Tier 1 Stubs
Re-opener Submission

March 2024
Classification: Confidential

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Ofgem Requirement

The table below outlines where each chapter of this application relates to Special Condition 3.2 of our Gas Transporter licence as well as Ofgem's requirements as set out in Special Condition 9.4.

Ofgem requirement	Application chapter
GT licence – Special Condition 3.18 Tier 1 Stubs REPEX policy Re-opener (STUBt)	
Circumstances for applying to Ofgem for re-opener (Para 3.18.4)	Chapter 1 – Executive Summary Chapter 3.1 – Problem Statement and Needs Case
Application requirements (para 3.18.6)	Chapter 3.1 – Problem Statement and Needs Case Chapter 3.2 – Options Considered Chapter 3.3 – Preferred Option Rationale Chapter 3.5 – Cost Information
RIIO-2 Re-opener Guidance and Application Requirements Document: Version 2 (Feb 2022)	
Introduction (Para 3.1 - 3.5)	Chapter 1.0 – Executive Summary
Gas Distribution Sector (Para 3.6 - 3.7)	Chapter 1.0 – Executive Summary Chapter 3.1 – Problem Statement and Needs Case Chapter 3.5 – Cost Information
Needs Case and Preferred Option (Para 3.8 – 3.12)	Chapter 3.1 – Problem Statement and Needs Case Chapter 3.3 – Preferred Option Rationale
Consideration of options and methodology for selection of the preferred option (Para 3.13)	Chapter 3.2 – Options Considered
Preferred Option (Para 3.14)	Chapter 3.3 – Preferred Option Rationale
Stakeholder engagement and whole system opportunities (Para 3.16)	Chapter 3.4 – Stakeholder Engagement
Cost Information (Para 3.19 – 3.20)	Chapter 3.5 – Cost Information

Point of Contact

The table below provides a point of contact for this re-opener application should you wish to discuss any elements of it or have further questions. To ensure any correspondence is picked up in a timely manner, should the point of contact be out of office, please also copy in our mailbox referenced below.

Name	Position	Email	Telephone
[Personal info]	*[Personal info]*	*[Personal info]*	*[Personal info]*

Chapter 1.0
Executive Summary

This paper is Cadent's application to the Authority requesting an adjustment to our RIIO-GD2 allowances under the Tier 1 Stubs REPEX Policy re-opener mechanism. This modification is necessary to support Cadent's compliance against the HSE requirement to safely decommission and remove redundant Tier 1 Stubs.

Cadent Gas Limited ("**Cadent**") are making a re-opener submission under Special Condition 3.18 Tier 1 Stubs REPEX policy Re-opener, Part C, Para 3.18.6 for the opportunity to recover costs for decommissioning Tier 1 stubs. Tier 1 iron stubs are short lengths of Tier 1 Main, attached to larger diameter Tier 2 or 3 Parent Mains at one end and polyethylene main at the other, which meet the criteria for decommissioning under the Iron Mains Risk Reduction Programme (IMRRP).

Following an interim review of the iron mains replacement policy, a modified Iron Mains Risk Reduction Policy (IMRRP) was introduced by the HSE and Ofgem in 2013. The revised programme excluded almost all Tier 2 and 3 iron pipes. This change in policy left a significant number of Tier 1 stubs, which would have been replaced with the parent main under the original programme, still requiring to be decommissioned. If the Tier 1 stubs were to be left in service it would contravene the remainder of the IMRRP which mandates the replacement of all small diameter, Tier 1, iron by 2032.

To align with the IMRRP's directive to replace all small diameter Tier 1 iron pipes by 2032, and to avoid contravening its mandates, we adopted an innovative, cost-effective strategy. This strategy involves assessing Tier 1 stubs and removing them from operation only if they present a significant risk or their condition deems them unsafe. For high-risk stubs requiring removal, Cadent explores innovative techniques like *[Third party tech]* or *[Third party tech]* to minimise the need for cut out tee replacements, demonstrating our commitment to delivering safety at a reduced cost.

We had no baseline allowance in our GD2 final determination and are therefore requesting a revenue adjustment of [Cost Data] to allow us to deliver our stubs programme. This has been detailed by year & network in the table below.

	21/22	**22/23**	**23/24**	**24/25**	**25/26**	**Total**
EN (£m)	[redacted]					
NL (£m)						
NW (£m)						
WM (£m)						
Total						

Table 1 Total Stubs cost (18 19 Prices)

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Chapter 2.0

Alignment with our RIIO-GD2 business plan and future price control

Chapter 2.1 - Alignment with our RIIO-GD2 business plan

Our consumers want a safe and reliable service. To achieve this, we have focused on delivering the outcomes that our consumers tell us matter to them.

