast error?
- What network behaviours could arise from inclusion within the base plan?
  - What would the customer impact be?

3. Qualitative assessment of the options

- What options other than inclusion in the base plan are available?
- Why are they the options?
- What option(s) are we proposing and why?
- How would the mechanism(s) work? (Implementation, triggers, materiality thresholds etc.)
- What are the customer benefits & drawbacks of the mechanism(s)? (Inc. simplicity)
- Why do the customer benefits outweigh the drawbacks?
- What network behaviours could the mechanism drive?
  - What would the customer impact be?

4. Quantitative assessment of the proposed options

- How do we know our ‘input variables’ are the best available? (i.e. ranges of workload, costs, trigger points, frequency, probability etc.)
- How are we assuring our modelling results?
- What is the best view of materiality for the area?
- What is the modelled cost volatility for the area?
- How does the proposed mechanism(s) deliver value for money?

5. Quantifying the overall customer impact

- What is the overall customer impact of all areas of forecast uncertainty – with and without mechanisms?
- What does this mean for the balance of forecast risk between customers and networks?
- What does this mean for customer bills?

6. Setting standards that customers love

- Are our proposals, and the associated impacts, easy to understand?
- Can it be demonstrated that they protect customers and investors?
- Is our suite of proposed mechanisms acceptable to customers and stakeholders?

Uncertainty area			
Demand uncertainty	Legislative uncertainty	**Cost confidence**	Heat policy

Repex – Tier 2a iron mains including Pipes Above Safety Threshold (PAST)

Tier 2a proposed by Ofgem, PAST proposed by Cadent

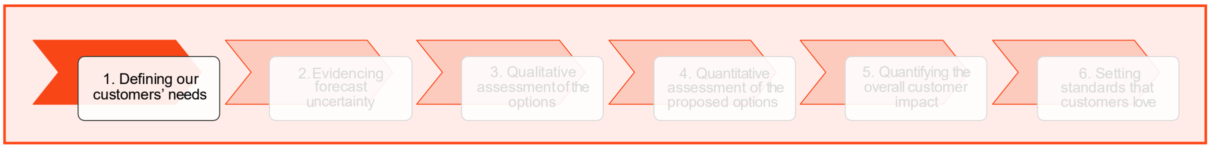
Volume Driver Uncertainty Mechanisms

We are focused on keeping our customers safe. A key of this is tracking the performance of our distribution network with regard to the risk posed by individual lengths of pipe through time. To do this, we use a Health and Safety Executive supported safety risk scoring software, the Mains Risk Prioritisation System (MRPS).

If a pipeline's score increases above a fixed safety threshold - as a result of increased failures or changes which mean that gas is more likely to enter homes - we will act to replace that pipe within a short period. This ensures we keep our customers safe and comply with the Pipeline Safety Regulations (1996). Although we can model failure rates at a population level, it is not possible to model at an asset level or to model changes in the likelihood of gas from a failed asset entering a home.

Ofgem has proposed to address this risk for tier 2a iron mains through a volume driver, which is already in place. We propose to expand this with an additional volume driver to address other pipes above a safety threshold. This would ensure consistent treatment of all our high-risk main pipes.

1. Defining the need



1.1. What is the area?

Throughout our operations, we are focused on maintaining the security of supply for our customers and ensuring this is done in a safe way. A key part of this is monitoring the performance of our pipe network and identifying pipes that need to be replaced to ensure compliance with Pipeline Safety Regulations (PSR, 1996). As a pipeline operator we have duties under the PSR:

- Regulation 9 requires that our pipelines are constructed to be sound and fit for purpose.
- Regulation 13 requires networks to ensure that the pipelines they operate are maintained in an efficient state, in efficient working order and in good repair.

These duties are absolute and there is strict liability. Pipes that breach the standard shall therefore be replaced based on safety rather than on economic, environmental or customer-service considerations.

To do this, we use a risk-scoring software known as the Mains Risk Prioritisation System (MRPS), which is supported by the Health and Safety Executive (HSE). We will act to replace a pipeline that achieves a risk score above a fixed safety threshold which is agreed with the HSE. The threshold is calculated to ensure no individual should be exposed to a risk of more than 1 in 1,000,000 of fatality as a result of living or working within 30m of our distribution pipes. Further details on the calculation of this risk criteria are outlined in Appendix 09.02 Distributed Mains and Associated Services (Iron, PE, Steel and Other).

In RIIO-1, a volume driver is already being used to fund the replacement of tier 2a cast iron and certain ductile iron mains which meet specific risk criteria. **Ofgem has proposed to maintain this mechanism for RIIO-2.**

Our absolute duty under PSR is not limited to cast iron tier 2 pipes. It is applicable to our whole pipe network. **As such, it is appropriate that the principles agreed for risk above threshold (RAT) are extended for all our distribution pipes**. These pipes have an MRPS score, are covered by PSR and should conform to the same safety thresholds agreed with HSE. We will expand the mechanism to apply to all pipes in GD2. We propose that a 'pipes above safety threshold' (PAST) mechanism should be introduced which covers all pipes and will include the existing RAT mechanism. We have included the existing volumes of known work in our base plan.

1.2. Why is it important?

It is extremely important for the safety of our customers that we monitor the levels of safety risk in our network and take relevant actions to mitigate when risks breach safety thresholds. This is in line with the HSE's expectations, a key area of concern for our customers and a legal requirement to ensure compliance with PSR. Table 1, below, outlines the legislative requirements that drive our work in this area.

