Northern Gas Networks

A22.l Mandatory Repex

Engineering Justification Paper

Contents

1. Summary table

Name of Project	*Mandatory Repex RIIO-GD3 Programme*		
Scheme Reference	A22.l.NGN		
Primary Investment Driver	*Safety (HSE Compliance)*		
Project Initiation Year	*2026/27*		
Project Close Out Year	*2030/31*		
Total Installed Cost Estimate (£)	*£643.70m (T1/T2A/<2ST/Non-standard/Other services/stubs)*		
Cost Estimate Accuracy (%)	*+/-5%*		
Project Spend to date (£)	*£0*		
Current Project Stage Gate	*Construction*		
Reporting Table Ref	*CV6.01, CV6.02, CV6.05, CV6.08, CV6.11*		
Outputs included in GD3 Business Plan	*As per BPDTs above*		
Spend Apportionment (£m)	**RIIO-GD2**	**RIIO-GD3**	**RIIO-GD4***
	£488.29m	£643.70m	c.£120-150m

*Expecting all investments listed for RIIO-GD3 to complete in RIIO-GD3. RIIO-GD4 spend estimate has been based on indicative spend in RIIO-GD3.

2. Executive summary

The Iron Mains Replacement Programme (IMRP) was introduced by the Health & Safety Executive (HSE) in 2002 to mitigate the risk surrounding iron distribution mains. This well-established programme has been ongoing since

then and will culminate in 2032, when all originally at-risk iron mains within 30 meters of a property will have been replaced with PE or decommissioned altogether.

The volumes we are proposing for RIIO-GD3 are in line with RIIO-GD2 and are as follows:

Tier	Annual Volume	Total Volume	Total Cost
T1	437.3km	2,186.5km	£450.64m
T2A	2.02km	10.1km	£11.15m
<=2ST	44.7km	223.5km	£30.71m
Non-standard materials	0.5km	2.5km	£0.24m
Associated services	41,986	209,930	£146.05m
Stubs	458	1,374	£4.91m

Table 1 Preferred option volumes and costs summary

The cost associated with represents a 35% increase when compared to RIIO-GD2. Section 10.2, Chapter 6 and A21 Cost Assessment and Benchmarking Approach provided details on the drivers of this. In summary, the key areas contributing to this increase include higher labour costs, the changes in complexity of the work basket towards the end of the programme (such as change in replacement technique), increased mobilisation requirements due to projects that are more segmented in nature and an increased percentage of ductile iron replacement due to the natural changes in the distribution mains population based on the risk prioritised replacement since 2002. The below table provides a high-level comparison between RIIO-GD2 and RIIO-GD3.

Asset	RIIO-GD2		RIIO-GD3 EJP Preferred Option	
	Workload units	Repex (£m) 23/24 prices	Workload units	Repex (£m) 23/24 prices
Tier 1	2,186.8km	£332.51m	2,186.5km	£450.64m
Tier 2A	8.2km	£6.20m	10.1km	£11.15m
<=2" Steel	202.4km	£28.10m	223.5km	£30.71m
Non-standard	0.5km	£0.10m	2.5km	£0.24m
Stubs	2,200	£11.31m	1,374	£4.91m
Total Mandatory Mains	**2,397.85km**	**481.59m**	**2,422.6km**	**£643.70m**
Mandatory Associated Services	204,464		209,930	

Table 2 Mandatory RIIO-GD3 strategy and comparison to RIIO-GD2 summary

3. Introduction

This Engineering Justification Paper (EJP) outlines the processes we have undertaken to determine the mandatory replacement investments we plan to complete on our distribution network through RIIO-GD3. This covers Tier 1 iron mains (those <= 8" diameter within 30m of property and captured by HSE's Iron Mains Risk Reduction Programme), Tier 2A iron mains (iron mains >8" and <18" diameter scoring above the agreed Risk Action Threshold), mains made from non-standard materials (principally asbestos), associated services and small diameter (<= 2") steel mains or services encountered during our activities, whether these are planned works or following escapes.

This is a well-established programme scheduled to complete in 2032. Due to this, we are highly confident in our proposal, as reflected in the cost estimate accuracy detailed in the Summary Table in section 1. This estimate has been arrived at by analysing our RIIO-GD2 performance and comprehensive historical data, which has been adjusted in our forecasts for known cost drivers as set out in Section 10.2, Chapter 6 and A21 Cost Assessment and Benchmarking Approach.

4. Equipment summary

NGN's pipe distribution network < 7 bar consists of over 36,000km of mains and over 2.5 million services providing gas to domestic, commercial and industrial consumers. This network, whose development began in the late 1800's and continues to this day, is constructed from a variety of materials; principally pit-cast iron, spun-cast iron, ductile iron, steel and polyethylene. There is also a small population of mains made from other non-standard materials, principally asbestos.

Of the total distribution mains in the network, approximately 33,000km are non-mandatory metallic and PE mains which are discussed in the Engineering Justification Paper for Non-Mandatory Mains and Services. For mandatory mains, the current material mix is shown in Figure 1 below:

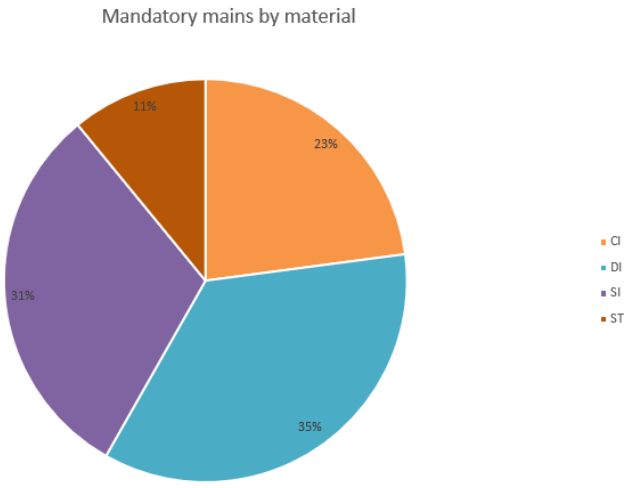

Figure 1 Mandatory mains distribution by material

The remaining recorded population of mandatory mains can be summarised as follows:

Tier	Material	Length (km)	% total
T1	Cast Iron (CI)	889.87	22.86
T1	Ductile Iron (DI)	1,375.04	35.33
T1	Spun Iron (SI)	1,200.16	30.83
T2A	Cast Iron (CI)	1.84	0.05
T2A	Ductile Iron (DI)	0.01	0.00
T2A	Spun Iron (SI)	0.61	0.02
2ST	Steel (ST)	424.74	10.91

Table 3 Mandatory mains distribution by material and tier

It should be noted that due to historical practices, some mains have not been recorded. This only usually applies to small diameter steel mains, therefore the full population of this tier cannot be 100% represented. Any undigitised steel mains that are 2 or less inches in diameter will normally be replaced as soon as practicable after being discovered. We are confident of our provision for this in the RIIO-GD3 plan given our extensive historic run rates for undigitized steel mains.

Of the above detailed Tier 1, the remaining population at the end of RIIO-GD2 is estimated to be approximately 2,603km, with 84% of this total being planned for replacement during RIIO-GD3 and the remaining 16% in the first year of RIIO-GD4 in line with the IMMRP timelines.

5. Problem / opportunity statement

When the gas distribution network was established, the pipes transporting gas around towns and districts were made from iron. Iron was considered to be a sound material for gas distribution at the time. However, following several high-profile fatal incidents, national risk-based programmes to replace targeted iron mains came into operation and have been in place in various forms since the 1970s.

The Iron Mains Replacement Programme (IMRP) was introduced by the Health & Safety Executive (HSE) in 2002 specifically to address concern about the failure of iron mains, particularly cast-iron mains, due to fracture. The Mains Risk Prioritisation System (MRPS) was also created at this time to provide an estimate of the risk of an incident presented by each individual section of main. This enabled NGN and other gas distribution networks to prioritise investment on iron main replacement, targeting investment towards replacing the riskiest pipes. The IMRP required the distribution companies to replace all ‘at risk’ iron mains (i.e. those within 30 metres of a property) within 30 years of 2002 and became known as the “30/30 programme”.

Following a 10-year review commissioned by the HSE, the IMRP was revised in 2013 to become the current Iron Mains Risk Reduction Programme (IMRRP), also known as the ‘Three-Tier Approach’. The key advances to the methodology were:

- For most iron pipes (those ≤ 8” diameter within 30m of properties – Tier 1) the requirement remained unchanged – those pipes within 30m of property are still required to be decommissioned by 31st March 2032.

- For iron pipes >8" and <18" (Tier 2) a Risk Action Threshold was established, with all pipes above this required to be decommissioned.
- Tier 2 pipes below the Risk Action Threshold and Tier 3 pipes (iron pipes ≥ 18") are subject to condition monitoring and management regimes (which may include decommissioning where the pipes have deteriorated beyond safe or effective repair) and may also be subject to decommissioning where this is justified by a Cost Benefit Analysis. Replacement of these pipes is covered in the Non-mandatory EJP.