Safety, including the prevention of emergency situations that occur when our pipes leak, was consistently highlighted as the most important, or joint most important, priority across each engagement method during our research with over 23,000 consumers, businesses, and stakeholders. Engagement methods included deliberative workshops, a domestic customer survey, a public survey, focus groups with hard-to-reach groups, stakeholder interviews and vulnerability interviews. Ninety-four percent of respondents to our domestic survey said that the security of the network was important to them. During joint GDN engagement with stakeholders, organised by the ENA in 2018, investing in infrastructure to ensure asset integrity and safety emerged as strong themes. Participants who took part in acceptability and affordability testing stated that keeping gas flowing and ensuring customer safety was very important, and the main purpose of Cadent existing as a business.

We are responding to this customer demand by replacing aged metallic mains with new plastic pipes. Much of this work is mandated by the Health and Safety Executive (HSE) and, alongside this, we also have obligations under Pipeline Safety Regulations (1996) which mean we must act where pipes are in an unsuitable condition to transport gas.

The Health & Safety Executive (HSE) mandates certain mains replacement work through an enforcement policy that sets the standard for a safe service and reflects society's appetite for risk. By far the largest driver of work is the Iron Mains Risk Reduction Programme (IMRRP).

The Iron Mains Risk Reduction Programme (IMRRP) was introduced in 2002 to address 'societal concern' regarding the potential for failure of cast iron gas mains and the consequent risk of injuries, fatalities, and damage to buildings (defined as incidents). The objective of the IMRRP was to decommission all cast iron mains within 30 meters of property in 30 years. Subsequently the programme was modified by the HSE and Ofgem and as a result Tier 1 pipes, that is pipes up to and including 8" in diameter, are required to be replaced by the end of 2032 but most larger pipes are not. This results in the creation of 'stubs' where a smaller pipe being replaced is connected to a larger one that is not being replaced.

As HSE policy and enforcement drives most of our investment, any change that occurs in their approach during RIIO-GD2 has significant implications for the standards we are required to meet, and therefore the expenditure we must undertake. Such policy changes are driven by safety considerations. Therefore, it is extremely important that gas networks have the flexibility to adapt and respond accordingly to any new requirements.

During the RIIO-GD2 business planning process the four Gas Distribution Networks (GDNs) held five sessions with the HSE to specifically discuss RIIO-GD2 and any impact on IMRRP. From these discussions, it was understood at the time that the IMRRP would not be materially changed as we progressed into RIIO-GD2 (i.e. there will be no repeat of the strategic review conducted prior to the start of RIIO-1).

In preparation for RIIO-GD2, the GDNs collaborated with *[Third Party]* to conduct a comprehensive review on the use of stub pipes in the gas distribution network, motivated by the understanding that the majority of Tier 2 and Tier 3 mains would not undergo replacement before 2032, and the number of Tier 1 stubs connected to them is on the rise. The review by *[Third Party]* concluded that the fracture resistance of a stub pipe is comparable to that of a 9-inch cast iron (CI) pipe. This comparison was based on the rationale that if a 9-inch Tier 2 pipe is deemed fit for continued operation, then a stub, provided it demonstrates equivalent strength, should also be considered safe for continued use.

This report received provisional acceptance from the Health and Safety Executive (HSE) and its Science Division, affirming the principle that stubs can remain operational if they are verified to be safe. The approach to ensuring the safety of these stubs was comprised of a rigorous condition assessment to inform decision-making, grounded in the measured integrity of each stub and an evaluation of the specific challenges they face. This method is part of the risk controls detailed in the 'REP/2' procedure found in **Appendix 2 - CAD_PM_REP_2** , which also includes a review of the pipe's operational history to exclude unsuitable candidates, the application of a Modelling Risk Pipeline Safety (MRPS) system incorporating a safety factor to retain only those pipes deemed to present an acceptable level of risk, and the implementation of a maintenance regime designed to identify changes, such as encroachment, prompting necessary interventions.

The proposals aimed to safeguard the public from the minor but ongoing risks associated with operating stubs. These measures enhance the foundational work by *[Third Party]* by considering practical constraints, such as compliance with IGEM/TD3, and by ensuring that the balance of risk between occupational safety and ongoing gas pipeline safety is maintained. They include detailed real-world risk assessments of stubs to ensure that only those with sufficient strength and projected service life are kept in operation. Together, these risk controls formed a comprehensive system offering sustained, multi-layered protection. Ongoing discussions and engagement with HSE during the RIIO-GD2 planning stage to secure approval for the REP/2 process meant that no baseline funding was included in our business plan. Consequently, Ofgem opted to manage Tier 1 stubs through a re-opener mechanism in the RIIO-GD2 framework, allowing for adjustments based on evolving insights and conditions.