Table 1: Our legislative requirements for pipe safety

Instruments	Main legislative drivers
Pipeline Safety Regulations (PSR – 1996) (PSR13a – 2003)	As a pipeline operator, we have duties under the Pipeline Safety Regulations (PSR 1996/ PSR13a 2003). • Regulation 8 requires that our pipelines are constructed of a suitable material. • Regulation 9 requires that our pipelines are constructed to be sound and fit for purpose. • Regulation 13 requires networks to ensure that the pipelines they operate are maintained in an efficient state, in efficient working order and in good repair. • These duties are absolute and there is strict liability. • PSR 13a provides a defence to a breach of PSR duties but this is only for iron mains within the IMRRP (Appendix 2).
Gas Safety (Management) Regulations 1996	• As a gas transporter, we have duties under the Gas Safety (Management) Regulations 1996 (GSMR). • To be able to convey gas in a network, we must prepare a safety case that is accepted by the HSE as per Regulation 3. • We must conform with that safety case as per Regulation 5. • The duty to follow the arrangements in the safety case is only affected by the interests of health and safety and not any economic considerations.
Health and Safety at Work Act 1974	• As a company, we have general duties to conduct our undertakings in such a way as to ensure, so far as reasonably practicable, that persons other than themselves or their employees are not exposed to risks to their health and safety.

1.3. What insights are shaping our thinking?

We are focused on maintaining the security and safety of supply to our customers, who value this as a high priority. Customers have a primary expectation that we operate our assets in such a way as to keep their supply of gas flowing and to keep them safe throughout the process. We have existing obligations from the HSE, who we engage with as a key stakeholder in this area.

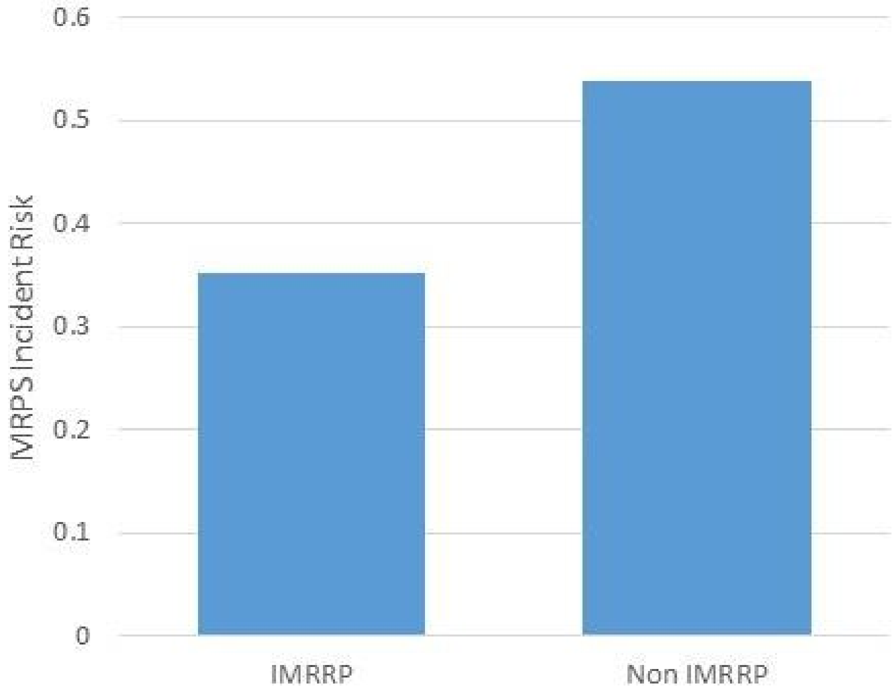
This is demonstrated by our engagement with customers. Safety, including prevention of emergency situations, was also consistently highlighted as the most important or joint-most important priority across each engagement method during phase 1 research which included deliberative workshops, domestic customer survey, public survey, focus groups with hard to reach groups, stakeholder interviews and vulnerability interviews. The May 2019 Cadent employee survey found that ‘guaranteed gas supply’ was scored as the fourth-highest priority (with a weighted score of 4.49 out of 5) for staff when answering as ‘customers’ (the survey asked staff to consider questions both as customers and employees).

There are 5,569km of non-PE assets which have MRPS risk scores and are not part of an HSE mandated IMRRP programme; 84% of these assets are steel. We have an absolute duty to maintain these pipes to ensure that they operate in efficient working order and in good repair.

Prior to RIIO-1, the incident risk associated with iron mains was viewed as a higher priority than that associated with steel due to the number of incidents caused by these assets – hence the introduction of the mandatory iron mains replacement programme (IMRP). This also drove the introduction of the tier 2a mains volume driver. Over the course of the IMRP and the iron mains risk reduction programme (IMRRP) the iron risk, although still not acceptable, has been reduced significantly.

Going into RIIO-2, based on the current MRPS scores, the safety risks posed by iron compared to other materials are similar, as shown in Figure 1. This has led us to review the safety risks associated with non-IMRRP assets and propose a new way forward.