Tier 1: These pipes must be replaced by 31st March 2032 and we are required by HSE to replace these pipes at a rate which will achieve full decommissioning by 2032 at the latest. This programme of work is agreed with the HSE and forms part of NGN's Safety Case.

Tier 2A: These are Tier 2 pipes scoring above the Risk Action Threshold that we have agreed with HSE and are also required to be replaced under IMRRP.

Non-standard Materials: We are required by HSE to replace all mains made from non-standard materials, principally asbestos.

Small diameter (<= 2") steel mains: HSE requires us to replace these (subject to our agreed procedures) when they are encountered either during planned works (e.g. mains replacement activities) or following escapes.

Steel Services: As with small diameter steel mains, HSE requires us to replace these when they are encountered either during planned works or following escapes.

Why are we doing this work and what happens if we do nothing?

Decommissioning of Tier 1, Tier 2A and 2 inch steel distribution mains is mandatory, therefore doing nothing is not an option. Failure to continue with this programme would constitute a violation of HSE enforcement policy, potentially resulting in an improvement notice, civil liabilities or prosecution and even the revocation of our Gas Transporters Licence.

NGN's Value Framework

We have developed a Value Framework which we use to assess the value of intervention options consistently across asset classes for CBA and business planning purposes. We use the Network Asset Risk Metric (NARM) methodology as the basis of our Value Framework and are consistent with the Consequence Measures. However, we have recategorised them into five risk groups, not four, so that there is clear distinction between NGN and societal costs and benefits and so that the present values being calculated are correct. This is further explained in our Network Asset Management Strategy. The five risk groups within our Value Framework are: Customer Risk, Health & Safety Risk, Environmental Risk, Compliance Risk and Financial Risk. We discuss each of these in more detail below.

To derive a monetary value for the Cost of Consequence, each Consequence Measure is allocated a monetary value which is multiplied by the quantity of the consequence. The monetary values used within our Value Framework are based on the agreed NARM assumptions and uses values common across GDNs such as the base price year, industry approved values such as the cost of carbon or the social cost of an injury. In addition, we use values specific to our business such as the cost of maintenance or the cost of loss of supply. The quantities used are specific to our network such as the number of domestic properties at risk of a supply interruption and have been derived from system data, network analysis or assumptions based on demands, flow and redundancy.

When justifying our RIIO-GD3 REPEX programme the monetary value of each Consequence Measure is calculated to determine the benefit or avoided cost of an intervention. Examples include:

- **Customer Risk** – Avoided GDN costs through a reduction in costs of supply incidents (loss of supply). These costs have been calculated from historic incidents and the probability and scale of the incidents are based on NARM models.
- **Health & Safety Risk** – Societal benefits in avoided costs through reductions in the probability of fatality or non-fatality injury. These costs are in accordance with the NARM methodology.
- **Environmental Risk** – Societal benefits in avoided costs through reductions in the volume of carbon emitted when gas is leaked or consumed. These costs are in accordance with the NARM methodology and industry approved values.
- **Compliance Risk** – Avoided GDN costs through a reduction in costs of fines and paying for explosion damage. These costs are in accordance with the NARM methodology. They have been separated from direct Financial Risk as we consider them highly uncertain and likely significantly underestimated by the values in NARM, which does not consider reputation, legal and handling costs.
- **Financial Risk** – Avoided GDN costs through reductions in the costs to fix assets on failure and the direct financial cost of the gas leaked from and consumed by our assets. These costs are in accordance with the NARM methodology.

Quantifying Mandatory Risk

Mandatory Mains and Services Risk Profile (start RIIO-GD3)	Compliance Risk £m	Customer Risk £m	Environmental Risk £m	Financial Risk £m	Health & Safety Risk £m	Total Risk £m
	0.77	3.11	30.24	37.39	4.82	**76.34**

Table 4 Mandatory risk profile at start of RIIO-GD3

Without intervention, over the course of RIIO-GD3, risk increases predominantly due to deterioration of the assets but also due to other effects such as environmental risk and the rising cost of carbon. Table 4 highlights that without intervention we would see total risk to our mandatory assets increase by 13% over RIIO-GD3.

Mandatory Mains and Services Risk Change over RIIO-GD3 w/o intervention	%
	13%

Table 5 Risk change for mandatory over RIIO-GD3 without intervention

Consideration of Mandatory Asset Health

We have utilised the NARM Value Framework in order to assess the health of our assets. We are however using the latest NGN asset data rather than the NARM data which is held in time as at the start of RIIO-GD2 for regulatory reporting purposes.

Mains and services assets are assigned a Health Banding 1-10 based entirely on the total failure rate (i.e. the sum of all failure rate components). There are ranges of failure rates which assign an asset to bands 1-10. For mains specifically, if the asset has less than 0.2 total failure rate (expected number of failures per year), it is in band 1, but if the failure rate is greater than 1.8 then it is in band 10.

Consideration of all distribution mains health trends is useful in the calculation of asset risk. The below table highlights the health of our assets using the NARM value measures. This shows that 13% of our distribution mains have a score of 6 or more at the start of RIIO-GD3. Without intervention, this increases to 18% by the end of RIIO-GD3. If our Preferred Option of investment is followed in RIIO-GD3, this remains at 13% (with some movement,

increase, between bands) at the end of RIIO-GD3 with investment. This is because we are assuming median risk reduction for mains so movement to HI1 and HI2 bandings with intervention comes from mid-HI bandings.

Distribution Mains Health Index		1	2	3	4	5	6	7	8	9	10	Total
Baseline start of RIIO-GD3	km	28874	0	0	0	1815	106	648	282	1636	1828	35190
	%	82%	0%	0%	0%	5%	0%	2%	1%	5%	5%	100%
End of RIIO-GD3 w/o intervention	km	28874	0	0	0	0	1815	106	274	646	3475	35190
	%	82%	0%	0%	0%	0%	5%	0%	1%	2%	10%	100%
End of RIIO-GD3 with interventions	km	31606	0	0	0	-866	1782	69	43	523	2033	35190
	%	90%	0%	0%	0%	-2%	5%	0%	0%	1%	6%	100%

Table 6 Mains Asset Health Scoring

What are the outcomes that we are aiming to achieve?

The primary driver and outcome for the IMRRP remains an improvement in the safety of the gas distribution network and, in particular, the reduction in the risk of an incident arising from the failure of an iron main and gas entering a property, leading to an explosion and potential injury and/or loss of life.

However, replacement of this category of asset also contributes significantly to reducing additional risks relating to:

Reliability: Replacement of these assets will improve condition and operational performance, resulting in fewer leaks arising from joint failures, corrosion and fractures and the associated impacts these have upon the reliability of supply to customers – particularly unplanned interruptions but also interruptions from the ongoing planned repair of asset failures.

Environment: Failures of these assets result in fugitive emissions of gas (leakage) with a significant environmental impact. Asset replacement results in the removal of these emissions and delivers a significant improvement in environmental performance.

Financial: Without full replacement, ongoing asset deterioration leads to asset failures that require permanent repair. These repairs add significantly to the operational costs of these assets on an enduring basis. Replacement forgoes the requirement for future repairs and these associated costs.

These risks are captured in our Cost and Benefit Analysis using our Decision Support Tool (DST) and the Value Framework. These are described in more detail in section 7.

To implement a resolution to the problem at hand in a way which aligns with our customer priorities we have defined the following objectives:

We want to manage the risk we hold within this group of assets. We know that reliability and safety remain top of our customers' priorities and so our investments in RIIO-GD3 will be focussed on effectively managing these risks.

We want to ensure efficient costs. We plan to balance risk and value to deliver the optimal solution for our customers at the most efficient cost. We use our decision support tool and asset data to maximise the value of our investments and our financial database to accurately and consistently forecast expenditure.

We want to maintain our excellent service levels. We continually monitor failures and leaks to ensure our investments allow us to maintain levels of service measures, such as expected number of supply interruptions. We target mains that pose the greatest risk and have the most disruptive impact on customers and the environment.

We want to protect our customers from future uncertainty. To ensure the investments we make in RIIO-GD3 are right for both our existing and future customers, and to avoid the risk of asset stranding we must ensure that our investments offer a payback before either the asset life or a point in time where future uncertainty could reduce the forecasted benefits. As set out in section 9 and despite it being a mandated work that we have no choice over, our mandatory programme pays back within 18 years, meaning that it represents value for money for our customers regardless of energy pathway to Net Zero.

From our stakeholder research (for example, see Insight 1, 9 and 10 from Appendix A3 below) we know that network reliability and cost remain our customers key priorities.

We have proposed five objectives covering risk, cost, service, uncertainty and compliance. These will be used to determine how successful each option considered is at delivering against our customer's expectations.