Chapter 2.2 - Alignment with our future price control

In Ofgem's RIIO-GD3 Sector Specific Methodology, Ofgem propose to revise its stance on the costs associated with Tier 1 stubs activities, viewing them as no longer uncertain therefore not requiring a re-opener in RIIO-GD3. This change is based on the comprehensive data gathered by the Gas Distribution Networks (GDNs) on stubs replacement and remediation costs during RIIO-GD2. As we plan our activities for the upcoming price control period, it's important to note that any modifications to HSE policies affecting the Tier 1 iron stubs workload can be addressed through the HSE policy re-opener provision in RIIO-GD3.

Chapter 3.0

Formal Application

Chapter 3.1– Problem Statement and Needs Case

Introduction

Stubs are short lengths of tier 1 mains that are connected (usually via a tee) to a tier 2 or 3 'parent' main. Downstream of the stub, the tier 1 main is replaced by PE (generally by insertion) as part of the tier 1 iron mains replacement programme whereas the larger diameter parent main is not being replaced under such programme. These stubs are often located at operationally difficult areas (e.g. road junctions), where the tier 2/3 parent main runs down a main road while the tier 1 main serves consumers in a side street.

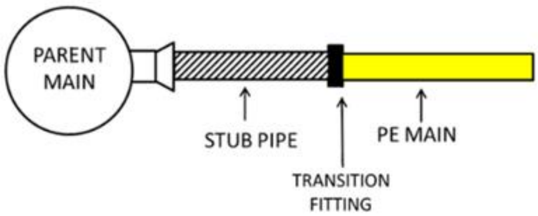

Figure 2. Diagram of a typical stub

Prior to RIIO-GD1, the replacement programme required that all iron pipes within 30m of property be replaced so any stubs that might be left by a particular project would be replaced when the parent main was replaced. Also, prior to RIIO-GD2 Cadent carried out zonal replacement of pipes up to 12" in size because this is least cost to consumers if the entire legacy pipeline population is to be replaced and so fewer stubs were created. However, following an interim review of the iron mains replacement policy, a modified Iron Mains Risk Reduction Policy (IMRRP) was introduced by the HSE and Ofgem in 2013. The revised programme excluded almost all Tier 2 and 3 iron pipes. This change in policy left a significant number of Tier 1 stubs, which would have been replaced with the parent main under the original programme, still requiring to be decommissioned. If the Tier 1 stubs were to be left in service it would contravene the remainder of the IMRRP which mandates the replacement of all small diameter, Tier 1, iron by 2032.

The operational practicalities of replacing these short, isolated tier 1 sections, and associated costs, are significant due to their location and the need to intervene on the parent main for flow-stopping and cutting out of the parent main tee to remove the stub pipe.

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Investment Driver

Cadent has legal duties under the Health and Safety at Work Act to operate safely. The Health and Safety at Work Act is enabling legislation under which there are several statutory implements such as the Pipeline Safety Regulations, which are relevant to our safety management of our pipeline systems. In addition, the Gas Transportation License requires us to agree a Safety Case with the HSE and to comply with its provisions. Understanding the risk posed by our assets and introducing and operating appropriate controls is required to enable us to comply with the legislative and license requirements.

The Tier 1 iron mains programme requires that all stubs within 30m of property be taken out of operation, however, Cadent has introduced a regime that has been accepted by the HSE that delivers required safety outputs at a lower cost whilst managing risk. Cadent's regime has Tier 1 stubs assessed and taken out of operation only when the risk that they pose or the condition that they are observed to have is such that they cannot safely remain in operation.

If a stub is found to be high risk, it is removed from operation. Where this work is required, Cadent will consider innovative techniques such as *[Third Party tech]* or *[Third Party tech]* to ensure that a cut out tee replacement is mitigated where possible. We recognise the significant impact that cut out tee's have both in terms of cost and disruption to the customer and thus strive to avoid any unnecessary works.

Scope of work

When replacing a gas main that connects to another main via a tee, leaving a stub of the original main or grouting allows connection to the unchanged main. Cutting out and replacing the tee, especially in larger Tier 2 or Tier 3 mains, involves complex and risky operations like double bag or iris stops, requiring large excavations and significant traffic management, impacting both public and worker safety. This process also compromises the main's integrity due to multiple new holes for stop operations and bypass connections. Although grouting the stub and making a new connection is safer and simpler, it still presents challenges, such as the need for large excavations and the difficulty of grouting up to the main, indicating no perfect solution exists.