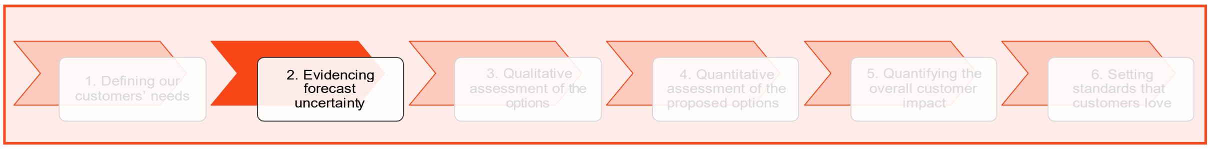
Figure 1: Indicative MRPS Incident Rate for IMRRP and Non-IMRRP Assets



The MRPS risk score for these assets, which is an approach supported by the HSE, has been reviewed by DNVGL who have stated after their review that "*The Steel Risk Model is a valid basis for the risk assessment of steel distribution pipes within 30m of buildings".*

Consistent with the agreed approach to tier 2a iron mains, we have calculated risk thresholds for non-mandatory mains at a level which ensures no individual should be exposed to a risk of more than 1 in 1,000,000 of fatality as a result of being within 30m of such assets. The assets, which are identified as being above the risk threshold in 2019, have been built into the base investment plan (see Appendix 09.02) for replacement. The network will continue to evolve during RIIO-2 and we therefore need a mechanism to address pipes which cross the safety threshold in-period.

2. Evidencing the uncertainty



2.1. What we know about the future

We know the existing replacement requirements and safety thresholds that are agreed with the HSE. For tier 2A mains and certain ductile iron mains which meet the risk criterion, these replacements are currently funded with a volume driver. We can model the potential deterioration of our network and estimate associated unit costs for intervention. We also know that other categories of pipes beyond those captured by our existing volume driver are at risk of deterioration in the future and will require replacement works in RIIO-2.

Comparing uncertainty to costs included in our base plan

During RIIO-1, mains replacement has been funded via a fixed allowance for the delivery of the MRPS risk-removed score. This included the Tier 2a irons mains volume driver.

We have identified 37km of tier 2a safety mains activity above the risk threshold that needs to be replaced in RIIO-2. A further 300km of mandated non-IMRRP safety work has also been identified. These volumes are associated with a total cost of £199.5m in our base plan. Further details are provided in Appendix 09.02

Table 2: Baseline costs associated with safety threshold mains investment

Base costs *£m, 18/19 prices*	**2021/22**	**2022/23**	**2023/24**	**2024/25**	**2025/26**
East of England					
North London			Redacted due to commercial sensitivity		
North West					
West Midlands					

Our proposal for an uncertainty mechanism provides funding for additional volumes above and beyond those included in our base plan. As will be discussed further in this document, the mechanism is based on the same unit costs used to develop our base-plan proposals. In Section 3, we provide a full evaluation of how the mechanism would work in practice alongside a baseline allowance.

2.2. Why we face forecasting difficulties

While we can model the failure rates of pipes in our network at the population level, it is not possible for us to do this precisely for individual pipe lengths. We cannot model how likely an individual pipe is to deteriorate or fail, due to the dynamic nature of risk scores. More significantly, we are unable to model changes in the likelihood of gas entering a home from a failed asset – this is dependent on local factors such as the presence of buried ducting or local street furniture.

Ofgem recognised this difficulty as part of the GD1 settlement and agreed on the RAT methodology to protect customers and our business from volume uncertainty. The same challenges are present with other pipes above safety thresholds.

We are unable to fully control the volume of replacement work we will have to undertake in RIIO-2 for pipes that pass safety thresholds, which are externally determined risk scores that are calculated according to an objective criterion. As discussed in Appendix 09.02, we and other GDNs are finalising updates to the MPRS criteria that will provide us with a **better view** of the potential volumes of pipe that may breach safety thresholds. Our plan has been developed in line with the latest update to this criteria, which GDNs are aiming to finalise by April 2020.

2.3. Network impacts and behaviours from including in the base plan

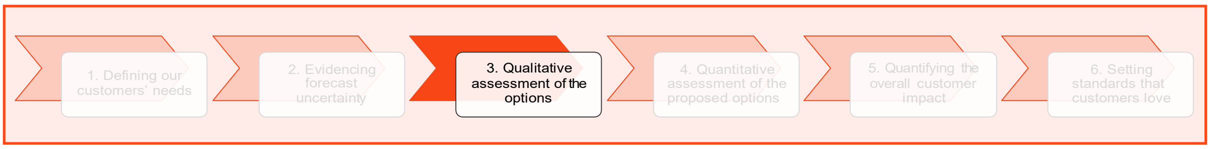
The risk with including all potential volumes and costs for pipe replacement above safety thresholds is that we would be required to rely on an uncertain estimate of future need for such work. Volumes of work are inherently hard to predict given the dynamic nature of risk scores.

If we were to include costs relating to the replacement of pipes due to unacceptable levels of risk in the base plan, we would be required to rely on an uncertain estimate on the volumes of work we may be required to undertake.

There is a **credible risk to us** that we may underestimate future volumes of required work or estimate a work mix based on pipe material and diameter that does not reflect our future workload. We would face an incentive to price risk into base plan estimates in order to ensure we were adequately funded if there was a significant growth in the length of pipes breaching safety thresholds.

However, this **creates a risk to customers**. Volumes might outturn below an allowance in RIIO-2, and this could create an opportunity for windfall gains. A mechanism also supports the reduction of risk in our asset, especially in the case of PAST which is designed to address increased risks identified in steel pipes.