What we heard	Appendix A3
Keeping bills as low as possible continues to be domestic and SME (Small Medium Enterprise) customers' top priority, however stakeholders are supportive of investment to respond to significant challenges of climate resilience and decarbonisation. Balancing the trade-off between investing now to future-proof and minimising expenditure to prioritise essentials poses a challenge. How can we ensure intergenerational fairness amidst these competing priorities?	Insight 1
Customers expect our top sustainability commitment to be keeping our infrastructure resilient. This means continuing to reliably supply customers in the short and long term, regardless of climatic conditions and impacts experienced by interconnected sectors (such as telecommunications, road networks etc). As customers are satisfied with the performance and availability of our services, they prefer us to maintain service levels at levels similar to today and asked for us to reduce future risk with targeted investments to enhance removal, reduction, resistance and recovery strategies.	Insight 9
The impact of climate change requires us to proactively reduce the vulnerability of networks to storms, particularly in rural areas, and a collaborative, cross-network approach. 'Preventing supply interruptions from extreme weather by providing back up power' was the most highly valued service improvement among billpayers in our Customer Value Perception study (on average, respondents were willing to pay £0.53pp at 75%).	Insight 10

Table 7 Customer insights

We know that our customers expect value for money and that we will make the right investment decisions for both our existing and future customers. We will use the five objectives covering risk, cost, service, uncertainty and compliance to determine how successful each option considered is at delivering against our customers' expectations. There are trade-offs to meeting these objectives; by way of example, if we want to maintain or reduce risk then we will need to invest, and this may impact upon our cost efficiency objective. We therefore have carefully balanced these competing objectives within the limits of meeting IMRRP programme requirements.

How will we understand if the investment has been successful?

The primary assessment of the overall outcome of the investment will be compliance with, and achievement of, HSE policy requirements for mandatory mains. We will also measure the risk position as reported under the NARM methodology. We have set a relative risk target which will be reported against annually.

Additionally, we are proposing within the RIIO-GD3 Outputs framework that workloads for tiers associated with the mandatory mains replacement, primarily <=2" steel, will not constitute a NARM deliverable, nor will it be a specific Price Control Deliverable (PCD) for both the overall volume of work but also the workload diameter band mix. Tier 1 and Tier 2A workload have been excluded from NARM in RIIO-GD2 and we propose this is extended to <=2" ST for consistency.

5.1. Narrative real-life example or problem

The Iron Mains Risk Reduction Programme (IMRRP) has been strategically implemented to enhance the safety of the gas distribution network. By replacing aging and potentially hazardous iron mains, the programme significantly reduces the risk of gas leaks that could lead to explosions, ensuring that any weaknesses in the network are addressed before they can result in catastrophic outcomes. This initiative also improves operational performance, reducing the number of unplanned interruptions and reducing methane emissions, which have considerable environmental repercussions. As a result, the programme not only enhances safety but also delivers benefits in terms of reliability, environmental impact, and financial efficiency by eliminating the need for numerous costly repairs over time.

The success of the investment in the mains replacement programme is primarily assessed through compliance with Health and Safety Executive (HSE) policy requirements for mandatory mains replacement. Additionally, the risk position is evaluated and reported under the Network Asset Risk Metric (NARM) methodology, with annual reporting. In essence, this comprehensive initiative requires funding to ensure that the gas distribution network remains secure and reliable for all stakeholders, aligning with broader environmental goals and regulatory requirements.

Ultimately, it is evident that the work carried out under this programme over the last 22 years has led to NGN's below 7 bar distribution network becoming over 81% PE. The programme's impact is reflected across all GDNs, with a recent DNV report[1] concluding that the average number of distribution main failure incidents dropped from 3.85 per year between 1990 and 2002 to 1.25 per year between 2003 and 2022.

[1] MRPS Trend Analysis 2023: Trend Analysis for Leaks and Incidents in the UK Gas Distribution System - 2023 update

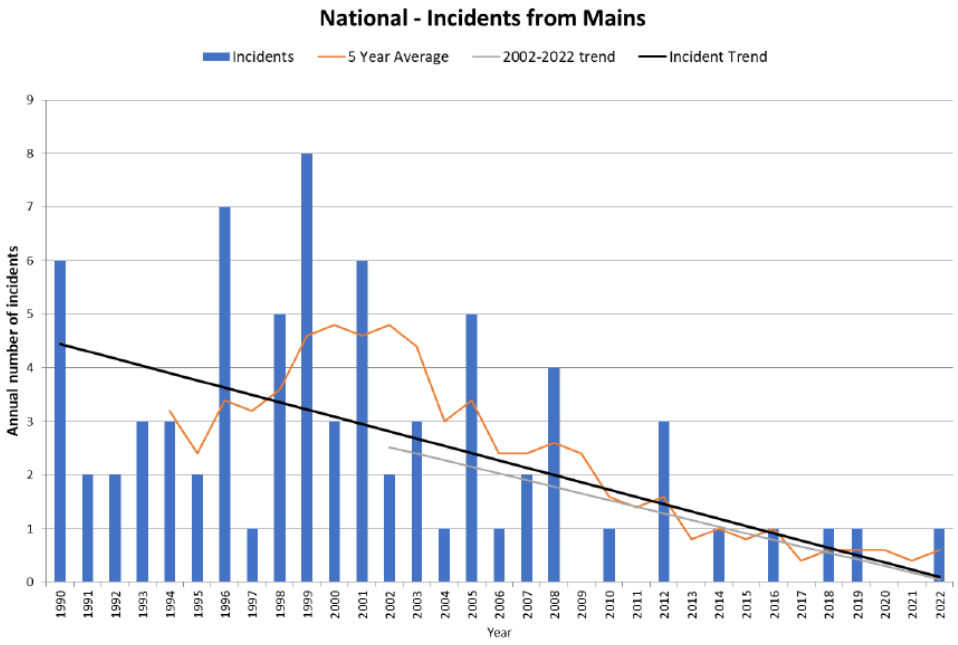

Figure 99 – Annual number of incidents, all GDNs

Figure 2 Trend Analysis for Leaks and Incidents in the UK Gas Distribution System - 2023 update.

5.2. Project boundaries

This EJP covers only those mains assets which are required to be replaced under current HSE policies. It does not include the costs to manage these pipes prior to their replacement (e.g. escape response and repair). The proposed costs do, however, include the costs for service relays and transfers associated with the replacement of mandatory mains and also steel services encountered as part of other works (for example service escapes) as these costs are unavoidable under current HSE policy and our requirement to maintain customer supplies.

6. Probability of failure

The Probability of Failure (PoF) of Tier 1 iron pipes is calculated within the MRPS model and also within NARM. Within NARM this is defined as:

PoF = Function (Install Decade, Diameter, Material, Pressure, Distribution Zone)

Within the NARM methodology the following Failure Modes have been identified for Distribution Mains:

- Capacity failure – where the pipe network is under-sized to meet demand
- Corrosion failure
- Fracture failure
- Interference failure – for example 3rd party damage
- Joint failure

- General emissions – background leakage or shrinkage from the pipe network. Values are typically expressed in number of failures per kilometre of pipe.

For mandatory Tier 1 iron pipes the Probability of Failure is not a determining factor as to whether a pipe will be replaced – all pipes within scope must be addressed. However, this is a long-term programme finishing in 2032 and so we consider the Probability of Failure – along with other factors – to inform the prioritisation order for replacement.

Long Term Risk Benefits Updates

The NARM methodology has been updated since RIIO-GD2 to incorporate changes for long term risk modelling and some changes in failure rates and deterioration rates to better reflect reality. Mains deterioration rates were reviewed as part of this. This was carried out as a cross GDN project, underwent a consultation process and is awaiting approval by Ofgem. Please refer to full details of updated methodology changes in the updated version of the NARM Risk Methodology document.

Updates to the methodology have been discussed with Ofgem during their development and have gone out to consultation. Formal approval is to follow on from the consultation. It was agreed with Ofgem that model updates as part of this project including Long Term risk would be used for RIIO-GD3 business planning purposes.

6.1. Probability of failure data assurance

The failure models are based on various industry standard guidelines (see GDN Asset Health Risk Reporting Methodology document) and the failure rates have been statistically derived using actual asset information such as age or material and historic failure data taking into consideration other influencing factors such as weather or temperature.

We have an annual process for gathering asset data from the business to support NARM RRP delivery, with majority of data coming ultimately from SAP. There is a documented process where the business leads supplying the data carry out reasonableness checks on the data supplied to the Asset Strategy team, who then carry out validation and consistency checks.

Our 2024 data improvement plan assesses key areas of data for robustness and completeness.

Our **Core Asset Data** for Distribution Mains includes location, Diameter, Length, Material, Pressure, Failures and Risk Scores. Most of the data is robust, such as mains location, pressure, material and length however, assumptions have been applied on the age of metallic distribution mains.