As a result of these factors, it is usually safer to leave the stub in use (situ) despite it being of a pipe type that is subject to replacement requirements because the balance of risk (of doing significant additional engineering activity in the public highway versus leaving a pipe that has a low level risk in use) favours this. Efficiency of replacement delivery is important because absorbing resources to deliver low value add and time-consuming activity such as cutting out tees distracts from eliminating risk elsewhere.

In order to determine if a stub can be left in situ all of our Tier 1 stubs are *[Sensitive information]*

Outlined below is a high-level overview of our condition assessment process, for further detail please refer to sections 7 to 11 of **Appendix 1 – CAD_WPL_MSL_1.1.**

Condition Assessment Process

[Sensitive information]

There are three techniques Cadent has adopted for the removal of Tier 1 Stubs that fail their assessment, the first being *[third party tech],* the second is *[third party tech]* and the third Traditional cut out.

Stubs decommissioning process

[third party tech], is the solution for fully decommissioning mains of engineering difficulty, such as stranded, one way fed, stubs or those found on mains replacement schemes. The *[third party tech]*technique fully decommissions mains right up to the last transition joint on mains of 4”-8” in diameter. These sections of main and associated tee pieces into parent mains, can be impractical and costly to excavate due to the location often being under a busy junction or in a sensitive area. This makes the remote deployment of *[third party tech]* the ideal solution.

[third party tech] is a highly innovative technique compared to more traditional methods because it uses remote live mains insertion which can be used on both single or two way fed mains. Additionally, *[third party tech]* allows for greater insertion lengths, up to 25 metres and has an improved ability to navigate obstructions with a specially developed nosecone designed to negotiate bends, existing services, and plugs. Due to *[third party tech]* use of *[third party tech]* signature sealant technology, which seeks out and seals loose particles, issues relating to rust or contaminants are also reduced.

- *[third party tech]* **-** technique is used for the safe, remote, 100% abandonment of unwanted sections of gas main, including the last transition joint. *[third party tech]* is the replacement technique for Live Stub End Abandonment.

  Enhanced *[third party tech]* was developed by *[third party tech]* in conjunction with *[Third party]*. It provides a safe and effective method of abandoning 100% of Tier 1 gas mains under ‘live’ conditions, without removing the tee piece.

  It is often impractical to replace a redundant main directly at the tee piece, where it is often located under a busy junction or is in a sensitive area where disruption caused by the work would be unacceptable to the local authority and/or members of the public, this has resulted in rejection of road closures in some cases. Full abandonment of these short sections of main is important if leakage problems are to be avoided in the future.

- **Traditional cut out -** is the last option pursued if both *[third party tech]* and *[third party tech]* cannot be considered. This involves creating an under-pressure tee with foam off or a chop out at parent main. However in certain specific engineering circumstances, the cut out can be the preferred solution.

Needs Case Summary

Decommissioning Tier 1 stubs is a critical component of our mandatory replacement initiatives. In 2021, as outlined in the REP/2 procedure **Appendix 2 - CAD_PM_REP_2**, we reached an agreement with the HSE, as documented in **Appendix 4 - HSE Evidence**. This document, the HSE's acceptance letter, acknowledges our proposed risk prioritisation system, which underpins our assessment process. Our initial proposal to the HSE is detailed **in Appendix 5 - Cadent HSE REP_2 Request**. This agreement allows for a Tier 1 stub to remain in situ, provided it passes a thorough assessment. We recognise this approach as more efficient compared to the blanket removal of all stubs.

Overview of our Workstack

In our summary of the needs case, we emphasise our strategy for stub remediation, which is based upon the principle of compliantly extending the asset life to ensure safety while minimising costs to the customer. To this end, instead of simply remediating all stubs, we introduced a condition assessment stage before decommissioning stubs, which centres on evaluating the condition of each asset to determine whether it can remain in place rather than defaulting to removal without assessment. Below, we present our data on our total volume followed by a breakdown of our total stubs, assessed, [third party tech]/ [third party tech] and cut out tees, along with a comparative analysis of the costs associated with each process. This approach enables us to highlight the cost-effectiveness of leaving stubs in situ whenever feasible.

	21/22	22/23	23/24	24/25	25/26	Total
EN	[redacted]					
NL						
NW						
WM						
All networks						

Table 2 – Total number of stubs actioned/to be actioned during RIIO-GD2 found in the Summary tables tab in Appendix 3 – Stubs re-opener cost tracker

Table 2 represents the total number of stubs we have actioned so far and expect to action over the remainder of RIIO-GD2. The forecast included is based on our best view of mains replacement work that we expect to carry out over the period. These stubs are by nature located in high traffic/traffic sensitive areas where our planned works are ultimately subject to the approval of the appropriate highway authority. Where approval is not granted, we will look to make changes to the programme, moving the work to accommodate the local highway authority requirements and bring forward alternative work. This ultimately means that our forecast number is representative of our current planned works but the stubs within those forecast numbers may change as required to accommodate the needs of the highway authorities.