3. Qualitative assessment



3.1. Options for addressing uncertainty

Given the uncertainty on the volume in RIIO-2 for replacement works, we have evaluated the appropriateness of different mechanisms that could address this risk:

Table 3: Evaluating options for uncertainty mechanisms

Mechanism Option	Description
Volume Driver	This relies on the use of a relevant unit cost estimate to forecast costs when volumes of workload are uncertain. This would effectively address the uncertainty around the volume of replacements in RIIO-2, as assets deteriorate beyond safety-threshold levels. It would also make use of cost information gathered from our existing experience of replacements in RIIO-1. We have a large programme of pipe replacement and unit costs are well understood.
Reopener mechanism	A reopener accounts for uncertainty in costs when both the design and requirement for projects in RIIO-2 is unknown. As uncertainty is driven by volumes, rather than the specification of a project, this is not applicable in this setting. There is also a risk with a reopener that critical investment may be inappropriately slowed due to additional checks and balances required to ensure we can recover revenues, which may not allow the timely implementation of replacement works expected by our stakeholders.
Use it or lose it allowance (PCD)	This would involve a Price Control Deliverable (PCD) as part of our RIIO-2 plan. While this would protect customers from under-delivery, a PCD does not address the challenge we face in forecasting a total cost given uncertainty in replacement volumes.

We have also undertaken a qualitative assessment of uncertainty in this area to further understand the need for an uncertainty mechanism both for tier 2 RATs and for PAST.

Table 4: Qualitative assessment of risks posed by tier 2 RATs and PAST

	Volume risk	Unit cost risk	Impact on outputs	Material cost/bill impact
Repex - Tier 2a iron mains	**High**	**Low**	**Low**	**Medium**
PAST	**High**	**Low**	**Low**	**High**

Further detail on our assessment is provided below:

- **Volume risk**: Our work in this area is driven by the outcome of safety thresholds that are agreed externally by HSE. The length of pipe which crosses the threshold is dependent on several local factors which cannot accurately be modelled. Consequently, we have limited control over future workloads.
- **Unit cost risk**: We have a good understanding of unit costs based on our historical workload. Uncertainty in total cost forecasts is driven by volume rather than unit cost uncertainty.
- **Impact on outputs**: This area of uncertainty is largely constrained to outputs linked to the environment, shrinkage, and interruptions to supply and safety. This impact is limited by the current volume driver for tier 2 RATs.

- **Material cost/bill impact:** There is significant uncertainty over the timing of future workloads, which cannot be reasonably estimated. This could involve significant levels of investment and would therefore have a material effect on bills. This will be amplified if extended to include non-irons mains replacement pipes.

3.2. Our proposed uncertainty mechanism

We are therefore proposing to address uncertainty both for tier 2 iron mains and for PAST with **volume drivers,** using a unit-cost approach to reflect the cost of undertaking replacement of failed pipes across our networks. The approach is already established in RIIO-1 for tier 2a iron mains – we are proposing to extend this approach to all pipe types.

Operation of the proposed volume driver in practice

- **Form of the trigger:** As discussed in Section 1.1, replacement volumes are triggered by risk scores above an objectively determined threshold. This methodology is agreed with the HSE. We have obligations under Pipeline Safety Regulations to undertake such work.
- **Mitigating the likelihood of the trigger:** We are required to address emerging risks on our network – it would not be appropriate for us to mitigate the volume of work we need to undertake on pipes that breach objective risk thresholds.
- **Claiming costs through the volume driver:** On an annual basis, as part of the RRP process, we would submit data on the actual volumes of new connections that we have undertaken. Revenues would be recovered with a year lag, in line with agreed unit rates, allowing time to verify our submitted volumes.

Form of the volume driver:

- **Unit of volume:** We propose volumes are measured in relation to length of pipes that are replaced (in km), split by diameter and material where applicable. This is in line with information already reported on an annual basis through the RRP process and reflects the different workloads associated with replacement work.
- **Establishing unit costs:** As discussed further in Section 4.0, we have proposed that the unit costs within this volume driver align to the unit costs used to develop our base plan allowances. These costs are well understood based on our experience to date with replacement work in RIIO-2. Further information on these costs is found in Appendix 09.02.

3.3. Evaluating our proposed uncertainty mechanism

A volume driver allows us to protect against the risk of submitting a full base plan allowance that may be calibrated on an incorrect forecast of the volumes of pipe requiring replacement in RIIO-2. If this occurred, customers may be exposed to the risk that actual volumes turn out below our allowed rate. We also face the opposite risk if higher than anticipated volume of pipes deteriorates, requiring attention to minimise safety risks. A volume driver would make use of agreed unit costs rates to ensure customers only pay for work that is undertaken.

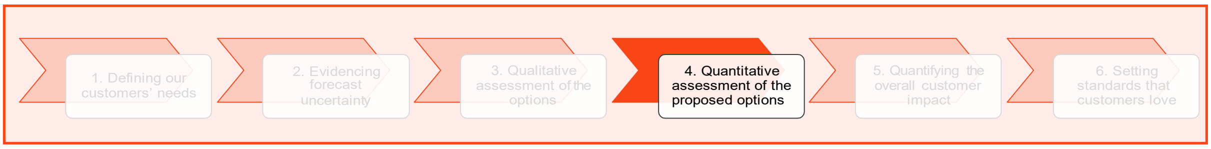
Nevertheless, it is important to fully evaluate the behaviours that our proposed uncertainty mechanism will encourage, to ensure they do not create perverse incentives. Below, we consider positive behaviours that a mechanism should promote.