It is recognised in the NARM methodology that the GDNs will have data gaps and will not hold the same level of asset data. To facilitate the population of the Monetised Risk modelling, a flexible but consistent methodology (with options) will be utilised to derive the Probability of Failure, Deterioration, Probability of Consequence, and associated impacts of Intervention. This is set out in Table 6 of the NARM Methodology and ranges from Option A (GDN specific data from company systems) to Option B (Pooled/Shared data – where applicable) to Option C (Global/Assumed). Assumed data could be data that has been analysed to be representative of the population, arrived at by expert elicitation, or arrived at by researching relevant published studies/reports.

7. Consequence of failure

Under the IMRRP, the principal consequence of failure is the risk of explosion as calculated by the MRPS model. This is the primary output of the model and is used to inform the priority order for the replacement of Tier 1 pipes and to determine if a Tier 2 pipe falls above the Risk Action Threshold and so is mandated to be replaced.

The NARM methodology sets out the Consequence Measures for each Failure Mode categorised into four risk groups: Customer Risk, Health & Safety Risk, Carbon Risk and Other Financial Risk. Within the CBA we quantify each of these risks over time (note that health and safety risk is split between fatality risk and non-fatality risk). The following consequence measures have been identified for Distribution Mains:

Customer Risk: Supply interruption – failure of the main/s resulting in gas escape and loss of supply / supply interruption to downstream customers.

Health & Safety Risk: Explosion – failure of the main/s resulting in gas escape leading to a gas in building event, leading to an explosion event.

Carbon Risk: Gas Escape – loss of gas following a failure event, or through leakage, with associated environmental (carbon) impact.

Financial Risk: Water Ingress – failure of the main/s leading to water ingress, resulting in financial cost to rectify. Or direct financial costs to the business for without-intervention work to the assets such as such as repair.

Monetised Risk

The principle of total monetised risk, applied across the asset base, is:

Total monetised risk = PoF x PoC x CoC

Different supply/demand scenarios have not been considered during our modelling as the current NARM Methodology does not include analysis for this. This is a future update to NARM in gas distribution that has been identified within the Methodology document and will be reviewed by the networks through NARM working groups. Overall, we are forecasting a slow recovery from impacts of the cost of living crisis and total domestic demand is forecast to return to 2021 levels between 2029 and 2031 for the NE (historically North-East) and NO (historically North) distribution zones of our network. This is based on established econometric modelling and demand forecasting methodologies.

Although the NARM Methodology does not account explicitly for supply demand scenario analysis, the fault and failure data we currently base our modelling calculations includes data collected over a period of historic years, which goes back to before 2021. Consequence data from company systems also reflects the latest available view for our asset base at 2023/24 and is also based on data from historic events collected over time. Therefore we do not anticipate demand to have a material impact on our investment decisions or their benefits during GD3.

Our Commitment to Resilience

Chapter 5 of our Business Plan demonstrates our longstanding commitment to ensuring that we are able to operate and maintain a resilient network. We have formalised our Resilience Framework and developed a number of individual resilience strategies which allow us to maintain our high standards. Our Resilience Framework ensures that we continually review the hazards facing our business and assess whether mitigations that we have in place remain sufficient or need to change. This is relevant to our asset management strategies as we need to take into account exogenous factors when considering both short and long term investment plans. Our Network Asset Management Strategy which is set out in **Appendix A18** brings this all together.

We have introduced a range of other resilience strategies, such as **Appendix A8 – Climate Resilience Strategy**. A climate risk assessment sets out the risks facing NGN currently, in 2050 and in 2100, as set out in section 1.5.2 of the strategy. The climate scenario risk analysis did not identify high risks for either the 2°C or worst-case 4°C warming scenarios assessed. As such, this recognises our resilience to material climate change risks in the long to very long term (2050+). This is due to our comprehensive asset integrity and management procedures that are in operation to ensure asset condition and performance. In addition, there is inherent resilience afforded by gas infrastructure assets being a sealed, pressurised system principally located underground. Resilience levels to climate change risks will be greater in lesser warming scenarios should they arise, due to lower climatic extremes. The likely current and future climate risk has been factored into our preferred strategies across Mandatory Repex from the outset by utilising our SME knowledge and risk assessments mentioned above.

We are taking a similar approach to RIIO-GD2 in putting together our investment plan, taking a balanced approach to asset management to ensure a safe, reliant and compliant network – ensuring we can continue to meet our licence obligations whilst at the same time minimising costs for customers.

8. Options considered

Optioneering for the mandatory mains is rather limited due to their nature – the replacement of these mains is due by 31st of March 2032. With only 6 years of this programme remaining at the end of RIIO-GD2, the options considered are:

1. Manage the existing mandatory replacement assets by only intervening following failure (i.e. “reactive” / “do nothing”)

2. Continue with the run rates delivered in RIIO-GD2 and carry out the proposed RIIO-GD3 Mandatory Replacement programme as detailed in section 8.2, broken down into the different categories of mandatory workload.

3. Provide additional funding to increase Tier 1, Small Diameter Steel and associated services to accelerate the programme and to complete Tier 1 mandatory replacement before 2032. This option is summarised in section 8.3 below.

The below graph summarises the impact the two REPEX investment have on the Total Monetised Risk when compared against the “Baseline” which is our reactive option. Both, the balanced and accelerated programmes have a significant impact on the risk, reducing it by approximately 26% and 31% respectively during RIIO-GD3. The

risk reduction difference between the latter two options is not substantial (5%) which, when considering the cost difference (17% increase to accelerate the programme) deems the third option to be less desirable.

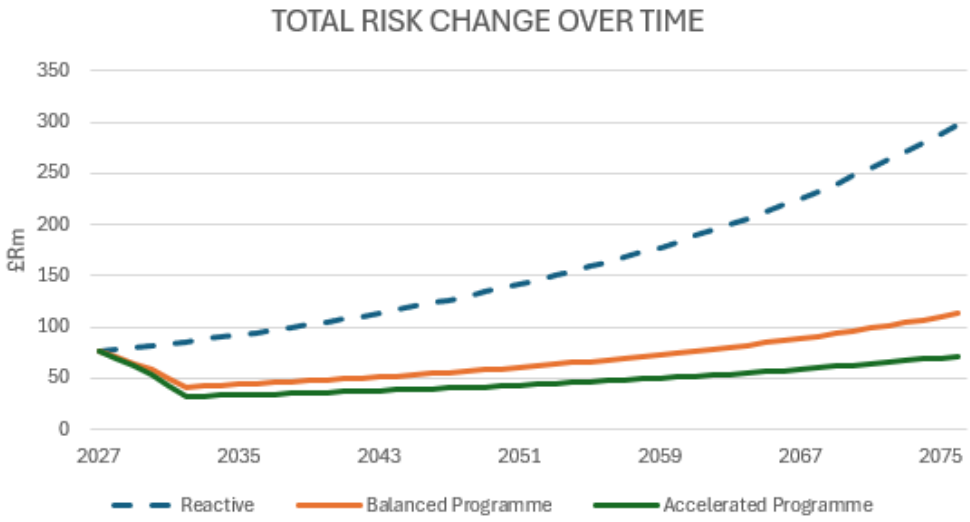

Figure 3 Total Risk change over time attributed to different options

Future Energy Pathways

Assumed proportion of methane is important within the risk calculations and CBA as within the NARM methodology the carbon equivalent of the methane content of the gas lost from our assets is quantified, resulting in a monetised Carbon Risk. Gas can be lost from our mechanical assets through leakage or failure.

We have gone with the default assumption of current assumed proportion of methane CO_2 in natural gas projected forwards due to uncertainties in the potential energy pathways and because this is reflective of the current gas quality legislation. However, we acknowledge that significant changes to gas demand or the allowed methane content of gas, for example due to the blending with or conversion to hydrogen, would impact the benefits of our investments.

We have not explicitly modelled changes in the methane content of gas in our CBAs, as overall gas demand and the change in CO_2 content of the gas is not expected to be different enough to materially impact the NPV, Payback & Option Ranking of our preferred investment programme. Our chosen programme represents value for money over a 20-year period regardless and is mainly driven by customer benefits such as avoiding loss of supply. The investments also ensure that we are compliant with relevant legislation. Our strategy therefore represents a no regrets investment programme that is consistent with net zero and will deliver value to customers whether a hydrogen or electrification pathway is chosen.