	21/22	22/23	23/24	24/25	25/26	Total
EN	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
NL	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
NW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
WM	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All networks	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 3 – Total number of stubs left in situ following assessment process found in the Summary tables tab in Appendix 3 – Stubs re-opener cost tracker

Table 3 shows the number of stubs left in situ following a successful on site assessment as described. Our forecast is based on an assumption that future on site assessments will maintain their current pass rate to allow us to leave a stub in situ.

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	21/22	22/23	23/24	24/25	25/26	Total
EN	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
NL	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
NW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
WM	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All networks	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 4 – Total number of [Third party tech]/ [Third party tech] Interventions found in the Summary tables tab in Appendix 3 – Stubs re-opener cost tracker

Table 4 above outlines the total number of *[Third party tech]* /*[Third party tech]* interventions we have carried out or expect to carry out in the RIIO-GD2 period. *[Third party]* remediation technologies are a key part of our delivery plan. These technologies allow us to minimise both cost and disruption to customers across our networks. Where possible we engage *[Third party] [Commercially sensitive].* Due to the nature of our works we will attempt to use one of these technologies but be prevented from doing so due to engineering constraints (E.G blockage in the main), these instances will ultimately result in a cut out tee.

	21/22	22/23	23/24	24/25	25/26	Total
EN	[redacted]					
NL						
NW						
WM						
All networks						

Table 5 – Total number of cut of tees found in the Summary tables tab in Appendix 3 – Stubs re-openers cost tracker

Table 5 above shows the number of cut out tees we have carried out or expect to carry out during the period.

Demonstration of efficiency

The principal consideration guiding our assessment process is its efficiency and cost-effectiveness, alongside minimising disruption for our customers. To illustrate this point, we will present a scenario using data from appendices. This scenario will compare the costs of our assets left in situ via the on site assessment process against a hypothetical situation where each assessment was remediated through *[Third party tech] / [Third party tech]* or traditional cut out. The comparison will demonstrate that remediation would significantly increase costs, reinforcing the value of our chosen approach.

	Assessment	*[Third party]*	Replacement	Total
Cadent (£m)	[redacted]			

Table 9 – Assessment efficiency – current cost apportionment

	Assessment	*[Third party]*	Replacement	Total
Cadent (£m)	NA	[redacted]		

Table 10 – Without assessment cost apportionment

The data in table 10 is calculated by applying the total volume of pipes left in situ *[Cost info]* to the ratio of *[Third party]* & Replacement works (Circa *[Cost info]* in volume respectively). We then apply the average appropriate unit cost to demonstrate the impact if the *[Cost info]* assets were not left in situ via the assessment process. listed in table.

To further highlight our commitment to efficiency, we have strategically employed both direct labour and contractors, optimising expenditure. The engagement of contracted services follows a rigorously competitive tender process, ensuring cost-effectiveness.

Customer communication is prioritised when remediation or assessments are conducted independently of the mains replacement schedule. This outreach is led by a Customer Liaison Officer or, through written correspondence, or both, tailored to the specific requirements of the situation. Furthermore, adopting the *[Third party tech]* technique during remediation significantly minimises the need for road closures, thereby reducing inconvenience to our consumers and maintaining community goodwill.

Chapter 3.2 – Options Considered

As part of our optioneering process, we identified four options for dealing with our Tier 1 Stubs workload.

- **Option 1** – Remove all stubs
- **Option 2** – Combine stub removal with Tier 2 or 3 parent main removal
- **Option 3** – Remove only stubs demonstrated to be in a poor condition (i.e. pose a risk greater than 1 in 1,000,000 pa. of causing a fatality)
- **Option 4** – Do nothing

To determine the most suitable solution to deliver the resolution required, each potential option was evaluated against the overall Cadent business objectives. The definitions of each business objectives can be found in **Cadent's Options Analysis Methodology (Appendix 4).**

	#1 Remove all stubs	**#2 Combine stub removal with Tier 2/3 mains**	**#3 Remove only stubs in a poor condition**	**#4 Do nothing**
Delivers business outcomes	Adequate – Risk reduced but at an inflated cost	Inadequate – Stub removal would be delayed until tier 2/3 mains replacement begins meaning greater risk of failure and potential incident or tier 2/3 removal to be bought forward elevating overall cost	Preferred Option – This is the most viable option balancing safety, cost, and risk. Creating a balanced investment approach	Inadequate – This would increase the risk to our consumers, resulting in the likelihood of an incident and going against our overall Safety Strategy
Removal of Safety Risk	Yes	Yes (If the tier 2/tier 3 main was replaced in period)	Yes	No
Effort to implement	Major	Moderate	Moderate	None