Table 5: Evaluating incentives created by our proposed uncertainty mechanism

Behaviours and incentives	Evaluation
To minimise costs	The costs we have proposed as part of our baseline allowance for safety mains replacement represent our view of achievable and efficient costs in RIIO-2. We have developed our proposed volume driver in line with these costs. A financial incentive remains under the volume driver to identify further efficiencies and to undertake replacement work below these unit costs where possible. This would also benefit customers, through the achievement of a lower unit cost in the future and sharing through the totex incentive mechanism.
To deliver required work	As discussed in Section 1, safety mains replacement is triggered by risk assessment against an objective criterion. Furthermore, we are required by the pipeline safety regulations to maintain the safety of our network. A volume driver would not create an incentive to avoid undertaking such work. This would have wider implications in terms of the health of our network and the safety of our customers, alongside regulatory and financial risks. It also would not be possible for us to undertake replacement work beyond the economically efficient level, given that such work is triggered by risk scores that breach an externally determined threshold. This approach is agreed with the HSE.
To take a whole systems approach	There may be a concern that a volume driver for safety mains replacement may limit our incentive to consider wider strategic solutions or to take a whole systems approach. However, we remain incentivised to deliver any future work in the most efficient way, given financial incentives that are created to identify savings against an agreed unit rate. Where appropriate, this would include identifying better solutions than the direct replacement of an individual pipe.
Interactions with expenditure included in our base plan	The costs and volumes included in our base plan are developed across volumes already reported through the RRP process. Our proposed volume driver has been developed using the same unit costs. These costs relate to pipes that have already been calculated to breach thresholds in RIIO-2. Our proposal is for further costs incurred due to dynamic growth to be allocated to the volume driver. It would not be possible for us to gain from whether a specific instance of replacement was determined as baseline or volume driver activity, as identical unit costs would apply in each scenario.

A potential drawback for customers is that bills may be exposed to any volatility in workload on an annual basis, with revenues recovered with a yearly lag. However, this risk is mitigated by the inclusion of investment for known volumes that are above risk thresholds, creating an element of stability within the overall bill impact of safety mains replacement.

4. Quantitative assessment



4.1. Inputs for uncertainty modelling

We have also considered relevant cost information to include in our uncertainty analysis both for tier 2 RATs and for PAST. For this purpose, we have developed 'low', 'likely' and 'high' scenarios for potential costs arising from changes in volumes of work:

- **Length –** the growth we are forecasting in replacement work in RIIO-2 on an annual basis. This relates to the volume of work we expect to undertake.

Further details are discussed below both for tier 2 RATs and for PAST.

Tier 2 RATs volume inputs

Firstly, we have developed assumptions on the potential volume of work that we may be required to undertake for tier 2 RATs in RIIO-2, as outlined in Table 6 below. To develop a low, likely and high scenario, we have analysed the period 2015 to 2019 to identify the potential volumes of work we may be required to undertake.

Our low case scenario is based on 50% of the growth rate observed over this rate in risk scores, as measured by MPRS. This 50% reduction accounts for the changing risk profile observed due to the new MPRS coefficients in the updated risk-scoring methodology, relative to RIIO-1[1]. Our high case applies the full growth rate observed to existing pipe volumes, while a likely case has been constructed as a weighted average of the two, placing 75% on the low case and 25% on the high case. This is summarised in Table 6 below.

Table 6: Input assumption – Annual volumes per scenario, tier 2 RATs

Cadent annual volumes for replacement Tier 2a iron mains (km)	Low	Likely	High
East of England	1.048	1.048	1.048
London	0.181	0.287	0.607
North West	2.751	2.751	2.751
West Midlands	0.000	0.042	0.168

PAST volume inputs

We have also developed volume assumptions for other safety pipe categories above safety thresholds, using the same approach to develop our low, likely and high assumptions. This is summarised in Table 7 below.

[1] Further detail on the methodological changes is provided in Appendix 09.02

Table 7: Input assumption – Annual volumes per scenario, other safety mains

Cadent annual volumes for replacement Other safety mains (km)		Low	Likely	High
EoE	Iron, Tier 3	0.733	1.241	2.764
	Steel, Tier 1	5.739	10.779	25.901
	Steel, Tier 2	3.448	5.027	9.763
	Steel, Tier 3	0.280	0.921	2.845
NL	Iron, Tier 3	0.746	0.884	1.297
	Steel, Tier 1	2.299	2.461	2.945
	Steel, Tier 2	0.208	0.587	1.722
	Steel, Tier 3	1.596	1.684	1.948
NW	Asbestos, Tier 1	0.072	0.072	0.072
	Steel, Tier 1	0.956	1.197	1.922
	Steel, Tier 2	0.311	0.902	2.674
	Steel, Tier 3	0.156	0.156	0.156
WM	Steel, Tier 1	7.206	7.518	8.445
	Steel, Tier 2	1.407	1.832	3.107
	Steel, Tier 3	0.063	0.063	0.063

Unit cost information

For the purpose of our uncertainty analysis, we have identified the average unit cost in RIIO-1 for each of the above workload categories to understand the potential total range of cost impacts. These costs represent an average across the different diameter bands within each category and represent a simplification of actual unit costs. Table 8 below summarises these values which have been used in our analysis. A +/- 20% range around these values has been included in our Monte Carlo analysis to reflect ranges within each volume category.