How we make Asset Decisions

We aspire to make conscious decisions that are balanced across our asset portfolio to ensure we can leverage the most value out of our assets. In making conscious decisions we can evaluate the risk we hold as a business and the impact it has on our strategic objectives. Asset management relies on accurate data and during RIIO-GD2 we have been working to improve our data and the way we capture and store this information, so it can be used to

benefit our decision-making process. We use a wide range of asset data, including global values such as the cost of carbon and specific values such as the loss of supply, costs from our updated unit cost analysis (see section 8.66 and the NARM methodology to calculate risk and value. Technical experts analyse options and set constraints (such as a constraint with the objective of maintaining risk) within our Decision Support Software which maximises the value of our investments for the given constraints. We use the value measures from our Decision Support Software in Ofgem's Cost Benefit Analysis template to compare the Net Present Value (NPV) of each option against the baseline option to determine the most suitable Repex programme in RIIO-GD3. While we have little choice over the remaining work under the IMRRP programme, we can use these principles to maximise the value for customers of the remaining programme overall and optimise in year decision making within the limits of the mandated work. The diagram below is a simplified representation of this process.

Figure 4 How we make asset decisions

Options Analysis

We consider various options when making asset management decisions to ensure the interventions we undertake are in the best interests of our customers and are optimal in terms of asset performance, capital expenditure and risk management.

Our Decision Support System is used to quantify risk and level of service measures and to aid asset management decision making. Optimisation within the software allows us to maximise the value of investments we are making, but we also combine this with bottom-up analysis and constraint application which comes from collaboration with our subject matter experts.

The different options we have modelled are set out below in Sections 8.1 to 8.3. These have been appraised against our objectives in Section 5 to determine a preferred option. For mandatory mains, although the optioneering is somewhat limited, we explored finishing the IMRRP in RIIO-GD3 (one year early) as the only compliant alternative. The summary of the options appraised can be seen in section 8.4.

Ofgem CBA Template Assumptions

For all CBAs in our RIIO-GD3 submission, we used an assumed weighted average cost of capital (WACC) of 3.92% based on Ofgem guidance (a real average basis). We have assumed a depreciation Acceleration Factor of 100% across all CBAs and scenarios, i.e. no additional acceleration of depreciation. For Capex CBAs we have assumed a capitalisation rate of 33.7% based on our Totex forecasts in BPDTs and 100% for Repex CBAs. First year of expenditure outflow is set to 2027 in all scenarios for consistent relative NPV calculations. This is in line with Ofgem guidance for RIIO-GD3 and the approach taken in RIIO-GD2. We consider that the plausible ranges of these parameters would not materially affect CBA outcomes and have provided only one version of templates with these consistently applied (as they can be adjusted by Ofgem in any case).

We have not provided direct Opex associated with each CBA scenario as it would require us to artificially and subjectively divide up our maintenance and repair expenditure into each sub-asset class (CBA) and make a judgement on how this would be affected by each scenario. We do not record or report data at this level and we have no robust basis on which to provide it. In reality, maintenance and repair teams attend to multiple asset classes in single visits as part of an efficient function. Instead, we have provided the objectively calculated VF Financial risk, which is based on agreed industry NARM based calculations for estimating impacts on Opex under each CBA scenario. For those asset groupings not covered by NARM we have only included benefits and impacts of key benefits e.g. leakage. We consider this to be a more robust and objective approach to our CBAs. We have completed the NARM monetised risk memo lines from values in the NARM BPDT for baseline and preferred where they are available and relevant.

8.1. Baseline – Do minimum/nothing

The Mains Replacement programme is not an optional requirement, therefore managing failures by only replacing sections of mains following a leak or a repair would not be in line with the HSE policy. Replacing on failure during RIIO-GD3 would not allow for the planning necessary to ensure that all mandatory mains are replaced by 2032 and would lead to an undeliverable workload volume remaining for the final year of the replacement programme which would fall within RIIO-GD4. Therefore neither not doing nor deferring the workload is possible under current policy.

8.2. First option summary - Balanced programme (preferred option)

Tier 1 Proposal: We are planning to replace Tier 1 pipes on a flat-line basis through RIIO-GD3 (i.e. replacing an average of 1/6th of the remaining 2026 population per year) and have calculated that the rate to achieve this is 437.3km / year. This includes 8.5km / year of Covid-19 related catch up from RIIO-GD1. We group pipes together into efficient projects to ensure the full clear-out of Tier 1 pipes and use optimisation techniques to schedule these through time in the most effective way, taking into account risk, efficiency of delivery, impact of pipe failures (e.g. forecast leaks), and the impact on stakeholders. We also put a key focus on the overall deliverability

of the programme of work up to 2032, considering geographic constraints around the maximum annual workload we can deliver in any given location and in particular ensuring that we complete a balanced programme of works rather than deferring all of the more complex works to the end of the programme.

Tier 1 Legacy Stubs Proposal: Prior to the 10-year review of the Replacement Programme (see section 5 above) all iron mains pipes within 30m of property were mandatory and required replacement by 2032. As a result, provided it was compliant with our agreed policies and procedures we sometimes left a short 'stub' of mandatory Tier 1 iron main from a smaller diameter pipe to a larger pipe as it was overall a more economic and efficient solution to replace the 'stub' when the larger pipe was replaced later in the programme. As many of the larger parent mains are no longer mandatory, RIIO-GD2 saw us commence a programme of work to remove stubs from the network. This programme of work is forecasted to continue into RIIO-GD3, culminating in year 3 of RIIO-GD3 with us investigating and actioning the remaining 1,374 stubs.

Tier 2A Proposal: Our T2A population has been largely addressed during RIIO-GD1, however, the MRPS risk score of a pipe changes through time based both on its performance and the performance of other pipes, and we currently estimate that approximately 2.0km / year of these pipes will migrate to above the threshold through RIIO-GD3 and so this has been included as part of our mandatory workload.

This is our current best estimate of the volume of Tier 2A pipes to be replaced through RIIO-GD3. However, the movement in risk score of an individual pipe over a period of time has many drivers including model coefficient updates and the performance of individual and groups of pipes (failures, Gas in Buildings, etc.) could be impacted by anything from the consequences of government policies (such as housing) to weather conditions. HSE have already indicated the T2A risk thresholds could be up for review, therefore potentially increasing the T2A population across the Networks, but nevertheless, this still means that the actual volume of Tier 2A pipes to be replaced through RIIO-GD3 is extremely difficult to predict. We are therefore proposing to have a Volume Driver for Tier 2A with funding being based on the amount of workload delivered and the associated mains diameter using the appropriate unit costs.

Non-standard Materials Proposal: This principally covers pipes made from asbestos. These have previously been mandated by HSE to be abandoned and all known pipes in this category have already been replaced (or are in progress). However, we occasionally encounter some of this type of material which had not been previously captured on our records system. This is a very small workload and we anticipate approximately 0.5km / year through RIIO-GD3.

Small Diameter (<= 2") Steel Proposal: We will continue to replace these (subject to our procedures agreed with HSE) when they are encountered either during planned works (e.g. mains replacement activities) or following escapes. The anticipated RIIO-GD3 workload associated with this is 44.7km/year.

Associated Services Proposal: We are required by HSE to replace steel services when they are worked on. We anticipate encountering approximately 182,836 services through RIIO-GD3 as part of the mandatory mains replacement programme detailed above. 60% (approximately 109,701) of these are expected to be steel, which will be replaced with PE. The remaining 40% are already PE and, following testing, will be transferred to the replacement main.

Other Services Proposal: In addition to the above, there are services which are not replaced as part of the mains replacement programme. Instead they are replaced after an escape has been reported on the network, as part of a service alteration, or when carrying out other meter work. As mentioned above, we are required by HSE to replace steel services where they are worked on. We anticipate this to apply to approximately 27,094 services.

8.3. Second option summary - Accelerate IMRRP

Option 3 considers the impact of the Tier 1 programme acceleration, to complete the outstanding length by the end of RIIO-GD3, a year earlier than prescribed by the HSE. This change would lead to an approximate 19% rise in our annual Tier 1 volume, bringing it to around 520 km per year. Consequently, the increase in Tier 1 will also cause a rise in 2ST volumes, as these mains, whether digitised or not, are addressed during our replacement operations. Additionally, higher mains volumes will result in more service replacements. This increase raises concerns around resourcing and deliverability. The cost of this option also poses considerable concerns due to the overall increase of the replacement unit costs. Our stakeholder research shows (Insight 1, Appendix A3) that now more than ever our customers are concerned about our investments and the impact those investments have on their energy bill; cost is therefore a key consideration in the rejection of this option.

8.4. Options technical summary table

The below table summarises the options considered and breaks down the investment volume per Tier, per annum. It also links the costs associated with those volumes for the whole RIIO-GD3 period.