Cost to implement	Significant – The removal of all stubs would incur significant costs not currently in our allowance [Cost info].	If funding was allocated, the financial implications would be substantial and subject to wide fluctuations. With Tier 2 replacements potentially costing around *[Cost info]* per meter and Tier 3 as much as *[Cost info]* per meter, the expenses associated with these upgrades are notably higher than those for Tier 1.	[Cost info]	Not applicable as it would go against the mandatory HSE requirement
Legal Compliance	Yes	Yes	Yes	No

Option 1: Remove all stubs (All identified stubs to be removed regardless of condition or risk score) – discounted

Removing all stubs is not the most efficient approach. Such a strategy not only increases the scope of work due to the challenging locations of some stubs but also often results in higher costs compared to assessing their condition to determine if leaving them in situ is safer and more cost-effective. Moreover, the impact of undertaking significant excavations and work associated with a greater number of cut out tee's will cause significant disruption for customers & local authorities.

Option 2: Combine stub removal with Tier 2 or 3 parent main removal (stubs could be removed in line with Tier 2 or 3 parent mains as part of the Iron Mains Replacement Programme) – discounted

This option entails the concurrent removal of stubs during the Tier 2 and 3 parent main removal projects, potentially streamlining operations by combining tasks. However, postponing stub removal until these scheduled main replacements introduces heightened safety concerns due to the extended period stubs remain in place. As outlined in our initial chapters, a mid-term review of the Iron Mains Risk Reduction Programme resulted in the replacement of Tier 2 and 3 parent mains being deemed non-mandatory, leaving such decisions to the discretion of the network operators. Consequently, although removing stubs in tandem with these mains could yield cost savings, the increased risk to public safety cannot be overlooked. Therefore, considering these safety implications, this approach was deemed unsuitable and not pursued.

Option 3: Remove only stubs demonstrated to be in a poor condition (i.e. pose a risk greater than 1 in 1,000,000 pa. of causing a fatality) (Stubs would be subject to a condition assessment and would only be removed if they fail) – preferred

In fulfilling our obligation to maintain a safe and reliable network, we are also guided by Section 9 of the Gas Act, which mandates that our operations be conducted economically and efficiently. As introduced at the beginning of this chapter, we have implemented an assessment process for Tier 1 stubs agreed with the HSE, believing this to be the most efficient and cost-effective method. Stubs are only removed if they fail their assessment, demonstrating our prudent and considered approach. This ensures that removal is carried out only, when necessary, based on the outcomes of our on-site evaluations, aligning with our commitment to both safety and operational efficiency.

Option 4: Do nothing – discounted

The consideration of a 'do nothing' approach was discounted, primarily because it contradicts our essential Health and Safety Executive (HSE) requirements, making it impractical and illegal. Although ignoring the assessment and remediation of stubs or postponing the removal of stubs until later price control periods might seem financially advantageous in the short term—offering immediate cost savings and easing the workload on our teams and partners—such an approach carries unacceptable risks.

Delaying necessary assessments or removals in favour of a reactive strategy introduces critical safety hazards. Unaddressed Tier 1 stubs pose a heightened risk of failure, threatening the integrity and safety of our entire network. Furthermore, neglecting these issues could severely impact the effectiveness of the Iron Mains Risk Reduction Programme (IMRRP), placing undue strain on future price control periods with potentially overwhelming workloads.

Considering the serious safety risks and the potential to jeopardise future operational efficiency, the 'do nothing' option was deemed impracticable and was therefore not considered further.

Benefits and Drawbacks of the options selected:

Option 1 - Remove all stubs	
Strengths	**Weaknesses**
• The risk of a stub failing in the future is removed	• This would be extremely costly and cause disruption to both consumers and local authorities • This would create greater safety risks to our engineers by working in busy junctions • Unproductive - Finite resource would be tied up removing low risk short pipes instead of large lengths of higher risk iron mains