Table 8: Input assumption – indicative unit costs by pipe type

Unit cost by pipe type (£ per km, 18/19 prices)	EoE	NL	NW	WM
Asbestos, Tier 1				
Asbestos, Tier 2				
Iron, Tier 2				
Iron, Tier 3				
Steel, Tier 1				
Steel, Tier 2				
Steel, Tier 3				

Redacted due to commercial sensitivity

In practice, we propose that granular unit costs for replacement works are applied to the tier 2 RATs and PAST volume drivers that align with our base plan are implemented. These costs have not been directly used in our Monte Carlo analysis given the format of constructed forecasts of future workload volumes. During RIIO-2, workloads would be recorded as part of the RRP requirements in line with these detailed unit costs.

These costs, which vary by pipe diameter, network, and replacement type have been taken from our ICS unit cost calculator, based on an average length of 60m per pipe. We present values both for open cut and for insertion methods – the applicable rate for an individual pipe will depend on the method that can be deployed. We have a large dataset on which to draw and have combined engineering insight with advanced data mining and analytics provided by our Consultants, ICS. The costs have also been subject to external review by our cost auditors, COSTAIN. Tables 9 and 10 outline these rates below.

Table 9: Input assumption – Unit cost rates for tier 2 RATs volume driver

	Unit cost rates Tier 2 RATs, £ per km 18/19 prices	Insertion	Open cut
EoE	Diameter Band E		
	Diameter Band F		
	Diameter Band G		
NL	Diameter Band E		
	Diameter Band F	Redacted due to commercial sensitivity	
	Diameter Band G		
NW	Diameter Band E		
	Diameter Band F		
	Diameter Band G		
WM	Diameter Band E		
	Diameter Band F		
	Diameter Band G		

In the case of PAST, costs for tiers 1 and 2 are based on steel pipes, as they represent most of our workload. For tier 3, a weighted average between iron and steel is constructed. We also propose that this volume driver applies to ductile iron medium-pressure (DIMP) pipes. These volumes have not been included in our base plan and historically have been a small but uncertain amount of work.

Table 10: Input assumption – Unit cost rates for PAST volume driver

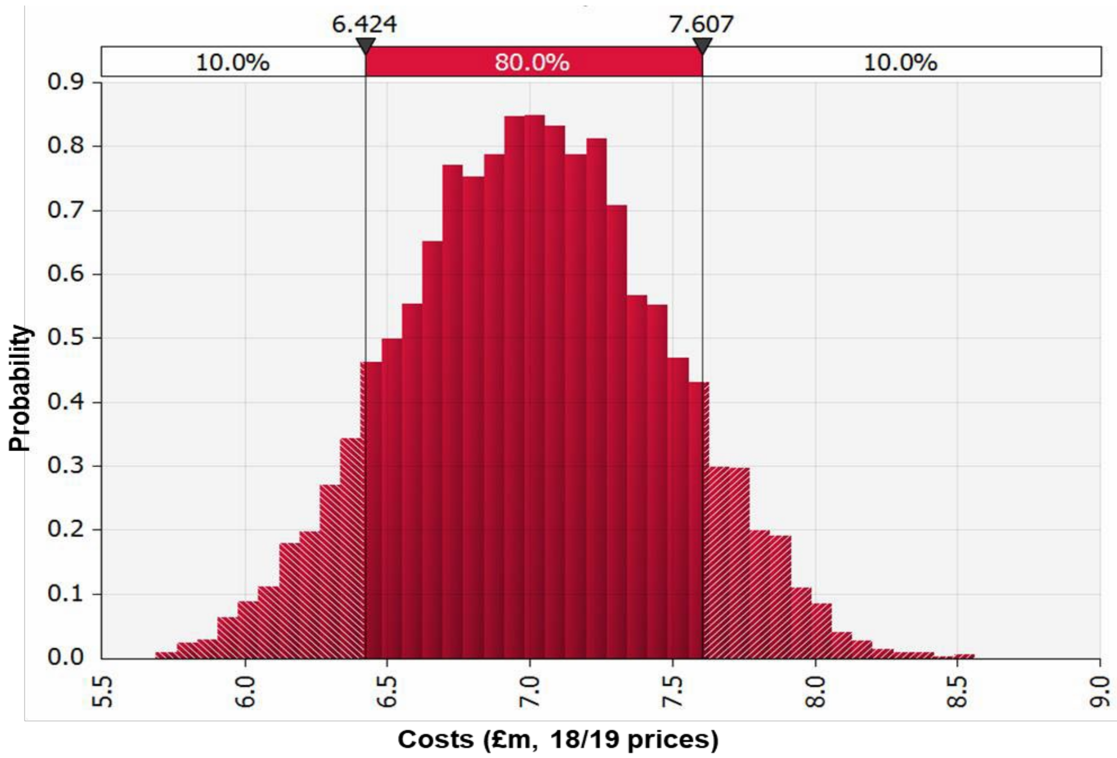
	Unit cost rate for insertion, PAST, £ 18/19 prices	Insertion	Open cut
EoE	Tier 1	Redacted due to commercial sensitivity	
	Tier 2		
	Tier 3		

	Unit cost rate for insertion, PAST, £ 18/19 prices	Insertion	Open cut
NL	Tier 1		
	Tier 2		
	Tier 3		
NW	Tier 1	Redacted due to commercial sensitivity	
	Tier 2		
	Tier 3		
WM	Tier 1		
	Tier 2		
	Tier 3		

4.2. Assessing uncertainty

Using our input data described above, we have undertaken Monte Carlo analysis to understand the range of cost impacts for this area of uncertainty in RIIO-2. This provides a distribution of the potential cost outcomes both for tier 2 RATs and for PAST, based on 10,000 iterations. This approach illustrates the high and low scenarios of uncertain costs, alongside the mean cost outcome and associated volatility.