Option number	Asset Category	Annual volume	Total GD3 Repex cost £m	GD3 Cost per asset cat £m	Outcome
Reactive	All	No prescribed volume	Linked to volume	Linked to volume	Rejected
Balanced programme	Tier 1	437.3 km	**£643.70**	**£450.6**	*Preferred*
	Stubs	458 (for 3 years)		**£4.9**	
	Tier 2A	2.02 km		**£11.1**	
	<=2" steel	44.7 km		**£30.7**	
	Non-standard	0.5 km		**£0.2**	
	Services	41,986		**£146.1**	
Accelerate IMRRP	Tier 1	520 km	**£754.95**	**£535.9**	Rejected
	Stubs	458 (for 3 years)		**£4.9**	
	Tier 2A	2.02 km		**£11.1**	
	<=2" steel	53.2km		**£36.5**	
	Non-standard	0.5 km		**£0.2**	
	Services	48,892		**£166.3**	

Table 8 Options technical summary table

9. Business case outline and discussion

9.1. Key business case drivers description

Option 1: Reactive option was rejected. HSE requires us to replace mandatory pipes, to produce plans and to demonstrate progress towards achieving this by their timescales. Failure to produce and then comply with a plan would be a breach of our Safety Case. In particular, if we were to fail to produce an acceptable plan for Tier 1 pipes, HSE would exercise its power under the Pipelines Safety Regulations to impose a programme of works on us (which would be in line with our preferred option) and require us to achieve this.

Option 2: Balanced Programme is our preferred option. This will deliver replacement of Tier 1 mains at a tested rate to achieve complete abandonment by 2032. We will also replace stubs, Tier 2 pipes if they migrate to above the Risk Action Threshold, replace mains made from non-standard materials if they are discovered and continue with our policy (agreed with HSE) to replace small diameter steel pipes – either <=2" mains or steel services – where they are worked on in line with our procedures.

Option 3: Accelerate IMRRP was considered but rejected. In addition to the CBA outputs between the two REPEX options being closely matched, there are a number of both operational and financial issues to consider when examining the acceleration of the Tier 1 replacement programme ahead of the baseline volumes to achieve the mandated completion date. These include:

- Operational
    - The programme has been developed and planned over a long period to ensure that it is sustainable and deliverable. Significantly accelerating workload will be constrained heavily in a number of geographical areas due to the large impact this would have on the local area in terms of road and lane closures.
    - Significant acceleration of the programme would require additional skilled resource (both internal and contractor) to deliver.
- Financial
    - To pull forward additional workload into RIIO-GD3 would increase the annual volume by around 19%. This would have a significant impact on the spend profile, as even continuing with volumes similar to RIIO-GD2 will see an increase in unit cost (this is further explained in section 8.2).

9.2. Business case summary

The table below details the headline business case metrics to allow a high-level comparison of the options.

The accelerated programme is clearly supported by the Cost and Benefit Analysis as a good long-term investment. It produces a positive Net Present Value (NPV) by 2043, just outside of the 16-year recommendation from Ofgem, and has the highest NPV in 2070. That said, our preferred option produces very similar results – positive NPV in 18 years and a comparable NPV by 2070. This had led us to a conclusion that our balanced programme is the preferred option, based on the closely matched outputs within the analysis, however at 17% less upfront cost. Cost has

emerged as one of the top concerns for our customers through our stakeholder engagement, thus it had a significant influence on our preferred strategy choice.

Option	Desciption	RIIO-GD3 Intervention Volume		Total NPV compared to Baseline at 2070 (£b)	Objectives		
		Mains (km)	Services (no)		Total Risk Change from 2026	RIIO-3 Total Capex Cost (£m)	Payback (years)
-	Baseline	-	-	-£3.1	12.8%	£0.0	-
1	Preferred	2,422	26,140	£1.0	-45.3%	£450.6	18
2	Accelerate IMRRP	2,878	243,386	£1.3	-57.7%	£728.9	17

Table 9 Business case summary

Option	Desciption	RIIO-GD3 Intervention		Total NPV compared to Baseline at 2070 (£m)						Payback (years)	Total Risk Change from 2026
		Mains (km)	Services (no)	2035	2040	2045	2050	2060	2070		
-	Baseline	-	-	-£705.1	-£1,073.5	-£1,429.4	-£1,775.2	-£2,448.5	-£3,131.3	-	12.8%
1	Preferred	2,422	26,140	-£112.0	-£73.0	£47.6	£221.6	£615.9	£1,028.3	18	-45.3%
2	Accelerate IMRRP	2,878	243,386	-£122.3	-£67.8	£83.0	£296.9	£781.4	£1,291.7	17	-57.7%

Table 10 Options Summary including NPV

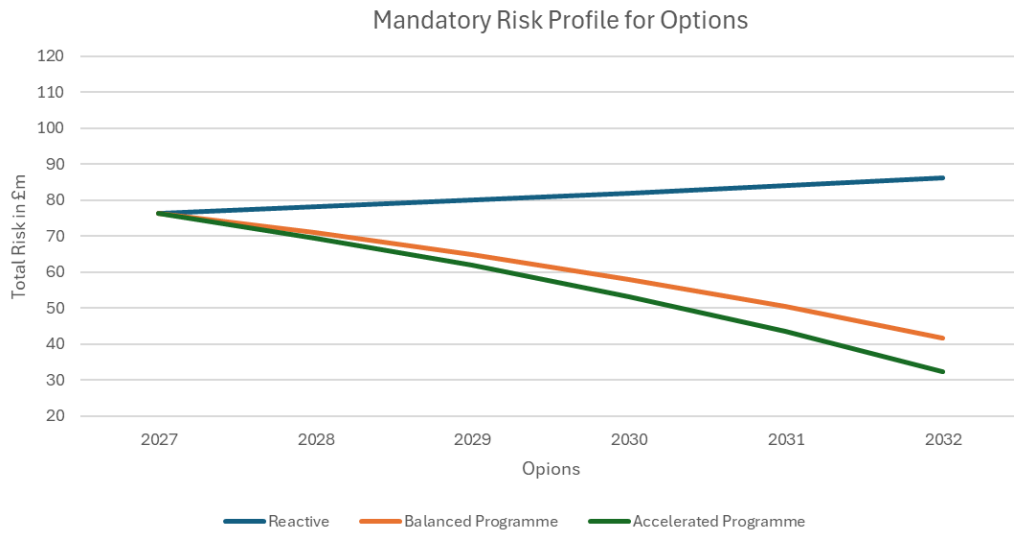

Figure 5 Mandatory Risk Profile for Options

10. Preferred option scope and project plan

10.1. Preferred option

The preferred option is Option 2 – replace Tier 1 mains at a constant rate from 2026 to achieve complete abandonment by 2032; continue with the Tier 1 stub replacement into RIIO-GD3, completing the programme in year 3; replace Tier 2 pipes if they migrate above the Risk Action Threshold; replace previously unidentified mains made from non-standard materials where these are encountered and continue with our policy (agreed with HSE) to replace small diameter steel pipes – either <=2" mains or steel services – where they are worked on in line with our procedures.

The table below provides details of the preferred option REPEX spend (all A3) alongside Single Year Risk benefit and Long-Term Risk benefit output as shown in our NARM BPDT (Business Plan Data Template). Long-Term Risk calculations allow for accrual of benefit over the life of the intervention. These intervention lives are detailed in full in our NARM BPDT submission. In section 8.2 we detail the investments within our Preferred option.

	REPEX Spend (£m)	NARM BPDT	
	All Investments	Single Year Risk Benefit (R£m)	RIIO-GD3 Long Term Benefit Output (R£b)
Mandatory mains and services	643.70	35.314	7.270

Table 11 A3 Mandatory mains and services investment NARM benefit

10.2. Asset health spend profile

Throughout RIIO-GD3 we anticipate the cost of the REPEX programme increasing by around 35% compared to RIIO-GD2. This change is not unexpected, as the analysis during RIIO-GD1 and RIIO-GD2 shared with Ofgem indicated a cost increase at the end of this 30-year programme. We established the key contributors to this cost increase as follows:

1. Labour/Contractor Market
2. Increased mobilisation
3. Replacement Technique
4. Local Authority/Streetworks costs
5. Materials mix change

By establishing delivery unit rates for all remaining works using some key factors including tier and material type, area, construction method and surface type has allowed a more accurate breakdown of our works and the costs involved, all pointing to the above listed cost increase drivers. This section will expand on these contributors individually to explain the reasons behind their importance.

Labour/Contractor Market: Rising wages, limited availability of skilled workers and inflationary pressures all contribute to higher labour and contractor costs. In order to retain the workforce required to complete this programme of work we must address these challenges by securing the necessary funding. Additionally, recent inflation has meant increased material prices which adds to the overall financial burden.