	• We would need to procure a larger workforce with a specialist skill set that is not currently available in the market • Engineers with existing competence on large diameter mains is fewer than those competent on Tier 1 mains, if requirements change this may mean that works are not completed requiring a secondary team to visit
Option 2 - Combine stub removal with Tier 2 or 3 parent main removal	
Strengths	**Weaknesses**
• Overall cost of replacing Tier 1 and or Tier 2/3 would become more efficient for both planning and delivery, leading to less disruption in the long term	• There would be a greater safety risk to our Engineers working on these pipes/stubs • There would need to be a huge outlay of training to ensure full competency of our engineers removing stubs and Tier 2/3 mains together • Hypothetically, if tier 2/3 mains replacement was undertaken outside of the IMRP programme this would leave a potentially high risk Tier 1 stub that is non compliant.
Option 3 - Remove only stubs demonstrated to be in a poor condition	
Strengths	**Weaknesses**
• Targeted investment approach that balances safety, cost, and risk. • There is a supply chain that has capacity to deliver this approach mitigating the need for upfront investment from suppliers on training etc. • Different remediation techniques can be explored that have less impact on the integrity of our network • Less risk to our engineers as number requiring traditional cut out vastly reduced • Less impact to the public as fewer excavations required	• Stubs left in situ will be treated as mains and will have a risk applied to match the main, they are attached to, these will then require ongoing monitoring
Option 4 – Do nothing	
Strengths	**Weaknesses**

• No initial spends required on either assessments or remediation	• Risk of failure materialising on a stub that is in poor condition that has been left unassessed and in situ. This could then give rise to consequences such as unplanned disruption to the public and gas in building event and subsequent incident • Failure to meet expectations on our mains replacement programme

Chapter 3.3 – Preferred Option – Option 3

By removing stubs, we are creating benefits to consumers / members of the public through risk removal. Consumers/members of the public living in close proximity of a poor condition metallic main are at risk of a gas in building event should the main fail and subsequent risk of an explosion. Downstream consumers are also at risk of an unplanned interruption to their gas supply. Removal of the poor condition stub also reduces the risk of a repair being needed on the metallic pipe and subsequent unplanned disruption to consumers.

Through the assessment process we are making informed decisions on our assets whilst maintaining the integrity of our network. This in turn creates less disruption for our customer.

We always try to adopt the *[third party tech]* technique where possible as *[third party tech]* is less intrusive and the least costly remediation option. We would only complete a traditional cut out as a last option if both *[third party tech]* and *[third party tech]* are not possible.

Chapter 3.4 – Stakeholder Engagement

Cadent recognises the importance of safely and cost-effectively managing stubs for its consumers, identifying the need for operational shifts to achieve these dual objectives. The strategy involved generating potential solutions and providing multiple cost-efficient options for addressing individual stub issues.

The solution development phase leveraged external technical expertise and tools. Collaborations with industry manufacturers and service providers, notably *[third party]* for practical solutions and *[third party]* for developmental insights, were instrumental. Additionally, using the *[third party]*-developed iron pipes risk management tool was pivotal in refining risk assessment methodologies.

Specifically, the stubs risk assessment protocol integrated two key processes: Cadent's proprietary Pipe Above Risk Threshold (PAST) calculation, an initiative initially developed across Gas Distribution Networks (GDNs) with *[third party]* support, and Cadent's pipe splitting methodology for assessing partially replaced pipes. Having been vetted and approved by the Health and Safety Executive (HSE) in prior procedure validations, these methodologies underpinned a commitment to compliance and safety.

Cadent's approach to stub condition assessment amalgamated pre-existing techniques with new methodologies, ensuring a robust and consistent application. This initiative saw the refinement of operational procedures and technological integrations, ensuring comprehensive data capture and efficient process management. The effectiveness of these strategies was further confirmed through trial phases, which involved preliminary HSE engagement and feedback, underscoring the procedures' robustness, cost efficiency, and emphasis on public and operational safety by minimising the need for extensive excavations and live gas work.

In cases where a stub's retention is deemed untenable due to high risk, alternative measures are employed to avoid cutting out the tee. These involve sealing the stub with a gas-tight material, either within the annulus between an inserted pipe and the carrier pipe or fully sealing it and establishing an alternate connection to the main pipeline. Developed in collaboration with industry partners like *[third party]*, such practices have been broadly adopted across GDNs, illustrating a proactive and safety-conscious approach to stub management.

Chapter 3.5 Cost Information

We have allowed our networks to explore what the most effective delivery models for stubs would be. Over the past 2-3 years we have trialled both assessments and replacement being delivered by both our direct labour workforce or a contractor. *[commercially sensitive].*

With regards to remediation and replacement of stubs, we are driving our networks to address stubs as we create or find them during our mains replacement works. This has proved to not always be possible or the best solution as the nature and location of these stubs can cause disruption that a local authority may request we address at another time. We have reflected this as a cost efficiency for undertaking our works alongside MRP (e.g. sharing an excavation) in our actual and forecast costs.