Figure 2: Monte Carlo: Total Cadent RIIO-2 cost risk for tier 2 RATs, no mechanism. Costs, £m 18/19 prices



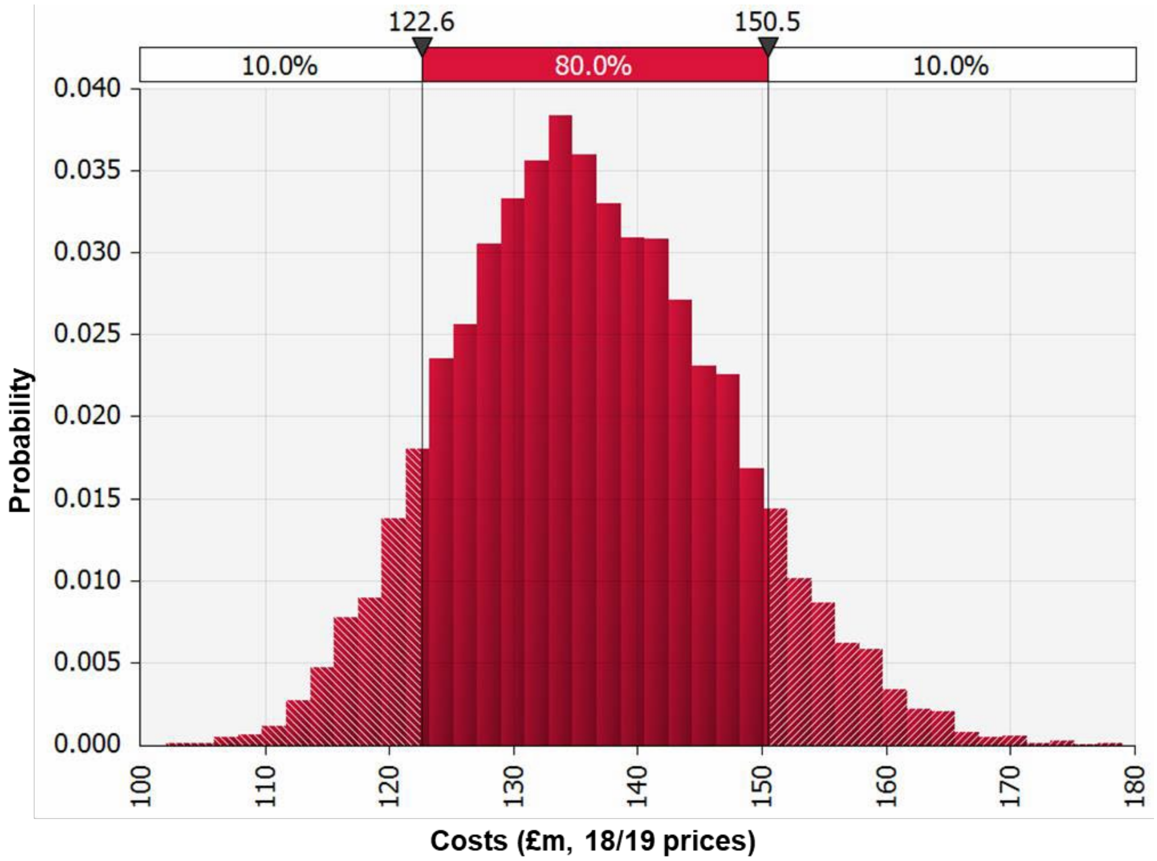
Minimum	Maximum	Mean	Standard Dev	Iterations
£5.69m	£8.56m	£7.01m	£0.45m	10,000

Without the introduction of relevant uncertainty mechanisms, this represents a significant risk to us in RIIO-2. Our ability to respond to future needs that are currently unknown would be limited, potentially resulting in future harm for our customers and network.

Table 11: Monte Carlo: Total RIIO-2 cost risk for tier 2 RATs by network, no mechanism. Costs, £m 18/19 prices

Network	Minimum	Maximum	Mean	Standard Dev
East of England	£1.13m	£1.69m	£1.41m	£0.11m
North London	£0.35m	£1.50m	£0.76m	£0.20m
North West	£3.77m	£5.63m	£4.70m	£0.38m
West Midlands	£0.00m	£0.38m	£0.14m	£0.07m

Figure 3: Monte Carlo: Total Cadent RIIO-2 cost risk for PAST, no mechanism. Costs, £m 18/19 prices



Minimum	Maximum	Mean	Standard Dev	Iterations
£102.09m	£179.01m	£136.20m	£10.79m	10,000

Without the introduction of relevant uncertainty mechanisms, this represents a significant risk to us and our customers in RIIO-2. Our ability to respond to future needs that are currently unknown would be limited, potentially resulting in future harm for our customers and network.