Increased Mobilisation: Compared to previous RIIO periods, RIIO-GD3 projects are shorter, more spread out, or disjointed. This shift is due to the nature of the replacement programme, which has historically targeted the riskiest iron mains on the network. Instead of the longer, continuous projects that benefited from economies of scale, RIIO-GD3 must address a greater number of smaller, more isolated segments of the

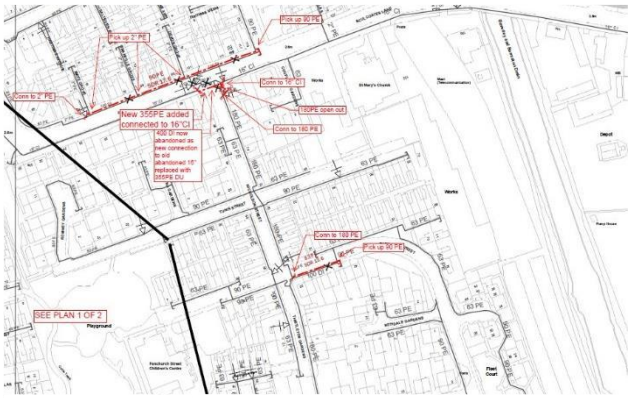

Figure 6 R1/001043 [redacted] project schematic showing replacement sections in red and unaffected mains in black.

distribution network. This fragmentation increases the overall "cost per meter" of the replaced pipe, as the fixed costs such as setup, design, mobilisation, demobilisation, and administrative expenses cannot be distributed over a larger volume of work.

The type of projects in RIIO-GD3 inherently reduces the ability to achieve efficiency gains witnessed in previous periods. Long projects allow for more streamlined approach and associated cost savings; however, the shorter lengths and scattered nature of RIIO-GD3 projects negate these benefits, largely due to the increased mobilisation costs associated with frequent setups and removals.

Replacement Technique: One of the key cost drivers for the entire REPEX programme is the technique used to lay the replacement pipe, with insertion being less disruptive to customers and more cost efficient from a productivity perspective when compared to open cut i.e. less excavations and plant and materials used to complete works. The table below summarises the increase in open cut works due to the remaining work basket (as illustrated in section 4) and associated factors limiting insertion technique.

TECHNIQUE			
	GD1 & GD2 (Actuals)	GD2 Forecast	GD3 Forecast
Insertion	89%	85%	74%
Open Cut	11%	15%	26%
TOTAL	**100%**	**100%**	**100%**

Table 12 Replacement technique ratio across different regulatory periods.

Local Authority/Streetworks costs: We have always been conscious of maintaining positive relationships with Local Authorities and Stakeholders – sometimes leading to changes to the programme and more intrusive or expensive work being rescheduled. The ability to do this will be highly limited going forward resulting in us not being able to spread out the more expensive works in sensitive areas such as city centers, on arterial routes or those that are affected by any other Local Authority embargo. The cost difference between work in more and less sensitive locations is evidenced by the cost change during COVID where such work was prioritised due to national restrictions and Local Authority support. Unit Cost on Tier 1 & <2" Steel (Mains & Services), for example, increased from £132/m to £158/m (20%).

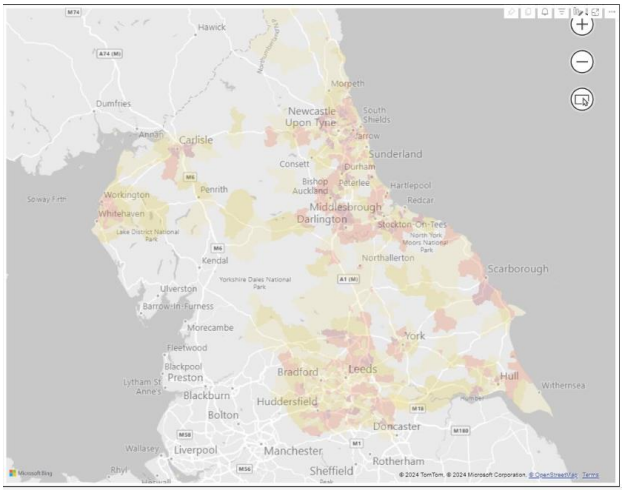

Figure 7 Heat map showing highest concentration of replacement work remaining.

Furthermore, Local Authorities are imposing additional requirements on undertakers of streetworks which include lane rental charges and stricter permit conditions. These new rules can substantially increase the costs of mains replacement projects through more rigorous traffic management such as temporary traffic signals, manual control associated with that or road closures. We anticipate that these charges will continue to increase, and it is essential to account for them in the Repex budget.

Material mix: As well as technique, another key cost driver is the material type of the pipe being replaced. As shown in section 4, Ductile Iron constitutes the largest percentage of our remaining mandatory main population. Replacement of ductile iron pipes bring additional costs to the project due to the techniques required to abandon the pipe resulting in additional equipment costs and reduced productivity.

The below graphic is from Chapter 6 of our Business Plan which details our approach and view on Long-Term Value for Money. The graphic shows the key impacting factors that contribute to the overall cost increase. “Construction method” covers the change in replacement technique, “engineering complexity” captures the change in material mix, “Productivity & Resourcing” covers increased mobilisation and general labour costs, and finally “Geographical Location” captures Local Authority and streetworks costs.

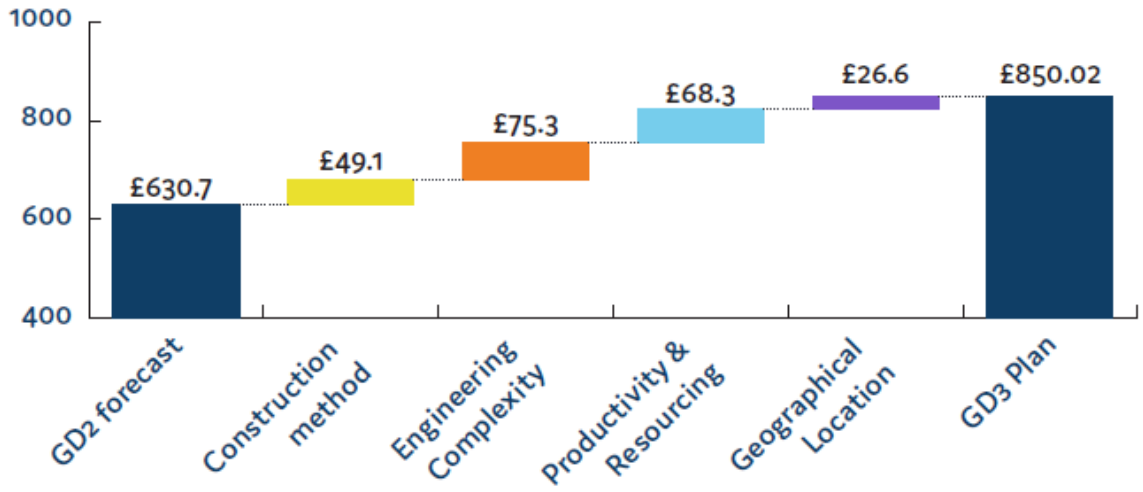

Figure 8 Overall REPEX cost increase illustration in Chapter 6

10.3. Investment risk discussion

Workload Risk Mitigations

There are several risks associated with the Mandatory REPEX programme to be mitigated and managed. Most significantly, the skilled workforce completing this work on the ground are highly sought after within our, as well as other industries, due to their transferrable skillset. NGN have maintained our DSP model successfully since 2013, moving away from the nation-wide Tier 1 contractors, in favour of smaller, local businesses, allowing us to have a more meaningful partnership, rather than a strict contractor/manager relationship. This model, led by a team of NGN’s operational leads, is underpinned by hundreds of skilled workers, driving an excellent safety record, customer service, efficiency, and ongoing improvement. Retaining this workforce until the end of the replacement programme, in the light of the reducing levels of certainty around workload post 2032 is viewed as a major risk. Through regular engagement with our partners, it became clear that to mitigate this risk, an incentive mechanism had to be developed, we have therefore implemented a Long Term Incentive Programme, allowing our partners to benefit from a lump-sum payment in 2032, which is accrued through their loyalty until the end of the replacement programme.

In addition to the resourcing challenge, an ongoing risk to the investment is associated with accessing the distribution mains proposed for replacement. Due to the nature of our network, we predominantly work on public highways, therefore impacting a variety of stakeholders – from regular road users to other infrastructure custodians. Access has to be carefully coordinated and the Local Authorities are at the heart of this process. NGN developed some excellent working relationships with the Local Authorities within our network and maintain regular engagement to ensure that these relationships remain mutually beneficial. This is evident, as NGN is the only utility company in the Northeast, Cumbria & Yorkshire with no improvement notice from local highway authorities. So far, NGN have been able to align our replacement programme with the Local Authority plans, where possible, deferring projects to future years on Local Authority request. With the mandatory replacement programme coming to an end, we will be far more restricted in the way we can manage this, therefore it is imperative that the stakeholder engagement continues to grow and develop throughout RIIO-GD3.

Finally, the HSE has suggested that to tackle the perceived lack of risk reduction with Tier 2 mains within the industry, there may be changes to the coefficients used in the risk threshold calculations. Although the T2A population is already relatively fluid, with individual distribution pipes migrating between the tiers based on most recent data held on these assets, the uncertainty around the threshold is introducing another challenge to our proposals; a large reduction in the current threshold could increase our T2A volume significantly. As discussed above, this is a key driver in requesting the continuation of the T2A volume driver for RIIO-GD3.

Unit Cost Risk Mitigations

We have used our updated unit cost analysis to determine our unit costs.