	21/22	**22/23**	**23/24**	**24/25**	**25/26**	**Total**
EN (£m)	[redacted]					
NL (£m)						
NW (£m)						
WM (£m)						
Total						

Table 1 – total cost

This is the total requested revenue adjustment as highlighted in the exec summary. The detailed cost breakdown is available in Appendix 3.

[Commercially sensitive]

Chapter 4.0

Glossary of terms and Appendices

- **Appendix 01: CAD_WP_MSL_1.1 Cast Iron stub assessment work procedure May 2021**
- **Appendix 02**: **CAD_PM_REP_2**
- **Appendix 03**: **Stubs cost calculation**
- **Appendix 04: HSE Evidence**
- **Appendix 05: Cadent HSE REP_2 Request**

Chapter 5.2 – Glossary of Terms

Acronym	Description
PON	Pipe Object Number. This is a unique number that identifies each individual linear asset. (Also known as "SAP ID" or "PIPE ID")
MRPS	Mains Replacement Prioritisation System
DIMP	A main of ductile iron construction operating at medium pressure
PAST	Pipe Above Safety Threshold, as defined in CAD/PM/REP/2 section 2
[Third party tech]	*[Third party tech]*
[Third party tech]	*[Third party tech]*
ENA	Energy Networks Association
HSE	Health and Safety Executive
LDP	Local Delivery Partner
IMRRP	Iron Mains Risk Reduction Programme
DIPRA	Ductile Iron Pipe Research Association

Term	Definition
Cast Iron	This is grey iron, it has a high carbon content and is brittle; this means it can fracture. Cast iron pipes can be manufactured by casting in a sand mould, known as 'pit cast iron pipes' an older process (1800s to 1930s) or in a rotating water-cooled steel mould, known as 'spun cast iron pipes' a newer process (1930s to 1960s). Pit cast iron pipes are shown on maps as CI pipes, spun cast iron pipes are shown as SI pipes
Corrosion	The result of a reaction of a metallic material with its environment causing a measurable reduction in the thickness of metal including: **General corrosion** – corrosion resulting in a reduction of metal thickness over a large area of the surface. **Pitting corrosion** – corrosion which affects small, localised areas of surface pipe material, producing pits
Corrosion (ductile iron or steel)	This refers specifically to pipe barrel corrosion and in the context of corrosion escapes refers to through pipe wall corrosion. Corrosion of ductile iron and steel is much more significant than corrosion of cast iron because cast iron contains impurities that results in corrosion products having a greater strength than ductile or steel corrosion products whilst also being dimensionally more stable.
Fracture (cast iron)	Cast iron is brittle this means that when the stress in the pipe wall exceeds its strength the pipe will suddenly fracture. Being brittle the crack will not arrest, and the pipe will split. Smaller diameter iron pipes crack circumferentially, larger diameter pipes may also split axially. Fracture of such pipes may result in an incident because the rate of leakage changes from no leak to a substantial leak instantly reducing the likelihood that intervention occurs before a flammable concentration builds up.
Iron mains	Include ductile iron and cast iron but not steel
Leakage survey	A systematic search for escapes of gas
Low Pressure	Operating at pressures not exceeding 75 mbar
Medium Pressure	Operating at pressures greater than 75 mbar but not exceeding 2 bar
Ultrasonic Equipment	The equipment associated with carrying out thickness measurements
[Third party tech]	*[Third party tech]*

Double bag	Is a method which requires two bags to be installed both upstream and downstream of the section of pipe to be isolated. The isolated section can then be purged and the work on the pipe can begin. It is essential that the pressure in the bags is monitored at all times while the works are carried out.
Iris stops	Iris Stop was developed in the 1970's by British Gas as a means to carry out a flow stop. With over 30 years of use on mains ranging from 4″ to 48″ it has proven itself as a cost effective, safe, and reliable method on the isolation of mains.
Bypass connection	A bypass connection, or "Flow Through Connection" is a pipe that passes entirely through the plug, from one end to the other. It can be used for filling the piping to be tested with air or water. It can also be used to bypass the water flow and discharge it to another line connected to a pump.
Pipes Above Safety Threshold (PAST)	The RIIO-2 methodology for identifying high-risk pipes uses two safety thresholds: pipe-specific risk thresholds and societal risk thresholds. The former calculates risk based on building density around a pipe, using survey data to determine the number of buildings along the pipe's length. The latter, societal risk, evaluates the overall potential loss of life, recognizing that the risk of a fatal incident affects society differently than individual risks. This approach aligns with BSI standards, which find lower frequency, higher fatality incidents more acceptable than more frequent, lower fatality events. Pipes that exceed either individual or societal risk levels are classified as PAST pipes, indicating high risk.