Table 12: Monte Carlo: Total RIIO-2 cost risk for PAST by network, no mechanism. Costs, £m 18/19 prices

Network	Minimum	Maximum	Mean	Standard Dev
East of England	£26.05m	£81.81m	£49.07m	£9.07m
North London	£21.71m	£36.44m	£28.00m	£2.16m
North West	£5.71m	£26.45m	£13.85m	£3.71m
West Midlands	£33.60m	£61.25m	£45.28m	£4.05m

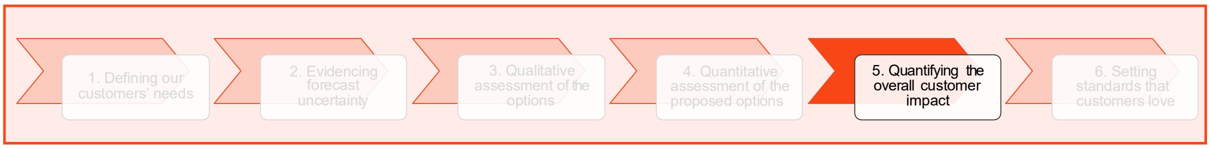
4.3. Impact of our proposed uncertainty mechanism

As we have assumed that income from volume drivers is not subject to the totex incentive rate, and given that a materiality threshold is not applicable, our modelling implies from a theoretical perspective that the uncertain cost risk outlined above would be fully mitigated using our proposed mechanism.

This **does not imply** that the costs associated with the uncertain volumes are fully mitigated and removed. Instead, the volume driver effectively allows us to collect associated revenues for replacement volumes for PAST and tier 2A replacement work we must undertake from a risk perspective. This removes a cost risk (i.e. we are not exposed to any remaining costs that cannot be recovered).

In practice, we will remain exposed to residual risk based on how outturn unit costs compare to the rate agreed as part of the mechanism. This places an incentive on us to maintain a focus on cost efficiency when undertaking replacement work. Customers are also protected as costs are only recoverable for the actual volumes of work we undertake. Given the drivers of these replacements are risk assessments, the specific pipes to be replaced is out of our control.

5. Quantifying the customer impact



In Section 5 of Appendix 10.00 Our approach to managing risk and uncertainty, we have analysed the overall customer impact of uncertain costs with and without our proposed package of mechanisms. We have also evaluated how our proposed package recognises the trade-off between sharing exposure of cost risk with our customers. In Chapters 10 and 11 of our Business Plan, we further quantify the impact of our proposed package of uncertainty mechanisms on customer bills in RIIO-2.

We have also quantified the bill impact associated with the tier 2A and PAST volume drivers individually. Table 13 and 14, below, summarise the potential bill impact per annum by the end of RIIO-2 for the mean, P10 and P90 costs estimated in our Monte Carlo analysis. As the costs associated with this uncertainty mechanism are categorised as capex, the bill impact is spread over a significantly longer period for the mean cost impact below. This is equivalent to £0.02 per annum for tier 2 RATS and £0.35 for PAST at the Cadent level.

Table 13: Tier 2 RATs RIIO-2 end bill impact, P10 mean and P90 costs from uncertainty analysis

RIIO-2 end bill impact (£, 18/19 prices)	P10	Mean	P90
East of England	£0.02	£0.02	£0.02
London	£0.01	£0.02	£0.02
North West	£0.08	£0.08	£0.09
West Midlands	£0.00	£0.00	£0.00

Table 14: PAST RIIO-2 end bill impact, P10 mean and P90 costs from uncertainty analysis

RIIO-2 end bill impact (£, 18/19 prices)	P10	Mean	P90
East of England	£0.52	£0.58	£0.64
London	£0.53	£0.58	£0.65
North West	£0.22	£0.24	£0.27
West Midlands	£0.97	£1.07	£1.19

For the purpose of constructing bill impact estimates, we have focused on the costs from our Monte Carlo analysis and have not considered the potential timing effects on revenue recovery from the use of a volume. In practice, bill impacts would materialise with a lag following a successful claim through the mechanism.

As outlined in Chapter 10 Managing Risk and Uncertainty, Ofgem's Business Plan Guidance suggests that "uncertainty mechanisms that highlight risks to consumers of which Ofgem would not otherwise have been aware" is an example that could constitute part of a Consumer Value Proposition (CVP). We discuss our CVP in Section 7.1 of Chapter 7.

The value of a bespoke uncertainty mechanism to customers does not obviously lend itself to be monetised in the same way of some of outputs commitments where we have calculated a social return on investment or have clear willingness-to-pay data. One way the value could be calculated is to look at the value that might otherwise have needed to be forecast into the base expenditure plan that may not have been subsequently needed if the uncertainty did not arise. For instance, the likely cost estimate could be considered and multiplied by the totex incentive-sharing factor that the customer would be faced with (e.g. 60%). This is not as robust a method as SROI or 'willingness to pay' but provides an indicative estimate. In the case of PAST, this is equivalent to approximately **£81.72m in RIIO-2.**

6. Setting the standards

Our proposals for a volume driver are clear and simple for our customers to understand. We will only be able to recover revenue for replacement work that we undertake for risk identified pipes in RIIO-2. Our proposed unit cost rate must be agreed by Ofgem as part of this mechanism to ensure we deliver connections efficiently. We are also unable to control the volumes of pipes that will deteriorate and breach a risk threshold in a systematic manner. This protects customers and avoids the creation of an incentive to maximise volumes beyond an efficient level. These proposals have also incorporated challenges we have received from our CEG.

Our evaluation on the implications of including costs for safety pipe replacement in our base plan, as outlined in Section 2.3, and of the incentives associated with our proposed volume driver mechanism demonstrate the benefits of this approach for customers and stakeholders.

Our overall approach to managing risk and uncertainty using uncertainty mechanisms has been tested with customers through our acceptability testing. A full discussion of this engagement is provided in Chapter 10 – it is noted here that customers found this approach to be acceptable, and that we had been thorough in our work to manage cost risk in RIIO-2.