We are not planning to undertake new work activities. We have undertaken all interventions previously and have historic costs allocated within our unit cost analysis.

We have well developed processes and assurance activities in place, with scrutiny and challenge provided throughout. This ensures that we can deliver value for money by driving cost efficiency. Details on unit cost processes are provided within Section 10.2.

We have experienced Project Managers who have a proven track record of delivering this type of work in the past and we have a commercial team of Quantity Surveyors who are focussed on delivering value for money.

Section 4.1 of **Appendix A7 – Workforce and Supply Chain Resilience Strategy** sets out some of the supply chain challenges that we have faced throughout RIIO-GD2. It acknowledges how NGN is a comparatively smaller GDN, which reduces our buying power (section 4.1.2) and also discusses the significant inflationary pressures that have been placed on GDNs (section 4.1.4). For example, it discusses how the prices charged for coiled pipes have increased by 82% in the period from January 2020 to August 2023. In spite of these challenges, we are confident that our input unit costs remain efficient. This Appendix also touches on a number of external shocks which have impacted on things such as lead times. Examples include the Covid-19 pandemic, the Suez Canal blockage, Russia's invasion of Ukraine and rising geopolitical tensions. We outline in the strategy how we expect volatility to continue across our supply chain, and that we will utilise storage facilities in order to mitigate against supply input shortages. We plan to resource our supply chain and procurement team appropriately to help us overcome these challenges.

Appendix A21 – Cost Assessment and Benchmarking Approach demonstrates how, despite challenges facing us, NGN leads the industry in terms of cost efficiency, having been ranked the most efficient operator by Ofgem in both RIIO-GD1 and RIIO-GD2. This Appendix further outlines the value of NGN in Ofgem's cost assessment modelling at RIIO-GD2 by showing how NGN's frontier setting performance enabled Ofgem to set cost allowances that were £211 million lower than they would otherwise have been. In other words, our efforts to lead the sector on cost efficiency have resulted in significantly lower bills for consumers across the whole country.

We have achieved this position by being innovative in our thinking and directly and aggressively challenging industry norms and practices by bringing forward market-led, commercially focussed business solutions across almost every area of our business. For example:

- NGN introduced modern labour terms and conditions (T&Cs) for the majority of its operational workforce, leading to a significant reduction in legacy staff costs.
- NGN introduced a Direct Service Provider (DSP) model, leveraging small local engineering firms to deliver its replacement program instead of relying on the traditional 'tier 1' companies that have typically dominated the industry.
- Given that NGN has made strong productivity improvements over time, we have re-invested our outperformance payments in areas that (among other things) improve our productivity further. For example, we have used outperformance to invest heavily in IT systems through the SAP4 Hana investment and 'Future Ways of Working' programme. These projects are expected to significantly improve the customer experience and enable NGN to become a data-focused business.

We also outline in this Appendix our suggestion to target a 0.5% Ongoing Efficiency (OE) target, alongside the reasons why this is an appropriate level (see section 6 of the Appendix). This means that in reality, NGN will be subject to a further 0.5% cost reduction target throughout RIIO-GD3 in order to meet the OE objectives that will be set by Ofgem.

We outlined above how we have faced price increases significantly above inflation during RIIO-GD2. The Real Price Effects (RPE) methodology attempts to adjust for the difference between input price inflation and consumer price inflation. We outline in the Appendix our broad support for RPEs, however we note that during RIIO-GD2, all networks have seen relatively large swings in real term allowances year to year due to RPE and inflation volatility from the geopolitical energy shocks in 2022 and 2023. RIIO-GD3 therefore presents an opportunity to refine the basket of reference indices to better capture GDNs actual input price movements and better mitigate this risk. The impact of RPEs have not been factored into our unit cost pricing.

10.4. Project plan

This is an ongoing programme which is currently at the construction stage and will remain as such during RIIO-GD3. The expected completion date of the entire programme is 31st of March 2032. The programme does not require any long lead items and the individual projects are being planned based on individual merits, but also in line with the annual volume commitments. This project can be described as cyclical – the annual workload will be analysed, designed and scheduled at least a year in advance, ready for delivery and close out in the allocated year. The high-level outline of the RIIO-GD3 tranche of this larger replacement programme is illustrated below.

	RIIO-2 Year 5	RIIO-3 Year 1	RIIO-3 Year 2	RIIO-3 Year 3	RIIO-3 Year 4	RIIO-3 Year 5	
Design							Year 1 workload
Schedule							Year 2 workload
Deliver							Year 3 workload
Close out							Year 4 workload
							Yeah 5 workload

Figure 9 Mandatory mains and services project plan

10.5. Key business risks and opportunities

The mains replacement programme is very well established, so risks associated with it are well managed, despite their evolving nature. As the programme is nearing completion, costs and workload spread are the two key risks that require additional focus.

We already see a significant increase in the cost associated with this workload, reasons for which are explored in section 10.2, we are therefore seeking and enacting ways to minimise this increase. As one of the cost drivers is replacement technique, we looked at ways to reduce the requirement to open cut, in favour of usually less invasive and cheaper insertion alternative. We analysed our network to pinpoint areas that would benefit from reinforcement – construction of small sections of new distribution mains to improve supply capacity. Doing this will allow us to increase efficiency, by extending our reinforcement programme we will be able to reduce our open cut to insertion ratio overall.

We discuss in Chapter 5 of our Business Plan how we are mitigating against the immediate risks facing our business in the RIIO-GD3 period. In terms of network asset management, we have identified asset condition deterioration, obsolescence and compliance – some of which are relevant to mandatory REPEX programme of works set out in our preferred strategy. There are also wider considerations which indirectly impact on our investment decisions. Our Workforce and Supply Chain Resilience Strategy (Appendix A7) sets out our plans to tackle potential future skills shortages. Whilst we are not envisaging specific skills shortages in the RIIO-GD3 period thanks to our long-standing commitment to ensuring we have a 24/7, highly skilled workforce, we do need to ensure that our longer term investment proposals are deliverable given the future challenges we may face as an industry. This strategy also discusses how we ensure that we have a resilient supply chain that can withstand shocks and unforeseen circumstances. This is also an important consideration given the limited supplier and resource pool facing increased demand as we move towards Net Zero.

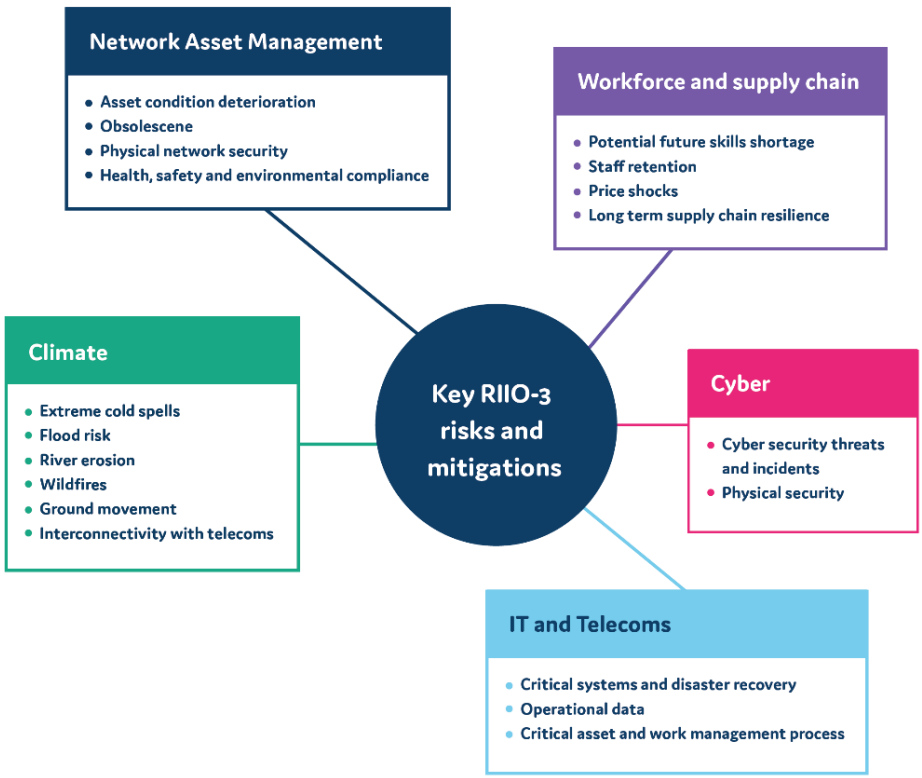

Figure 10 RIIO-GD3 Key Risks and Mitigations

10.6. Outputs included in RIIO-GD2 plans

We committed to replacing 2,376km of mandatory mains during RIIO-GD2 and are delivering on our commitment. The proposals for RIIO-GD3 are a continuation of this programme, including Tier 1, Tier 2A, <=2”ST, non-standard materials, stubs and services.